USGS Gulf Coast Science Conference and Florida Integrated Science Center Meeting: Proceedings with Abstracts, October 20-23, 2008, Orlando, Florida

Edited and compiled by Dawn Lavoie, Barry Rosen, Dave Sumner, Kim Haag, Ann Tihansky, Betsy Boynton, and Renee Koenig

Open-File Report 2008-1329

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Suggested citation:

The reference to the whole[1] or a part[2] of this report should be written as follows:

[1]Lavoie, D.L, Rosen, B.H., Sumner, D.M., Haag, K.H., Tihansky, A.B, Boynton, Betsy, and Koenig, R.R., (eds.), 2008, USGS Gulf Coast Science Conference and Florida Integrated Science Center Meeting: Proceedings with Abstracts, October 20-23, 2008, Orlando, Florida: U.S. Geological Survey Open-File Report 2008-1329, 157 p.
http://ngom.usgs.gov/gomsc/meetings/gcsm2008/abstract.html

[2]Dadisman, S.V., Flocks, J.G., Wertz, R.R., 2008, Overview of USGS Coastal and Marine Geology Program Data Management and Analysis Tools for Geologic and Hazards Information [abs.], *in* Lavoie, D.L., Rosen, B.H., and others, (eds.), USGS Gulf Coast Science Conference and Florida Integrated Science Center Meeting: Proceedings with Abstracts, October 20-23, 2008, Orlando, Florida: U.S. Geological Survey Open-File Report 2008-1329, p. 34-35.
http://ngom.usgs.gov/gomsc/meetings/gcsm2008/abstract_gom_pres6.html

USGS Gulf Coast Science Conference and Florida Integrated Science Center Meeting: Proceedings with Abstracts

October 20-23, 2008
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Welcome!

The USGS is the Nation's premier source of information in support of science-based decision making for resource management. We are excited to have the opportunity to bring together a diverse array of USGS scientists, managers, specialists, and others from science centers around the Gulf working on biologic, geologic, and hydrologic issues related to the Gulf of Mexico and the State of Florida.

We've organized the meeting around the major themes outlined in the USGS Circular 1309, Facing Tomorrow's Challenges—U.S. Geological Survey Science in the Decade 2007–2017. USGS senior leadership will provide a panel discussion about the Gulf of Mexico and Integrated Science. Capstone talks will summarize major topics and key issues. Interactive poster sessions each evening will provide the opportunity for you to present your results and talk with your peers. We hope that discussions and interactions at this meeting will help USGS scientists working in Florida and the Gulf Coast region find common interests, forge scientific collaborations and chart a direction for the future.

We hope that the meeting environment will encourage interaction, innovation and stimulate ideas among the many scientists working throughout the region. We'd like to create a community of practice across disciplines and specialties that will help us address complex scientific and societal issues.

Please take advantage of this opportunity to visit with colleagues, get to know new ones, share ideas and brainstorm about future possibilities.

It is our pleasure to provide this opportunity. We are glad you're here.

Dawn Lavoie
USGS Gulf of Mexico Science Coordinator

Barry Rosen
USGS Florida Integrated Science Center Director

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Capstone Talks

Poster Sessions by Theme

Abstracts (In Alphabetical Order by Author)

USGS Gulf Coast Science Conference & Florida Integrated Science Center (FISC) Meeting

Monday Afternoon - 10/20/08 (Gulf Coast Science Conference)	
1:00	Welcome, Introduction, Goals and Meeting Plans: *Dawn Lavoie (USGS Gulf of Mexico Science Coordinator) and Barry Rosen (USGS Florida Integrated Science Center Director) - Science Forum*
1:15	Regional Executive's welcome: *Jess Weaver and Stan Ponce*
1:30	**Understanding ecosystems and predicting ecosystem change: Ensuring the nation's economic and environmental future**
	CAPSTONE TALKS --- *Session chairs: Tom Doyle and Donald L. DeAngelis*
	Large Scale Landscape Change and Natural Hazards in the Northern Gulf of Mexico. *Speaker: John C. Brock*
	Biophysical Controls on Response of Coastal Wetlands to Climate Change, Elevated CO_2, and Sea-level Rise. *Speaker: Karen McKee*
	How Does Restoration Affect the Resiliency of Coastal Louisiana Marshes? *Speakers: Christopher M. Swarzenski, William Orem, Kenneth W. Krauss, Thomas W. Doyle and JoAnn Holloway*
	USGS Research Activities in Coastal Forest Ecosystems of the Northern Gulf of Mexico. *Speaker: Kenneth W. Krauss*
	USGS Ecosystem Modeling Applications in the Northern Gulf of Mexico. *Speakers: Donald L. DeAngelis and Thomas W. Doyle*
3:00	Break
3:30	**Climate variability and change**
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	USGS Role in Ocean Acidification Research. *Speakers: Lisa L. Robbins, Kimberly K. Yates, and Ilsa B. Kuffner*
	The USGS Role in Mangrove Ecosystem Research at Global Scales *Speakers: Thomas J. Smith III, Donald R. Cahoon, Richard H. Day, Don L. DeAngelis, Amanda W. Demopoulos, Thomas W. Doyle, Chandra Giri, Kristen M. Hart, Kenneth W. Krauss, M. Dennis Krohn, Catherine A. Langtimm, Carole C. McIvor, Karen L. McKee, Beth A. Middleton, Bradley M. Stith, Eric D. Swain*
6:00	**Monday Poster Session and Social (appetizers)**

Tuesday Morning - 10/21/08 (Gulf Coast Science Conference)	
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	Understanding the Shallow Stratigraphic Architecture of the Northern Gulf of Mexico: The Key to Indentifying Potential Resources for Shoreline Stabilization. *Speakers: James G. Flocks, S. Jeffress Williams, Jack Kindinger, and Mark Kulp*
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10:15	**National Hazards, Risk, and Resilience Assessment Program: Hurricanes**
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	Internet Map Serving the Hurricane Katrina Maximum Storm Tide in Alabama, Mississippi, and Louisiana. *Speakers: K. Van Wilson, D. Phil Turnipseed, James E. Hathorn, Dean Tyler, Jason Stoker, and Robert R. Mason, Jr.*
	Assessing the Stability and Fate of our Barrier Islands, Northern Gulf of Mexico. *Speakers: James G. Flocks, Dawn L. Lavoie, David C. Twichell, and Michael Miner*
	Subsurface Control on Sea-floor Erosional Processes Offshore of the Chandeleur Islands, LA. *Speakers: David C. Twichell, Elizabeth Pendleton, Wayne Baldwin, and James G. Flocks*
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Tuesday Afternoon - 10/21/08 (Gulf Coast Science Conference)	
1:30	**Wildlife and Human Health**
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	PANEL DISCUSSION: "Current Research on Wildlife and Human Health from your Perspective." What is missing? What should USGS be doing in the future? *Audience participation is expected.*
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	Louisiana's Coastwide Reference Monitoring System: Using Web Services to Integrate and Visualize Data for Assessing Restoration Effectiveness. *Speakers: G. Snedden, C. Conzelmann, G. Steyer, R. Raynie and S. Wilson*
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USGS Gulf Coast Science Conference & Florida Integrated Science Center (FISC) Meeting

Wednesday Morning - 10/22/08 (FISC Science Meeting)	
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	Seed Bank and Regeneration Ecology of an Annual Invasive Sedge in Florida Wetlands. *Speaker: Colette C. Jacono*
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10:30	**Coastal Processes**
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	Guest Speaker: *David P. Krabbenhoft* Mercury Sources, Cycling, and Bioaccumulation in the Gulf of Mexico: Research and Understanding Needs (invited)
Wednesday Afternoon - 10/22/08 (FISC Science Meeting)	
1:30	**USGS Senior Leadership Panel Discussion**
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6:00	**Wednesday Poster Session and Social (appetizers)**

Photo courtesy of Michael Hancock, Southwest Florida Water Management District

Thursday Morning - 10/23/08 (FISC Science Meeting)	
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	Water-Quality Data Web Services—A Collaboration between USGS and USEPA. *Speakers: Yvonne E. Stoker and Jonathon C. Scott*
2:45	Break
3:15	**Panel discussion – FISC Science Directions and Opportunities**
	MODERATORS: *Tim Bargar, Donald L. DeAngelis, and Terrie Lee*
4:15	Concluding Remarks: *Speaker: Barry Rosen, Florida Integrated Science Center Director*

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Understanding Ecosystems
(GOM - Posters - Monday - 10/20/08)

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The Vulnerability of Tidal Freshwater Forests of the Southern United States to Changing Climate and Rising Sea Level
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Rebecca J. Howard *and Steven E. Travis*

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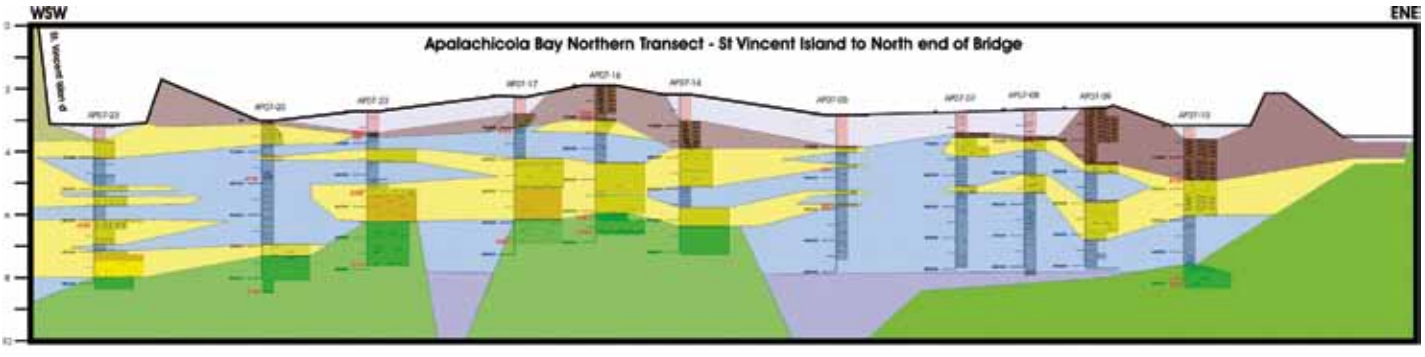
Winter Roost Sites of Western Burrowing Owls in Coastal Texas.
Marc C. Woodin, *Mary Kay Skoruppa, Damon Williford and Jennifer Keppers*



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(GOM - Posters - Monday - 10/20/08)

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Beth A. Middleton

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Monitoring Coastal Louisiana Wetland Impacts from 2005 Hurricanes Using Multi-temporal Modis NDVI.
Gregory D. Steyer, *John A. Barras, and Brady R. Couvillion*

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Poster Sessions by Theme
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(GOM - Posters - Tuesday - 10/21/08)

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Jill A. Jenkins, *Steve Hartley, and Charles R. Demas*

Landscape Simulation Model for Invasive Species Spread and Detection.
Thomas W. Doyle *and Randy G. Westbrooks*

Movements, Habitat Use, Diet, Thermal Biology, and Trapping of Burmese Pythons in the Southern Everglades.
Michael R. Rochford, *Michael S. Cherkiss, Matthew L. Brien, Skip Snow, Kenneth G. Rice, Michael E Dorcas, Alexander Wolf, Brian Greeves, Laurie Wilkins, Gordon Rodda, Robert Reed, Kristen M. Hart, and Frank J. Mazzotti*

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Richard H. Day *and Thomas W. Doyle*

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(GOM - Posters - Tuesday - 10/21/08)

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Greg Smith, *Scott Wilson, and Cindy Thatcher*

The Nonindigenous Aquatic Species Database and Alert System.
Pam Fuller

CPRIS
Larry Allain

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Eduardo Figueroa-Gibson

Flood Hardening of USGS Streamflow Gages along the Gulf Of Mexico Coast
David L. Fulcher *and Richard L. Kane*

Hydrogeology, Water-Level Altitudes and Changes in the Chicot, Evangeline, and Jasper Aquifers; Land- Surface Subsidence in the Chicot and Evangeline Aquifers in the Houston-Galveston Region, Texas
Mark C. Kasmarek *and Natalie A. Houston*

A Coupled Surface-Water and Ground-Water Model to Simulate Past, Present, and Future Hydrologic Conditions in Federally Managed Lands
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Nicasio Sepúlveda *and Kevin Rohrer*

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Amy Swancar *and David M. Sumner*

U.S. Geological Survey, Florida Integrated Science Center, Borehole Geophysical Logging Program
Michael Wacker

Poster Sessions by Theme
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Gulf of Mexico Conference

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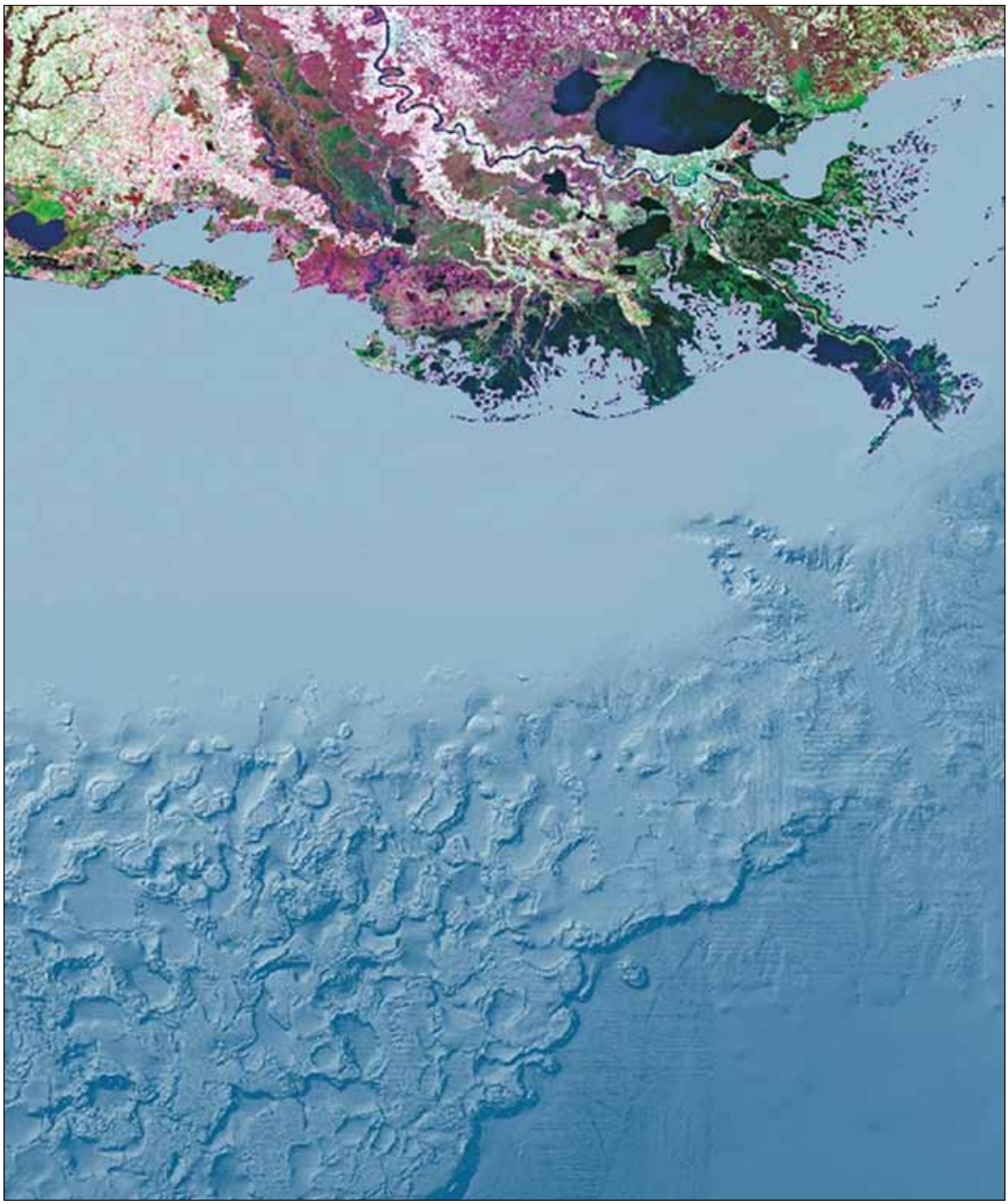

Coastal Prairie Restoration Information System

Larry Allain

USGS National Wetlands Research Center, Lafayette, LA

Over 550 plant species have been identified in Louisiana's coastal prairies to date. Efforts to conserve and restore this endangered ecosystem are limited by the ability of workers to identify, and access knowledge about, this diverse group of plants. The Coastal Prairie Restoration Information System (CPR) is a software program that allows users to query and view data about coastal prairie plant species. A variety of data are provided for each of 650 species including scientific, common and family names, authors, synonyms; plant characteristics such as origin, bloom color, bloom date, life span, height, growth form, seed size, and photosynthetic pathway; a range map and color photograph; text fields including a description, wildlife use, culture, natural history, and a list of references; wetland indicator categories and coefficients and floral quality values for each species. Selecting names or characters from dropdown menus allows users to search the database for particular prairie plant species.

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Poster

Assessment of Inundation Extent and Water Quality in the Atchafalaya Basin Floodway System 1983-2008 Using Landsat Imagery

Yvonne C. Allen[1] and Glenn C. Constant[2]

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Within the Atchafalaya Basin Floodway System (ABFS), there is a complex structure of lakes, rivers, canals, and spoil banks formed by both natural and engineered processes. The distribution and quality of water within each water management unit (WMU) is primarily driven by water level and condition found in the main river channels flowing through the ABFS. Diverse physical morphologies within each WMU, however can result in very different patterns of water distribution among the WMUs. River level gages have been established at many well-traveled locations throughout the basin but very little synoptic information has been available at more remote locations.

The amount, quality, duration, and flow rate of water in large part define the availability and quality of habitats for flora and fauna living in the basin. It is therefore critical to gain a better understanding of the dynamics of water distribution patterns at basin-wide and WMU scales. We classified 33 Landsat TM 5 and 7 (TM) images from 1983-2008 into categories of land, open turbid water, open swamp water, shallow turbid water and shallow swamp water. Each image was captured during leaf-off conditions to optimize delineation of ground conditions. Turbid water distribution was compared to concurrent ground truth sampling to validate the classification. This series of classified imagery can be used to evaluate the distribution of land, water and turbid water through time and also to predict the impact of various flooding scenarios. A historical record of turbid water distribution could also allow managers to identify open water areas that have consistently received high levels of sediment. These open water areas may be at risk for conversion to land due to sediment accretion.

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Poster

Persistence and Implications of Storm Deposits From Hurricane Wilma in the Mangrove Forests Along the Southwest Coast of Everglades National Park, Florida USA

Gordon H. Anderson[1], Karen M. Balentine[2], Ginger Tiling[2], and Thomas J. Smith III[1]

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On October 24, 2005, Hurricane Wilma made landfall on the southwest coast of Florida. A 3-5 m storm surge transported large volumes of fine-grained marine carbonate sediment from the Gulf of Mexico into the coastal mangrove forests and estuaries of Everglades National Park. There is evidence of hurricane storm deposits in the geologic record from previous storm events. However, the extent and thickness of Hurricane Wilma's deposits may only be exceeded in recent history by Hurricane Donna (1960). We measured Wilma storm deposits every year since 2005 at sites along the Shark and Harney Rivers. We observed possible physical and biological factors which may contribute to the persistence or loss of storm related deposition. Immediately post-Wilma, we observed average storm sediment depths of 6.6 cm at downstream Shark River site (SH3) and 4.6 cm at Harney River mid-reach site (SH4). Storm sediments at SH3 decreased by 11% (5.9 cm) in 2006 and by 32% (4 cm) in 2007. Storm deposits at SH4 decreased initially by 30% (3.2 cm) in 2006, but increased slightly to (3.6 cm) in 2007, suggesting local remobilization of storm sediments. Storm deposit layers of varying thickness are found in the geologic record are indicative of their persistence in the coastal Everglades. Consequently, what physical and biological factors may influence storm sediment stabilization or erosion? In sediment loss, we hypothesized rainfall erosion remobilized sediment particles and transported them into surface drainage rills whereas, riverbank levees restricted and contained storm sediments in the forest. Important biological factors influencing storm sediment stabilization are: the post-storm mangrove rootlet growth into storm sediment which bound storm sediment to underlying peat sediment; the presence of ground cover vegetation and mangrove prop roots which reduced sediment re-suspension and mobilization; and, the reworking of storm sediment which incorporated the storm sediments into mangrove peat by crab bioturbation. The persistence of storm deposits along the tidal rivers of the southwest mangrove coast of the Everglades may have several important implications to the coastal Everglades ecosystem. Specifically, increased riverbank levee elevation may buffer the effects of sea-level rise, and reduce tidal-flooding frequencies. This may increase forest water residence time by restricting local overland flow and tidal outflow into the estuaries. Reduced flooding frequency and impounded forest overland waters could alter nutrient and salt flux between the forest sediment and river, potentially influencing the local primary productivity of the forest.

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Poster

Observations of the Spatial and Temporal Distribution of Hurricane-induced Land Loss in Coastal Louisiana Over the Latter Half of the 20th Century

John A. Barras

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A combination of historical aerial photography and Landsat Thematic Mapper (TM) satellite imagery was used to identify hurricane-induced land loss in coastal Louisiana marshes from 1956 through 2005. Hurricane magnitude, track, and landfall information obtained from the National Oceanic and Atmospheric Administration (NOAA) were used to identify candidate storms. Landfall bracketing TM imagery and photography were then examined to identify probable storm-formed or storm-expanded water bodies. Most observed loss was related to the removal or partial removal of marsh vegetation by storm surge or to shoreline erosion caused by enhanced wave action. The satellite's high temporal frequency was useful for identifying storm-induced land loss occurring from 1983 and 2005 although its moderate spatial resolution limited minimal detectable storm-formed water bodies to greater than 2 acres in size. Bracketing images were often obtained within months to weeks of a storm's landfall. The TM imagery was successfully used to identify loss caused by Hurricanes Andrew (Aug. 26,1992), Lili (Oct. 3, 2002), Ivan (Sept. 16, 2004), Katrina (Aug. 29, 2005), and Rita (Sept. 4, 2005) and Tropical Strom Isadore (Sept. 26, 2002). The same techniques were applied to historical aerial photography to identify land loss caused by Hurricanes Audrey (June 27, 1957), Hilda (Oct. 3, 1964), and Betsy (Sept. 9, 1965). The photography lacked the temporal and spatial coverage of the TM imagery but was adequate for identifying historical hurricane-induced land loss.

Detectable hurricane-induced land loss increased with storm magnitude. Hurricane Audrey, a category 4 storm that made landfall near the Louisiana-Texas border, caused probable land loss 260 km east into western Terrebonne Parish. Category 2 or lesser storms caused detectable localized loss within 100 km east of landfall. Land loss magnitude and spatial distribution was greatest immediately east of storm landfall and then decreased eastward. Storm-induced land loss decreased immediately to the west of storm landfall implying most identifiable land loss was caused by storm surge rather than wind. Consecutive storm landfalls caused commingled land loss patterns of varying magnitude and spatial distributions consisting of new ponds and expanded ponds, some of which have remained in place since Hurricane Audrey's landfall in 1957.

These observations suggest that hurricanes have and will continue to contribute significantly to coastal land loss and that future coastal restoration activities should account for both past and future periodic hurricane impacts.

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Poster

Land Area Change in Coastal Louisiana: 1956 to 2006

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The USGS analyzed changes in land and water area in coastal Louisiana from 1956 to 2006 using a series of 14 sequential datasets. These datasets provide a spatially and temporally consistent source of land area information by physiographic province for coastal Louisiana. Land-area changes were interpreted using spatial analysis and linear regression. The spatial analysis quantified and spatially depicted coastwide land-area changes for five time periods: 1956 to 1978, 1978 to 1990, 1990 to 2001, 2001 to 2004 and 2004 to 2006. Linear regression analysis used data derived from a single source (classified Landsat TM imagery) to provide a robust estimate of recent land-area change from 1985 to 2004, prior to the 2005 landfalls of Hurricanes Katrina and Rita, and from 1985 to 2006.

Total net land loss for coastal Louisiana from 1956 to 2006 was 3,493.9 km^2. Annual land-loss rates were highest from 1956 to 1978 at 101.7 km^2/yr and accounted for 64% of the total land loss over the entire 50-year time period. Land loss occurring from 1978 to 2004 accounted for 21% of the total land lost during the 50-year time period. The 512.8 km^2 potential loss from the 2005 hurricanes accounts for 14.7% of the total loss from 1956 to 2006 and for 40.7% of the total loss from 1978 to 2006. The annual loss rate, based on linear regression analysis, declined between 1985 and 2004 to 30.7 ± 5.7 km^2/yr.

The majority of land loss from 1985 to 2004 occurred in the Deltaic Plain and was slightly offset by small gains in the Marginal Deltaic Plain due to land gains in the Atchafalaya River and Wax Lake Deltas. The Chenier Plain was stable during this period. The rapid decrease in land loss rates after the 1970s confirms findings of past studies although the rates observed in this study are lower. The permanency of the 2005 hurricanes' contribution to land loss is uncertain. Initial observations suggest that large hurricanes can contribute significantly to coastal land loss and that these significant episodic events can alter the long-term, time-averaged trends of landscape change. Prior trend assessments may lack the temporal resolution to identify the land loss contributions of past episodic events. Trend projections based on simple extrapolation of current rates may not adequately account for potential future episodic events.

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Poster

Landscape-Scale Modeling for Bird-Habitat Relations: Science Support for the Gulf Coast Joint Venture

Wylie Barrow, Jr.[1], Lori Randall[1], James Grace[1], William Vermillion[2], Barry Wilson[2], Robert Diehl[3]

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All migratory birds are designated as trust species in North America and are managed and protected by the Department of the Interior (DOI) as mandated in the Migratory Bird Treaty Act of 1972. There is now compelling evidence that the populations of many of these trust species have declined over the past forty years due to a variety of disruptions (e.g., habitat conversion, pollution, invasive species) occurring throughout their geographic range. Each year millions of landbirds migrate across or near the coast of the Gulf of Mexico moving between breeding and wintering grounds. During migration seasons, nearly all of the migratory landbird species of the Eastern United States, as well as some western species, stopover on the coastal plains along the northern and western Gulf of Mexico. Historically, these spatial dynamics of landfall were not a problem for migrants because forests and woodland patches were numerous and widespread. But during the past 300 years, human development, agriculture, and the spread of exotic/invasive plants have destroyed or degraded most coastal forest systems. The synergistic effects of these well-established population stresses and projected climate change present a daunting challenge to the Gulf Coast Joint Venture (GCJV), Department of Interior (DOI) land managers, and policy makers. The Gulf Coast Joint Venture is a regionally based, biologically driven, bird habitat conservation partnership of federal, state, and private organizations working within the coastal portions of Mississippi, Alabama, Louisiana, and Texas. To meet GCJV information needs to guide habitat conservation activities, we are using a combined Doppler radar, remote sensing, and structural equation modeling (SEM) approach to better understand bird habitat relations at multiple spatial and temporal scales (see Figure 1. for an example of radar data integrated with National Land Cover Data). By using SEM we can study path networks and understand the multiple processes controlling the system (Figure 2.). In particular, we will use SEM to assess the relative strength and the direct and indirect nature of the causal relations among geographic position, human development, habitat, and migrant landbird use.

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Poster

Coastal Forests and Migratory Birds: Broad-Scale Response of Landbird Migration to the Impacts of Hurricanes.

Wylie Barrow, Jr., Stephen Faulkner, Brady Couvillion, Robert Diehl, Lori Randall, Robert Dobbs, Clint Jeske, and Thomas C. Michot

Many species of landbirds that breed in North America migrate over the western Atlantic Ocean or the Gulf of Mexico to winter in the West Indies, Central America, or South America. Because the continent-wide pattern of migration concentrates these migrants in relation to ecological barriers, such as the Gulf of Mexico, forests of the river deltas along the northern Gulf of Mexico have been identified as stopover sites or staging areas of special concern to migratory landbirds. These coastal forests serve as habitat that migrating landbirds use to rest and replenish energy reserves before continuing migration. Autumn bird migration (August-October) coincides with the peak of hurricane season in the Gulf of Mexico, and hurricanes are known to frequently occur where high densities of migrating birds are staging prior to gulf crossings. At a broad-scale, we tested the hypothesis that historic preference by migrants for bottomland hardwoods habitat was altered after Katrina's passage because the hurricane caused disproportionate damage to bottomland hardwoods. As a consequence, we predicted migrants either 1) shifted their stopover distribution toward non-bottomland hardwood habitat (the less favored mixed pine uplands) or 2) avoided the entire landscape altogether. Response of migrant birds stopping over in the Pearl River bottomland hardwoods just after Katrina's landfall and up to several weeks after hurricane passage was to increase their use of the surrounding less-disturbed, pine-dominated woodlands. About five weeks after Katrina, much of the surviving forest canopy in the Pearl River bottoms began to resprout new foliage, and we observed a corresponding increase in migrant use of the bottomland hardwoods. These redistributions could be related to changes in vegetation structure or loss of food and foraging substrates. Results from our research after Hurricane Rita suggest that reduction in food resources is an important factor in driving broad redistributions of migrants stopping over in hurricane-altered landscapes.

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Poster

Recent Reductions of Subsidence Rates in the Mississippi River Delta Plain

Julie C. Bernier and Robert A. Morton

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The Mississippi River delta plain has long been characterized as an area with high rates of relative sea-level rise. This concept was tested by integrating National Ocean Service tide-gauge records with National Geodetic Survey benchmark releveling data and GPS elevations at Continuously Operating Reference Stations, providing a basis for understanding historical subsidence trends and most recent rates for southeastern coastal Louisiana. Tide-gauge records indicate that rates of relative sea-level rise at Grand Isle accelerated from about -2.2 mm/yr between 1947 and 1964 to about -11.5 mm/yr between 1964 and 1991 and then decelerated to about -3.4 mm/yr between 1991 and 2006. These trends and rates are independently verified by repeat leveling surveys that yielded average subsidence rates of -9.6 and -11 mm/yr from 1965/66 to 1993 at benchmarks between Raceland and Grand Isle and between Houma and Cocodrie, respectively, and GPS-derived elevation changes at Boothville, Houma, and Cocodrie that yielded average subsidence rates of -3.5 to -6.3 mm/yr from 2002/03 to 2007. The most recent slow rates of subsidence are similar to those averaged over geological time scales (e.g., radiocarbon-dated peats) that are attributed to natural sediment compaction and crustal loading.

The historical pattern of slow, then rapid, then slow subsidence may be caused by natural deep-basin processes (e.g., faulting, salt migration) but is more likely related to regional hydrocarbon production that followed the same general temporal trends. If accelerated subsidence was induced by reservoir compaction and fault reactivation associated with fluid withdrawal that also accelerated in the 1960s and 1970s, then the most recent reductions in subsidence rates likely reflect a balancing of subsurface stresses and a return to near-equilibrium conditions. Understanding historical and current trends in subsidence rates and their causes is critical for designing and successfully implementing coastal-restoration activities and for modeling and predicting expected impacts of relative sea-level rise on the delta plain.

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Poster

Development of High-Resolution Digital Elevation Products along the Northern Gulf of Mexico Coast

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The Northern Gulf of Mexico (NGOM) is an important ecosystem with a wide array of valuable resources that include commercial fisheries, petroleum and natural gas reservoirs, and wetland habitats for fish and wildlife. The morphology of the Gulf Coast is strongly influenced by anthropogenic and natural events. To be able to quantify morphologic modification, the U.S. Geological Survey (USGS) Coastal and Marine Geology Program (CMGP) has undertaken high-resolution mapping of fine-scale topography along the Gulf Coast. The system used is the Experimental Advanced Airborne Research Lidar (EAARL), which provides unprecedented capabilities to survey nearshore benthic habitats, coastal vegetation, and sandy beaches. Multiple repeat surveys have been conducted along the NGOM since Hurricane Ivan made landfall around Gulf Shores, Alabama, in 2004. The Gulf Coast became a major focus for coastal-change studies after Hurricane Katrina impacted areas from Louisiana to the Florida Panhandle in August 2005. Pre- and post-Hurricane Katrina EAARL lidar surveys have been processed to create products that show the canopy topography and bare-earth topography. These products support the CMGP Northern Gulf Coast Ecosystem Change and Hazard Susceptibility Project. DVD-based lidar-data products are published as USGS Open-File Reports (OFRs) or USGS Data Series, and include 1-m-resolution digital elevation model (DEM) geotiffs, Federal Geographic Data Committee (FGDC)-compliant metadata, and XYZ and LAS point cloud data. All published DVD products are distributed to Federal, State, and local agencies and are made available online.

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Poster

Large Scale Landscape Change and Natural Hazards in the Northern Gulf of Mexico

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Following the devastation wrought by Hurricanes Katrina and Rita in August –September 2005, a better understanding of the northern Gulf of Mexico (NGOM) coastal system is a basic requirement for sustainable restoration, redevelopment, and sound natural resource management strategies. Further impetus for investigations of the geomorphological structure, ecological function, and hazard vulnerability of the northern Gulf Coast stems from global climate projections that suggest more intense Atlantic hurricanes will occur over the next several decades. Moreover, dramatic landscape change in the NGOM region during the last century has reduced the level of hurricane protection afforded to NGOM human populations by coastal wetlands and barrier islands. The Coastal and Marine Geology Program is partnering with other USGS Disciplines and other federal and state agencies to investigate these highly societally relevant questions within the Northern Gulf Coast Northern Gulf Coast Ecosystem Change and Hazard Susceptibility project. This large interdisciplinary project is conducting research on 1) the reconstruction of Holocene geologic stratigraphy, paleoenvironments, climate, and sea-level histories, 2) the historical period evolution of the NGOM landscape, 3) forecasts of change in this landscape, and 4) the susceptibility of NGOM ecosystems and human communities to severe storms throughout the coming century.

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Oral

Communicating Science through Environmental Education: The Gulf of Mexico Alliance Environmental Education Network Digital Library

Linda Broussard

USGS National Wetlands Research Center

The USGS National Wetlands Research Center (NWRC) has contributed carefully selected and vetted content to the National Biological Information Infrastructure's (NBII) Central Southwest and Gulf Coast regional node since late 2004. The node provides Web-based access to data and resources about Arkansas, Louisiana, Oklahoma, Texas, and the Gulf of Mexico. Also in 2004, the Gulf of Mexico Alliance (GOMA), a partnership of the States of Alabama, Florida, Louisiana, Mississippi, and Texas, was formed with the goal of increasing regional cooperation among the States to enhance the ecological and economic health of the Gulf (GOMA, 2008). Because NWRC was already providing content on the Gulf Coast to NBII, working with the Alliance was a natural fit.

The initial focus of GOMA centered around five issues of regional significance that could be effectively addressed through teamwork at the local, State, and Federal levels:

Water quality for healthy beaches and shellfish beds;
Wetland and coastal conservation and restoration;
Environmental education;
Identification and characterization of Gulf habitats, and
Reducing nutrient inputs to coastal ecosystems (GOMA, 2006)

A sixth priority issue, coastal community resilience, was identified and recommended for inclusion (GOMA, 2008).

According to the Alliance white paper on environmental education, a three-fold approach is required for a successful program: (1) increasing public awareness and knowledge of the environment and its associated challenges, (2) developing critical thinking skills and plans to address those challenges, and (3) fostering proactive attitudes. This mission is addressed though both formal and informal education. Formal education involves the K-12 school systems and institutions of higher learning. Informal education is addressed through community- and professional-based programs (GOMA, 2005).

One of the commitments of the Environmental Education Network (EEN) in the Governors' Action Plan is to design and host a Web site to support education and outreach efforts of the EEN, including an electronic clearinghouse to disseminate effective Gulf Coast-related educational information and materials via the Internet (GOMA, 2006). In early 2006, NWRC began working to develop the electronic clearinghouse, or digital library. The GOMAEEN digital library went live in early 2008 through the NBII (http://www.nbii.gov/gomaeen). NWRC personnel are currently working with members of the Network to develop the GOMAEEN Web site. The site is expected to be accessible online by early 2009.

The GOMAEEN digital library offers resources that address the priority issues identified by the Gulf of Mexico Alliance. Each priority issue section features educational resources categorized by State, including lesson plans, reports, games, images, and information on science careers and field experiences. USGS Science Centers and projects throughout the Gulf States are highlighted.

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Poster

Climate Change: Physical Science Basis and Impacts in the Gulf Coast Region

Dr. Virginia Burkett

U.S. Geological Survey

During the past 100 years the average temperature of the Earth's atmosphere has risen by 0.74º C, with the greatest increase in warming occurring in the northern hemisphere, during winter months, and at high latitudes. The rate of atmospheric and ocean surface warming over the past 50 years increased significantly over that of the past 100 years. Atmospheric warming alters water availability by increasing evapotranspiration rates. Warming also increases the moisture-holding capacity of the atmosphere and intensifies the hydrologic cycle. Annual precipitation has increased slightly, but significantly, in coastal Mississippi and Alabama since 1905. Although precipitation has generally increased across most of the reminder of North America, it is occurring in the form of more heavy downpours with the number of days between rainfall events increasing for most of the Northern Hemisphere and droughts becoming more common in some regions. As ocean volume increases due to thermal expansion and a decline in land ice, low-lying coastal wetlands may be inundated and fresh-water wetlands that fringe the coastline may tend to become more saline. The warming of the ocean surface, coupled with the increase in the moisture holding capacity of the atmosphere, portends an increase in the intensity of tropical cyclones globally. The relationships between warming and increased tropical storm intensity during recent decades are particularly strong in the main development region for hurricanes in the North Atlantic Ocean. Whether or not hurricanes increase in frequency or intensity, however, flooding is likely to increase along the low-lying Gulf of Mexico shoreline as sea level continues to rise.

The projected changes in climate for the 21st century by the Intergovernmental Panel on Climate Change predict a suite of environmental consequences that could place many coastal, wetland, and aquatic systems at risk in the central Gulf Coast region. Model results, climatic trends during the past century, and climate theory all suggest that extrapolation of the 20th century temperature record would likely underestimate the range of change that could occur in the next few decades along Mississippi/Alabama coastline. While there is still considerable uncertainty about the *rates* of change that can be expected, there is a strong consensus regarding the direction of change for most of the climate variables that affect water levels, salinity and disturbance regimes (storms, fires, drought), and habitats in the central Gulf Coast region. The large and growing pressures of human development, however, are responsible for most of the current stresses on Gulf Coast natural resources which include: water quality and sediment pollution, drainage and filling of wetlands, human settlements along barrier island shorelines, dredging of natural rivers and engineered waterways, and flood-control levees that have decreased the amount of sediment delivered to the Gulf coastal zone. These and other human development activities could amplify the effects of climate change on coastal ecosystems. Examples from South Florida will illustrate how interactions of human development activities and climate change influence coastal ecosystems.

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Oral

Disease Issues in Wildlife in the Gulf of Mexico

Jacoby Carter, Jill A. Jenkins, and Clint Jeske

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Invasive species are threats to ecosystem integrity, disrupting communities by replacing native species and altering flows of energy and materials. However, invasive species can also be disease organisms and vectors. This talk will focus on invasive species with an emphasis on disease and disease vectors in the Gulf of Mexico region.

For the last two years, southern Louisiana crawfish operations have experienced significant mortalities due to white spot syndrome virus (WSSV) infection impacting *Procambarus clarkii* (red swamp crawfish). First seen in 1999, WSSV epizootics devastated Pacific coastal Latin American countries. Other emerging diseases with some level of regional monitoring include West Nile Virus, chytrid fungus (affecting frogs) and equine encephalitis.

Island applesnails (*Pomacea insularum*) are popular aquarium pets. In Asia they were introduced for the escargot industry but escaped and now are major pests in rice fields. In Southeast Asia they have disrupted tropical swamp ecosystems. Furthermore, applesnails are carriers for the nematode *Angiostrongylus cantonensis*, the rat lungworm, the most common cause of human eosinophilic meningitis. Recently breeding populations of Island applesnails were discovered in southeast Louisiana. Applesnails have the potential to disrupt Gulf Coast freshwater marsh and swamp ecosystems, and to damage the rice industry and spread disease.

Nutria (*Myocastor coypus*), imported in the 1930's, established feral populations throughout the Gulf Coast and elsewhere. Nutria herbivory can cause marsh loss and undermine coastal recovery efforts. Coastal marshes are the most cost-effective way to protect human lives and property against hurricane impacts. In addition to causing direct environmental damage, nutria can act as host for several parasites that affect people and livestock including *Strongyloides myopotami*, the roundworm that causes "nutria itch."

The USGS-NWRC in partnership with the Louisiana Department of Wildlife and Fisheries is sampling shorebirds and waterfowl for avian influenza as part of a USGS effort to identify and map influenza strains. While most of the focus has been on avian flu in the Pacific Flyway, the transmission of other highly pathogenic strains from South America by migrating wild birds is also a possibility and the Gulf Coast would be the first region affected. A better understanding of invasion and disease occurrence patterns will facilitate assessments of spatio-temporal vulnerability of humans and ecosystems.

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Poster

Late 20th Century Land Use/Land Cover Changes in the Northern Gulf Coast

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Land cover is an invaluable data set when evaluating the impacts of urbanization, wetland loss, climate change, sea-level rise, and other environmental stressors on the resilience of ecosystems and communities. Land cover change detection requires examination of multiple land cover datasets over a period of time using consistent methodology. Although several national programs have developed land cover data sets, they lack the period of record and/or specificity of cover classes necessary for such in-depth examinations. This is particularly true of land cover classes for coastal wetlands and forests. Recent events including hurricanes Katrina and Rita have highlighted the importance of accurate and detailed land cover data in these environments for use in decision support systems. These events have also emphasized the importance of accurate baseline assessments to initiate projections of future landscape changes. In the current study, we have created a 2006 land cover data set for the northern Gulf of Mexico region with increased specificity in coastal wetland classes. Nationally recognized classification methodologies, such as those used in NLCD and C-CAP, were refined slightly to provide increased land cover class discrimination, yet retain consistency with the original classification scheme. This data set will provide managers with an increased ability to more accurately inventory resources. Future efforts of this task will use this same methodology to create land cover datasets for multiple time periods from 1983 through 2008. These datasets will greatly increase managers understanding of trends in land cover, as well as the ability to draw inferences and project patterns.

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Poster

Priority Habitat Information System

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The Gulf of Mexico region is defined by environmental and economic conditions which represent a host of critical integrating factors such as mineral resources, fisheries production, ecological habitats for marine life and waterfowl, and human demands. The USGS National Wetlands Research Center has partnered with the U.S. Army Corps of Engineers (USACE) and the National Oceanic and Atmospheric Administration (NOAA) to develop the Priority Habitat Information System (PHINS) as part of the *Identification and Characterization of Priority Habitats* task within the Gulf of Mexico Alliance. PHINS incorporates a distributed data architecture and consists of three components: an enterprise metadata application to create and manage metadata, an online catalog to search metadata and find source data, and a geospatial data viewer to visualize habitat data using web mapping services (WMS). The USGS NWRC has worked with USACE and NOAA to develop the blueprint on which the distributed architecture is based. PHINS will initially be populated with seagrass datasets and be expanded to include datasets which meet the needs of the Gulf of Mexico Alliance.

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Oral

Overview of USGS Coastal and Marine Geology Program Data Management and Analysis Tools for Geologic and Hazards Information

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The USGS Coastal and Marine Geology Program (CMGP) has developed several databases to manage decades of data and information collected throughout State and Federal waters. InfoBank, usSEABED, LASED, and XSTORMS databases are important Gulf of Mexico data resource tools and represent a long-term CMGP commitment to data preservation, access, and integration.

InfoBank is an online field-activity catalog spanning seven decades of CMGP-related work (http://walrus.wr.usgs.gov/infobank/). The catalog holds information about past and scheduled fieldwork and links to related data and information products. InfoBank also contains over 5800 metadata records automatically harvested by the Geospatial One-Stop (GOS, http://www.geodata.gov/) portal.

The usSEABED database is a compilation of geologic, acoustic, geochemical, geotechnical, and biological data about the seafloor collected from numerous sources. The database combines analytical and descriptive data into comma-delimited tables for easy use with other software or databases. The Gulf of Mexico usSEABED database is published on DVD or online (http://pubs.usgs.gov/ds/2006/146/).

The Louisiana Sedimentary and Environmental Database (LASED) was developed by the USGS and cooperators to manage decades of geologic data from the Louisiana coastal zone (http://coastal.er.usgs.gov/lased/). The database allows integration of various data types including: sediment core and sample data, geochemical analyses, sub-bottom profiles, and raster-image maps. All data are integrated with spatial and attribute information that allows processing and visualization using standard Geographic Information System (GIS) and Internet browsing tools. LASED also provides a template for similar data-management efforts, like the recently developed Mississippi-Alabama Shelf Database (MASH).

XSTORMS was developed to manage and analyze coastal oblique aerial photographs and videos collected before and after extreme storms, associated lidar mission information, and storm meteorological data. Data are spatially linked so pre- and post-storm comparisons are made quickly and shared electronically from the project website (http://coastal.er.usgs.gov/hurricanes/). Exported post-Katrina photographs are also available via InfoBank in KML format.

LASED, XSTORMS, and usSEABED data are stored in an enterprise geodatabase, which is a crucial CMGP resource. Using standardized logs and data-management techniques enables rapid processing of new data, easy metadata capture, swift geodatabase population, and publishing of data archives. Recent technology allows digitized analog-data integration. Benefits to geodatabase storage include: data analysis through spatial or attribute parameters, centralized

storage and multi-user access, routine backups, and offsite storage or replication. Datasets can be linked to many resources like InfoBank, online publications, or project websites, and integrated with many additional databases via Web or Internet Map Server and Web portals such as GOS. Creating a distributed data-management scheme using these methods ensures data preservation, wide distribution, and the ability to maximize data integration and interoperability.

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Oral

Marsh to Mangroves: Consequences of Habitat Change in Louisiana Estuaries

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Black mangrove (*Avicennia germinans* L.) is the most cold-hardy mangrove species bordering the Gulf of Mexico and the only one that persists along the coast of Louisiana, where mangroves reach their northernmost extent. *Avicennia* at Fourchon, Louisiana, has historically been characterized as a low shrub because of periodic diebacks caused by recurring freezes. Recovery after a hard freeze is by basal sprouting and seedling recruitment from propagules. After almost 20 years without a hard freeze (since December 1989), mangrove stands at the Fourchon site have reached tree stature (over 4m) and are expanding rapidly. Black mangrove replacement of salt marsh is especially evident in areas of recent *Spartina alterniflora* L. dieback. Growth of individual mangroves has been monitored in recent years and increases in height and diameter are evident. Areal coverage of mangrove habitat has been increasing significantly based on analysis of historic aerial photography. Conversion of marsh to mangrove affects the source of the estuarine detrital food chain and availability of fisheries nursery/refugia habitat. Statistically significant differences in species assemblages of fish have been observed at the mangrove/water edge versus the marsh/water edge. This research suggests that periodicity of freezes could augment major changes in vegetation and faunal communities of Louisiana estuaries.

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Poster

Hydrology of Forested Wetlands in the Atchafalaya River Basin, a Major Distributary of the Mississippi River

Richard H. Day and Thomas W. Doyle

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The Atchafalaya River basin, which contains the largest contiguous riverine forested wetland in the United States (3584 km^2), receives 30% of the combined flows of the Red and Mississippi Rivers. The entire Atchafalaya basin is bordered by high levees to protect the surrounding landscape from flooding. The basin is also divided into subbasins bounded by lower natural and artificial levees. Water flow through the basin tends to be channelized. Hydrological exchange between subbasins and major channels occurs during high water overbank flooding, but this exchange is usually restricted to small channels which reverse flow regularly to fill and drain the subbasins with the passing of flood peaks. This limited exchange results in stagnation and hypoxic conditions, and the forested wetlands within the subbasins tend to be waterlogged for long periods of time. Hydrology within the forests is also influenced by rainfall, evapotranspiration, and subsurface drainage.

We examined long term records of water level gages in the Atchafalaya River and other in-channel gages and compared them to data collected from continuous water level recorders we installed within the forested wetlands to measure flooding above the surface of the forest floor. We compared hydroperiods within the forests to the hydrograph of the nearest source of riverine input to gain an understanding of the range of conditions within the forested environments in relation to the river connectivity of each site. The seasonality, depth, and duration of flooding within the forested wetlands control the composition of forest species and the flow of nutrients for sustained productivity. Riverine input also delivers sediment, which by its deposition causes gain in elevation, lowering flooding frequency and forcing change in forest composition.

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Poster

Hydrology and Salinity of a Tide-influenced Baldcypress Forest in Barataria Basin, Louisiana

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Andrew S. From

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Healthy tidal freshwater forests are usually located at or above the level of mean high water. In coastal Louisiana, many areas of baldcypress (Taxodium distichum) forest exist below the level of mean high water due to the combined effects of global sea level rise and local subsidence. Wind plays a greater role than astronomical tides in controlling water levels in the Barataria Basin, where tidal swamps are isolated by levees from any major riverine influence. Freshwater input is mainly from rainfall. A water level recorder was installed within a tide-influenced baldcypress forest in the Barataria Basin in August 2004. Salinity of the groundwater was measured in shallow wells every 4-5 weeks. A hydrograph of the water level data shows a tidal signature but it is dominated by wind driven water levels as depths varied from 90 cm above to 15 cm below the forest floor. The average daily wind speed and direction, measured at the Louis Armstrong New Orleans International Airport approximately 35 km from the study site, coincide with dominant peaks and valleys of the hydrograph. Groundwater salinity within the baldcypress forest ranged from 0.6 to 1.6 ppt until the Hurricane Rita storm surge in September 2005, after which groundwater salinity rose to 4.5 ppt. Prolonged drought after Hurricane Rita resulted in elevated groundwater salinity throughout 2006. These data will be used in ongoing studies of forest growth and productivity. Baldcypress at this site tolerate chronic exposure to saltwater, but are in danger of decline as relative sea level continues to rise.

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Poster

Nitrate concentrations in Lake Pontchartrain during the Bonnet Carre' Spillway opening, April 11 to May 8, 2008

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The Bonnet Carre' Spillway, located 28 miles above New Orleans, was constructed in the early 1930s as part of an integrated flood-control system for the lower Mississippi River system. Heavy rains in the Mississippi and Ohio River valleys in early spring 2008 increased the pressure on levees along the lower Mississippi River, threatening the City of New Orleans. In response, on April 11 the U.S. Army Corps of Engineers (COE) began opening the Spillway for the first time in eleven years. Mississippi River water was diverted into the 625-square mile Lake Pontchartrain, which retains a connection with the Gulf of Mexico. Average peak flows through the Spillway were about 169,000 cubic feet per second. The Spillway was closed on May 8.

On April 8 (3 days before the Spillway opening) the U.S. Geological Survey deployed a nitrate analyzer and a multi-parameter water-quality meter in Lake Pontchartrain at the request of the COE to assess the water-quality effects of the diversion on the Lake. The 2 units were suspended about 10 feet below the water surface (total depth 15 feet) at Lake Pontchartrain Causeway Crossover 7, about 15 miles east of the diversion and 3.5 miles from the south shore of the Lake. The units were programmed to record hourly measurements of nitrite + nitrate (presented as nitrate), water temperature, dissolved oxygen, specific conductance, salinity, and pH.

The nitrate analyzer operates using a standard "wet-chemistry" method of cadmium reduction/colorimetry: an alternative ion-selective probe that has been shown to perform poorly in high ionic-strength estuarine systems. The nitrate analyzer performs an automatic calibration with an internal standard every 12 hours and stores all waste reagents within the unit -- no toxic compounds are discharged into a receiving waterbody.

Both units recorded data hourly throughout the 27-day diversion. By May 23, the instruments had recorded the arrival, peak values, and decline of constituents associated with the freshwater influx from the Mississippi River/Bonnet Carre' Spillway diversion. The value of hourly monitoring of nitrate concentrations and field parameters such as specific conductance is clearly illustrated during the period April 16-April 25. The data show the short-term interactions of high-nitrate, low specific conductance river water and low-nitrate, high specific conductance lake water. The maximum influence of river water at the site existed during April 26-April 30. The first indications of a gradual reversion to pre-existing lake conditions began on May 1.

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Oral

USGS Ecosystem Modeling Research and Applications in the Northern Gulf of Mexico

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USGS Science Centers and scientists are engaged in developing ecosystem models of coastal ecosystems along the northern Gulf of Mexico to forecast potential effects of climate change and restoration alternatives on Department of Interior (DOI) trust species and Federal lands. Several ecosystem models have been developed by the USGS to address potential sea-level rise effects on shoreline, habitat retreat, and shifts in boundaries between habitats at the local, park and regional scale. Sea-level inundation models of coastal habitats have been constructed at different landscape scales to forecast NGOM-wide changes at the state and county level to more sophisticated and process-based models at specific park and refuge scale. Ecosystem-specific modeling applications have been advanced for mangrove forests of NGOM to investigate the potential impacts of climate change and freshwater flow on the quality and distribution of future mangrove habitat. This USGS mangrove model predicts the tree and gap replacement process of natural forest succession at the local and landscape scale as influenced by sea-level rise, hurricanes, and other disturbances and as related to planned hydrological restoration of the Everglades. Other USGS models include the ATLSS, (Across-Trophic Landscape Spatial Simulation) models, designed for evaluating alternative scenarios for Everglades restoration. The majority of ATLSS models are spatially explicit and deal with habitat suitability and population dynamics of animal species of particular interest. Because they use information on habitat type, they can be used to determine the impacts of changes in habitat on the viability of these species.

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Oral

HURASIM: Hurricane Simulation Model for Reconstructing Historic Windfields and Landfall Frequencies

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HURASIM is a spatial simulation model of hurricane structure and circulation for reconstructing chronologies of estimated windforce and vectors of past hurricanes. The model uses historical tracking and meteorological data of dated North Atlantic tropical storms from 1851 to present. The model generates a matrix of storm characteristics (i.e., quadrant, windspeed, and direction) within discrete spatial units and time intervals specified by the user for any specific storm or set of storms. HURASIM recreates the spatial structure of past hurricanes based on a tangential wind function, inflow angle offset, forward speed, and radius of maximum winds. Data input for the model includes tracking information of storm position, latitude and longitude, every six hours or less and maximum sustained wind speed. HURASIM model output from Hurricane Andrew (1992) was correlated with field data to construct data tables of damage probabilities by site and species and to determine critical windspeeds and vectors of tree mortality and injury. HURASIM has also been applied to reconstruct probable windfields of past hurricanes for remote field locations and correlated with tree ring growth patterns and direction of leaning trees and downed logs. HURASIM is also used to construct landscape templates of past hurricane activity that are linked with landscape simulation models of coastal habitat for predicting effects of climate past and future on the growth and succession of important wetland communities.

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Oral

SELVA-MANGRO: Landscape Model for South Florida Mangrove Ecosystems

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A landscape simulation model, SELVA-MANGRO, was developed for mangrove forests of south Florida to investigate the potential impacts of climate change on the quality and distribution of mangrove habitat. The SELVA-MANGRO model represents a hierarchically integrated landscape model that manages the exchange of system parameters up, down, and across scale between linked simulation models SELVA and MANGRO. SELVA is a Spatially Explicit Landscape Vegetation Analysis model that tracks predicted changes in the biotic and abiotic conditions of each land unit (1 sq ha) on an annual basis for the entire simulated landscape. The SELVA model administrates the spatial articulation of landscape units composed of habitat classifications (forest, marsh, aquatic) and any forcing functions that predict changes in hurricane activity, sea-level rise, and freshwater runoff. Intertidal forest units are then simulated with the MANGRO model based on unique sets of environmental factors and forest history. MANGRO is an individual (agent) based, spatially explicit stand simulation model constructed for mangrove forests of the neotropics. It is composed of a set of species-based functions for predicting the growth, establishment, and death of individual trees. MANGRO predicts the tree and gap replacement process of natural forest succession as influenced by stand structure and environmental conditions. SELVA-MANGRO has been used to evaluate the role of hurricane history and frequency on forest structure and composition and to predict mangrove migration upslope and displacement of freshwater habitats under rising sea levels projections from climate change.

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Poster

The Vulnerability of Tidal Freshwater Forests of the Southern United States to Changing Climate and Rising Sea Level

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Coastal forests along the Gulf of Mexico and south Atlantic are currently undergoing dieback and decline from increasing tidal inundation, saltwater intrusion, and altered freshwater flow attributed to global climate change and variability. Much of the impact on tidal freshwater swamps and maritime forest is within federal and state parks and refuges without any monitoring activity to document current and future land cover change. Baseline field research has been initiated to understand the process and pattern of forest dieback and habitat conversion that may be altering carbon flux and storage. Tidal freshwater swamps of the Gulf and Atlantic reaches are subject to different hydrogeomorphic settings, tidal amplitudes, drought and hurricane frequencies, subsidence rates, and streamflow volumes which, in part, account for varying degrees of salinity exposure and dieback conditions on a local and regional basis. Droughts and hurricanes are major natural factors that influence the extent and concentration of saltwater distribution that contributes to forest dieback in coastal zones. Field sites in eastern Louisiana show the impact of Hurricane Rita (2005) which inflicted a storm surge and salt pulse spanning hundreds of miles to the east of landfall. Field studies in South Carolina and Louisiana demonstrate that forest complexity and productivity are negatively correlated with residual interstitial soil salinities in these coastal cypress forests of the southern United States. Projected sea-level rise and changing climate is expected to accelerate the processes and extent of saltwater intrusion that will further impact freshwater swamp habitats and restoration efforts in the absence of adaptive coastal management.

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Poster

Landscape Simulation Model for Invasive Species Spread and Detection

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A landscape simulation model of Federal lands across the southeastern United States has been developed to foster early detection and rapid response of the translocation and movement of invasive species. The model documents known population loci of invasive plants and insects and predicts their potential spread by generational patterns and rates combined with probabilities for rapid relocation of viable progeny by tropical storms making landfall. The counterclockwise circulation of tropical storms and hurricanes in the northern hemisphere may hasten the western and northern spread of spores, seeds, and reproducing adults across the Gulf coastal plain. The landscape model works in concert with another physical model (HURASIM) that tracks hurricane paths, historical and hypothetical, to investigate the role tropical storms may have on invasive spread. The ultimate goal is to monitor the paths of tropical storms across coastal areas where particular invaders are known to occur, and to simulate translocation across impacted inland areas. In this project, we modeled the potential spread of the South American Cactus Moth (Cactoblastis cactorum) by Hurricane Dennis in July 2005, from infested areas along the Gulf Coast of Alabama to inland areas where prickly pear cacti (Opuntia spp. – the only host of Cactus Moth) are known to occur. With such a system, conservation land managers in impacted areas could be alerted soon after a storm event, and thus be able to implement appropriate actions to prevent the establishment and spread of target species. In the future, the system will be expanded by adding distribution information on high profile invasive plants of concern such as cogongrass (Imperata cylindrica) and old world climbing fern (Lygodium microphyllum).

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Poster

SLRRP: Sea-Level Rise Rectification Program and Seawater Inundation Model under Climate Change

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The Sea-Level Rise Rectification Program (SLRRP) is a software program designed with a user-friendly interface to generate a suite of future sea-level projections from various Global Circulation Models (GCM) and emission scenario options obtained from IPCC (2001), Intergovernmental Panel on Climate Change. The SLRRP model allows the user to select a region-based tide station, GCM model, and emission scenario to generate a graph and output file of future sea-level change. Sea-level rise was modeled as a function of historic sea-level conditions at long-term tide stations based on mean monthly tide records projected into the 21st century with the addition of curvilinear rates of eustatic sea level rise expected from climate change. The historical record was retained to mimic the natural cycle of high and low tidal variation attributed to astronomical and meteorological causes. The data record was extended into the next 100 years with the addition of eustatic rates of sea-level rise based on IPCC (2001) low, mid, and high projections obtained from various global climate change models. Model simulations were achieved for each of 7 climate change models and 6 emission scenarios included in the IPCC (2001) dataset. SLRRP rectifies the historic tide record and future eustatic sea-level rise into a common datum (default = NAVD88) to facilitate comparison with landbase features and elevations. The SLRRP model generates a sea-level prediction by wrapping the historic mean monthly records for the period of record for all future years up to year 2100. A series of sequential pop-up windows is used to facilitate user selection of GCM models, scenarios, and manual entries for projecting future sea levels. The SLRRP model allows the user to manually enter a local subsidence rate and a eustatic rise by the year 2100 in lieu of model defaults. After selecting a GCM model and emission scenario, the user can specify the actual effects and components of the GCM results that include degree of glaciation and thermal expansion. The program gives the user options for saving graphical and digital formats of SLRRP predictions and generating a supplemental graph to visualize the timing and extent of yearly flooding potential for a given elevation (NAVD88). In effect, the model shows the prospective data and time period for which sea level will overtop a given landscape feature under a future changing climate. Flooding potential is the percentage of months within a year when there is inundation by seawater at a select land elevation determined by the user.

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Poster

Geologic Controls on the Distribution of Oil and Gas Fields in Neogene Strata of the Gulf Coast, USA

Russell F. Dubiel, Janet K. Pitman, and Ofori N. Pearson

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A study of the geologic controls on undiscovered conventional oil and gas resources in Neogene strata of the onshore coastal plain and State waters of the Gulf Coast of the United States included evaluations of: (1) hydrocarbon source rocks (source-rock maturation, hydrocarbon generation and migration), (2) reservoir rocks (sequence stratigraphy and petrophysical properties), and (3) hydrocarbon traps (trap formation, timing, and seals). Principal factors controlling the distribution of both known and undiscovered fields include the distribution of paleo-drainage systems, pre-existing shelf margins, salt-related structures, minibasins, top of the overpressured zone, and climate-influenced eustatic sea level fluctuations. Components of the study included well-log cross sections, sequence stratigraphy, reservoir quality, existing production data, field-size distributions, analogs in offshore federal waters, source rock and thermal modeling, seismic interpretation, and structural modeling. Sequence stratigraphic interpretations, coupled with geophysical studies of overpressured reservoirs and geochemical studies of hydrocarbons and source rocks, indicate that known oil and gas fields reside primarily in highstand and transgressive systems tracts in clastic reservoirs deposited on continental shelves and shelf-margin deltas. In contrast, the majority of undiscovered conventional oil and gas resources are thought to reside in stratigraphically deeper clastic reservoirs that were deposited primarily in slope fans and basin-floor fans that formed as low-stand systems tracts in response to episodic fluctuations of sea level.

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Oral

Communicating USGS Gulf Coast Science to the Public

Gaye Farris

USGS National Wetlands Research Center

Scientists of the U.S. Geological Survey (USGS) develop and disseminate scientific information, primarily through scientific publishing and workshops that reach other scientists. The USGS, however, realizes the need to communicate with other audiences: non-core professionals including policymakers; the general public including media and students; and the internal USGS audience. The literature documents the need for public science literacy because of our increasingly knowledge-based economy, our generation of children dubbed with "nature deficit disorder," and a documented fundamental shift away from nature-based recreation. To reach diverse audiences along the Gulf Coast and elsewhere, the USGS National Wetlands Research Center (NWRC) employs a tailored approach recommended by the National Science Foundation.

Outreach at NWRC covers three areas: community relations, education, and media. Different strategies are employed for each, and all activities are not done annually because resources and personnel are limited. Web sites, including podcasts, and many fact sheets and handouts are produced for all audiences (including scientific ones). Occasionally a USGS Circular is produced for the public.

Community relations are geared to high-visibility events like Migratory Bird Day, Earth Day, GIS Day , Black History and Women's History Months with national leaders such as Jerome Ringo and Sen. Mary Landrieu speaking, university museum and library exhibits, and a Gulf Coast juried art competition and auction. Ad hoc projects include helping with a hospital mural, wetland-theme ballet, creative writing class, author readings, and Elder Hostel tours.

The backbone of the educational program is the goals of the National Science Education Standards that ultimately define a scientifically literate society. Thousands of school children tour NWRC each year and learn about wetlands and science careers. Job- shadowing programs and classroom visits are offered. Students with special needs or from underrepresented groups take part in fishing rodeos for Winners on Wheels, tours for children from shelters, and the JASON and SEEDS projects. The NWRC is part of a grant to help two local schools with high minority enrollment. NWRC has also created an educational clearinghouse/library for the Gulf of Mexico Alliance and is represented on the Alliance's educational steering committee.

Media strategy is based on building relationships. Although NWRC dealt with more than 50 national and international media after Hurricane Katrina in 2005, NWRC primarily concentrates on Gulf Coast media. Since the mid-90s NWRC has sponsored Science and the Media seminars to improve communications between scientists and media, and has arranged for a Pulitzer Prize-winning journalist to speak at USGS national events.

Finally, NWRC looks outside to improve communications. Staff members examine published case studies, attend USGS Communications meetings, and are involved with organizations such as the National Association of Government Communicators and Public Relations Society of America.

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Poster

Understanding the Shallow Stratigraphic Architecture of the Northern Gulf of Mexico: the Key to Identifying Potential Resources for Shoreline Stabilization

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The wetlands, bays, and barrier islands of the northern Gulf of Mexico were formed through the interaction of modern coastal processes with a geologic framework that began with the erosion and redistribution of Pleistocene fluvial-deltaic deposits during Holocene sea-level rise. As a result, the Mississippi River Delta Plain and adjacent Mississippi-Alabama Shelf are a complex arrangement of progradational facies (prodelta, delta front, distributary channel, and marsh deposits), and transgressive facies (inlet channel fills, shoal deposits, and nearshore marine deposits).

Continued sea-level rise, increased storm impact, human alteration of the landscape, and a finite sediment-supply have resulted in a measurable net loss of land area in the Northern Gulf of Mexico over the past few centuries. To accommodate the loss, a key component of coastal management is shoreline renourishment through recovery and redistribution of suitable sediments from submerged and buried sand deposits. Understanding the stratigraphic architecture is necessary to identify subsurface features that can be classified into distinct units of predominant grain-size and texture for use in stabilization and management efforts. Over the past two decades the U.S. Geological Survey has been actively developing technologies to characterize this near-surface geology and understand the process-response of the coastal zone. Remote sensing through acoustic profiling, direct sampling through coring, and the management, synthesis and distribution of existing information is key to characterizing the shallow stratigraphy and indentifying spatially distinct deposits that are potential resources for shoreline and wetland restoration. This presentation is an overview of efforts by the Coastal and Marine Geology Program and it's collaborators to provide information that can be utilized by coastal managers to protect the fragile ecosystem of the Northern Gulf of Mexico coastal zone.

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Assessing the Stability and Fate of Our Barrier Islands, Northern Gulf of Mexico

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The barrier islands of the Northern Gulf of Mexico provide habitat for a variety of flora and fauna, a platform for human infrastructure and recreation, and protection of interior wetlands and mainland populations from storm activity. The Chandeleur Islands of Louisiana and Gulf Islands National Seashore (GUIS) of Mississippi are preserved natural environments that are vital assets to the entire Gulf Coast. The islands formed between 6,000 and 4,000 years ago in response to decelerating sea-level rise and wave-directed transport of sediments from existing geologic formations. The development of barrier islands is a finite process, and the conditions that initiated these islands have been reduced or no longer exist. A diminishing amount of sediments available to build and maintain the islands is being scavenged by storms and reworked by prevailing wave climate to support the shorelines, with a net loss of island area. This natural process is being exacerbated by human alteration of the islands and adjacent inlets, continued sea level rise, subsidence, and increased storm activity. In 2005, hurricane Katrina overtopped the islands with up to 10-m of storm surge and caused significant erosion of sediment from the shoreface and protective dune systems. This combination of natural longevity, human alteration and the impact of a devastating 100-year storm brings into question what the future configuration of the barrier islands will be, what protective function they will provide for the mainland wetlands and human population centers, and whether they can continue to provide the same level of functional habitat for nesting birds and other wildlife.

Beginning in 2006, the U.S. Geological Survey in collaboration with federal (National Park Service, U.S. Army Corps of Engineers, Fish and Wildlife Service, Minerals Management Service) and state agencies (Louisiana Department of Natural Resources, Pontchartrain Institute of Environmental Science, Mississippi Minerals Research Institute) began an assessment of the topography, bathymetry and stratigraphy of the barrier islands. Understanding the geologic processes that influence the islands is crucial in determining their stability and fate. Collection of high-resolution scientific data is the first step in answering the questions about the future configuration of the islands, and identifying resources useful for island restoration. Initial assessment of the information collected around the Chandeleur and GUIS barrier islands reveals direct relationships between subsurface features and island configuration, and identifies potential sources of suitable material for island restoration. Examples of the initial studies conducted around the islands, and the methodologies developed by the U.S. Geological Survey and collaborators for collection, processing, analysis and distribution of scientific information around the barrier islands of the Northern Gulf of Mexico, is presented.

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Oral

Risk Assessment of Potential Invasiveness of Exotic Reptiles to South Florida Based on Import Pathway

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Global trade of live reptiles has facilitated introduction and establishment of exotic reptiles in many locations around the world. In south Florida, a subtropical climate and frequent import of exotic reptiles as pets have contributed to successful establishment of numerous taxa of reptiles. In this risk assessment project, we developed quantitative models to predict the successful establishment of exotic reptiles in south Florida. To identify which biotic, abiotic, and human-induced factors may be the best predictors of successful establishment for exotic reptiles, we used discriminant analysis, logistic regression, and recursive partition and regression trees.

Significant variables in the models included taxonomic group, maximum temperature match between native range and Florida, animal price, and manageability. We applied the models to predict establishment success of the 33 reptiles that were most frequently imported through Miami and St. Petersburg ports in Florida from 2000-2005. Among the assessed reptiles, we identified eight lizards and two snakes as potentially successful invaders. We further assessed risks associated with potential invaders should they become established by identifying species that are (1) dangerous to humans; (2) upper trophic-level predators in an ecosystem; (3) have the potential to spread rapidly; and (4) particularly difficult to manage or control.

Once exotic reptiles become established, managing them is expensive and labor intensive, thus prevention of establishment is the ideal management goal. Our study provides a foundation to develop screening tools that identify potentially problematic species among imported reptiles.

This project has relevance to Everglades restoration. If restoration activities alter microhabitat features of the landscape to be more favorable for exotic reptiles, the probability of establishment may increase. In addition, restoration of native and endangered species habitats may be negated by release and establishment of exotic reptiles in south Florida. Management tools that screen potential invaders and assess risk of establishment must be integrated into restoration goals and future modeling scenarios.

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The Non-Indigenous Aquatic Species Database and Alert System

Pam Fuller

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The Nonindigenous Aquatic Species (NAS) database *(http://nas.er.usgs.gov)* maintained by the U.S. Geological Survey in Gainesville, Florida, serves as a repository for spatial occurrence data on introduced aquatic species nationwide. The NAS program is a publicly accessible system designed to assist state and federal agencies and non-governmental organizations in understanding and managing non-native species in their jurisdictions. Whereas the NAS database focuses mainly on freshwater species, the NAS staff works closely with the Smithsonian Environmental Research Center, which focuses mainly on marine species. We also work in partnership with Portland State University which maintains the aquatic plant portion of the database. The NAS system is highly integrated and has many capabilities. Species are all linked to collection data, fact sheets, images, references, pathways data, an alert system, and interactive, real-time maps. Currently the system provides mapping by hydrologic unit codes; however, the capability to provide point distribution maps and maps by population status is being developed. The NAS Alert System is activated whenever a species is entered from a locality (state, county, or drainage) where it has not been previously recorded in the database. The alert is reviewed for relevance before being sent out. Users may register to receive alerts (by state, taxonomic group or species) via e-mail or can browse and search the archive on the site. Species introduced into the Gulf of Mexico include the jellyfish Phyllorhiza punctata, and Drymonema dalmatinum, green mussel Perna viridis, the tunicate Didemnum perlucidum, the Tessellated blenny Hypsoblennius invemar, Asian tiger shrimp Penaeus monodon, and Nile tilapia Oreochromis niloticus. Vectors that bring new species into the Gulf include shipping, ocean currents sweeping up species from the Caribbean, oil and gas platforms towed from South America, and escapes from aquaculture facilities.

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Poster

A Statistical Methodology for Conservation Science

James B. Grace

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It is little appreciated that the univariate model (e.g. ANOVA, multiple regression), which is the cornerstone of conventional approaches to the design of studies and analyses of data, is not well suited for the study of systems. Rather, conventional hypothesis testing methodology has been designed for studying individual processes and is not suited to evaluating hypotheses about complex systems. Structural equation modeling (SEM) is a method for addressing causal hypotheses about simultaneous interactions among the components of a system and, in contrast, is specifically designed for learning about systems using multivariate data. So that the potential utility of this methodology can be better realized, we are working towards development and application of a more complete set of tools for SEM for use in the ecological and conservation sciences. To accomplish this overall goal, three synergistic activities are being undertaken: (1) methodology development, (2) comprehensive applications to select conservation issues, and (3) exploratory applications. Here we demonstrate the utility of SEM for experimental studies relevant to the real world of complex, large-scale conservation science.

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Poster

Movements, Habitat Use, Diet, Thermal Biology, and Trapping of Burmese Pythons in the Southern Everglades

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Native to Southeast Asia, Burmese pythons (*Python molurus bivittatus*) are a recently established invasive species in South Florida. Burmese pythons have the potential to adversely affect their new environment. The release of Burmese pythons in South Florida is especially troublesome because they appear to thrive in both disturbed and undisturbed habitats within the Everglades. The purpose of this project is to provide science support to develop control measures for Burmese pythons and to evaluate impacts of pythons on native biological diversity. We are using radio telemetry to determine habitat use, extent and timing of movements, and find aggregations of pythons during the breeding season. Since December 2005, 17 adult pythons have been captured and surgically implanted with VHF radio transmitters in Everglades National Park and on lands owned by South Florida Water Management District. Distances traveled by the pythons varied from shorter movements of several hundred meters associated with breeding, to distances greater than 78 kilometers for pythons that had been relocated. The unique dispersal capabilities of Burmese pythons and affiliation with water indicate that effective management of the rapidly expanding python population in south Florida requires cooperation and involvement of all land managers and relevant agencies.

Burmese pythons are generalist predators that consume a wide variety of mammal and bird species, as well as reptiles, amphibians, and fish. Prey species in the digestive tracts of Burmese pythons were identified by examining hair, bone, and teeth. Fourteen species of mammals, five species of birds, and one species of reptile have been found in the digestive tracts of pythons collected and examined in Florida, including several federally endangered Key Largo woodrats (*Neotoma floridana smalli*); one threatened species, the American alligator (*Alligator mississippiensis*); and two species of special concern, the limpkin (*Aramus guarauna*) and the white ibis (*Endocemus albus*).

Because temperature affects nearly all aspects of the biology of ectotherms, examining patterns of body temperature variation can often provide insight into their activity and behavior. To better understand the ecology of introduced Burmese pythons in ENP, we initiated a radiotelemetry study of pythons within and adjacent to the ENP and monitored their temperatures using surgically implanted micro-dataloggers. We simultaneously monitored environmental

temperatures. Using these data, we hope to provide information on python thermal biology, behavior, and activity that will assist in a better understanding of their overall ecology and development of effective population controls.

Trapping is one control method currently under development. The purpose of trapping is to remove pythons from the Everglades system. We are currently testing various trap and trap door designs. We intend to synthesize the knowledge gained from radio-telemetry, diet, and thermal studies to increase trapping success. This multi-faceted approach should increase success in reaching our primary goal of developing control methods for Burmese pythons.

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Poster

Moving from Monitoring to Modeling: Regional Assessment of Nutrient Sources, Transport, and Delivery to Streams and Coastal Areas

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The SPARROW model (SPAtially-Referenced Regression on Watershed attributes) was used to investigate transport and fate of nitrogen on the landscape and in streams in river basins in Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, and Florida. The SPARROW model integrates water-quality monitoring data with nitrogen source data to estimate mean-annual rates of combined overland and subsurface nitrogen transport from sources in a watershed to the adjacent stream channel. Delivery rates are characterized as functions of landscape factors such as soil permeability and depth.

The model produces estimates of mean annual load and concentration of nitrogen for each stream reach in the model area, providing a tool for addressing a number of questions about stream nitrogen loads entering nutrient-sensitive water bodies in the southeastern U.S. For example, what are the proportional contributions of nitrogen delivered to each water body from atmospheric deposition, agricultural land, urban land, and point-source wastewater discharge? How will changes in inputs from these sources affect the annual load delivered to the water body? SPARROW results can also address the proportional contributions of nitrogen to the water body from watershed subbasins, annual load responses to incremental changes in subbasin nitrogen inputs, and the effects of variation in landscape characteristics among subbasins.

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Oral

Monitoring the Impact of a Hydrologic Restoration Project on Vegetation of the Ten Thousand Islands Region in Southwest Florida

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The Ten Thousand Islands region of southwest Florida is characterized by a complex of mangrove forests and salt, brackish, and fresh marsh habitats that have been hydrologically modified since the 1940's, leading to changes in vegetation community structure. At Ten Thousand Islands National Wildlife Refuge (TTI NWR), marsh habitat area has decreased while mangrove forest area has increased. This study documents more recent vegetation change resulting from the U.S. Army Corps of Engineers' Picayune Strand Restoration Project (PSRP), which attempts to restore historical hydrologic regimes to the Ten Thousand Islands region. Three monitoring stations consisting of two permanent 50-m long transects were established in fall 2007 in each of three marsh types (fresh, brackish, and ecotone marsh) at TTI NWR; the nine stations had previously been equipped with continuous water-level recorders. Additional transects were established as controls at five sites outside the PSRP impact area. Species cover was estimated to the nearest 5% at six 0.5-m^2 quadrats along each transect, as was number and height for woody species within a 100-m^2 wide belt. Analysis using multi-response permutation procedures (MRPP) indicated separation between the three marsh types at TTI NWR ($P = 0.00$, $A = 0.16$). Three separate control groups were also identified by using MRPP ($P = 0.00$, $A = 0.26$). Indicator species analysis identified species associated with each of the six vegetation groups. Long-term monitoring will identify future shifts in plant community composition, providing information on the link between specific hydrologic characteristics and vegetation response.

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Poster

Stress Tolerance in Eurasian versus U.S. Gulf of Mexico clones of *Phragmites australis*

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The competitive ability and stress tolerance of the Eurasian haplotype of *Phragmites australis* have been cited as probable causal factors in the expansion of this lineage in North American wetlands. To test this idea, we conducted greenhouse experiments measuring growth of *P. australis* individuals collected in Louisiana. We analyzed chloroplast DNA and found that the plants represented both the gulf coast (I) and Eurasian (M) haplotypes. Salinity, water depth and soil type were manipulated in two experiments, which included clones of both haplotypes. Growth was affected by all factors, and several interactions between factors were identified. Stem height of both I and M clones was significantly decreased in salinities of 10 and 18 psu compared to freshwater; no difference between haplotypes was evident. When grown in a commercial soil mix, M clone biomass was lower than that of I clones in stressful conditions (deeper water, higher salinity). However, M clones had greater stem density and height than I clones in organic and silt soils, but not in clay soils, regardless of salinity. The study suggests that growth of both haplotypes in response to interactive stressors is complex, and that invasiveness of the Eurasian haplotype may be related to soil characteristics.

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Poster

Recent Sedimentation Patterns Within the Central Atchafalaya Basin, Louisiana

Cliff R. Hupp[1], Charles R. Demas[2], Daniel E. Kroes[2], Richard H. Day[3], and Thomas W. Doyle[3]

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Sediment deposition and storage are important functions of forested bottomlands, yet documentation and interpretation of sedimentation processes in these systems remain incomplete. Our study was located in the central Atchafalaya Basin, Louisiana, a distributary of the Mississippi River and contains the largest contiguously forested riparian wetland in North America, which suffers from high sedimentation in some areas and hypoxia in others. We established 20 floodplain transects reflecting the distribution of depositional environments within the central Basin and monitored general and local sediment deposition patterns over a three-year period (2000–2003). Deposition rate, sediment texture, bulk density, and loss on ignition (LOI, percent organic material) were determined near or just above artificial markers (clay pads) located at each station per transect. Transect mean sedimentation rates ranged from about 2 to 42 mm/yr, mean percent organic material ranged from about 7% to 28%, mean percent sand (. 63 m) ranged from about 5% to 44%, and bulk density varied from about 0.4 to 1.3. The sites were categorized into five statistically different clusters based on sedimentation rate; most of these could be characterized by a suite of parameters that included hydroperiod, source(s) of sediment-laden water, hydraulic connectivity, flow stagnation, and local geomorphic setting along transect (levee versus backswamp), which lead to distinct spatial sedimentation patterns. Sites with low elevation (long hydroperiod), high hydraulic connectivity to multiple sources of sediment-laden water, and hydraulic damming (flow stagnation) featured the highest amounts of sediment trapping; the converse in any of these factors typically diminished sediment trapping. Based on aerial extent of clusters, the study area potentially traps 6,720,000 Mg of sediment annually, of which, 820,000 Mg represent organic materials. Thus, the Atchafalaya Basin plays a substantial role in lowland sediment (and associated contaminant) storage, including the sequestration of carbon. Findings on local sedimentation patterns may aid in management of flow to control sediment deposition and reduce hypoxia.

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Poster

USGS Gas Hydrate Studies in the Northern Gulf of Mexico

Deborah R. Hutchinson

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For more than a decade, the U.S. Geological Survey (USGS) has partnered with other entities to study the occurrence of gas hydrates in the Gulf of Mexico. Gas hydrates are ice-like forms of water and gas, usually methane, which occur in most continental margins of the world where appropriate temperature and pressure conditions exist, usually in the uppermost few hundred meters of sediments. In the northern Gulf of Mexico, studies were initially driven by concerns about hazards associated with penetrating gas hydrates during conventional oil and gas drilling in water depths >500 m where gas hydrates are typically stable. More recently, interest exists in gas hydrates as a potential unconventional energy resource. USGS research aims to define the geologic framework for gas hydrate occurrence, to quantify its occurrence, and to anticipate impacts of its dissociation. A major drilling program in 2005 in cooperation with the Department of Energy and the Joint Industry Project on Gas Hydrates in the Gulf of Mexico yielded strong evidence for a fault-controlled gas-hydrate accumulation in the minibasin province at about 1300 m water depth. A second exploratory drilling and logging campaign is planned in 2009 to better understand gas hydrate-bearing sands. Three areas will test alternative geological models and geophysical interpretations supporting the existence of potential high gas hydrate saturations in reservoir-quality sands. The three sites are near existing drill holes which provide geological and geophysical constraints in Alaminos Canyon (AC) lease block 818, Green Canyon (GC) 955, and Walker Ridge (WR) 313. In addition to testing geological methods and models used to infer the occurrence of gas hydrate in different settings in the northern Gulf of Mexico, the drilling results will be used to (a) calibrate geophysical models used to detect gas hydrate sands, map reservoir thicknesses, and estimate the degree of gas hydrate saturation; and (b) delineate potential locations for subsequent JIP drilling and sampling. The northern Gulf of Mexico gas hydrates research program focuses on quantifying the complex interactions of physical, chemical, geological, hydrological, and biological processes controlling the formation, occurrence, and dissociation of gas hydrate.

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Oral

Integrated Measures of Anthropogenic Stressors in the Lower Mississippi River Basin: Targeting Biomarker Collections in Aquatic Animals

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Integrated, quantitative measures of anthropogenic stress over large geographic regions can be valuable for environmental research and management. In order to develop regional stress measures, pre-existing spatial datasets of variables can be categorized into classes of anthropogenic stress based on measures such as agricultural use, human population levels, point source pollution, and land cover type. By mapping these stress measures, spatial patterns may become apparent, whereby gradients of stressors can be chosen along which hypotheses may tested according to management needs.

Historic, accurate, and detailed images are a cornerstone for reconstructing scenarios that can be used to analyze, model, and predict the status and conditions of natural resources within river basins, such as the Lower Mississippi River Basin (LMRB). In the LMRB, constructed data sets include the National Gap Analysis Program (GAP) land use/land cover, the USGS GIRAS land use/land cover, and the National Land Cover Data (NLCD). These data sets have been converted to a common projection and datum, and reclassified according to a crosswalk by which categories can be compared through USGS interactive map servers. These land use/cover classifications can be further manipulated and useful for environmental assessments of patterns with respect to water quality analysis, growth management, and other environmental impact assessments.

Temporal spatial analysis can provide patterns of change as a basis for which organismal data can be collected. Because artifacts due to classification methods, scale, and projection directly impact temporal change analyses, rigorous quality control measures must be considered. Data needs may be either immediate or long-term, and are dependent on factors that may include acute or hazardous incidences, invasive species encroachment in ecosystems, human and development impacts, and water quality changes. Geospatial data overlays can be used to delineate impact severity patterns. Hence, hypothesis testing for site differences in water quality and consequent biomarkers can be performed using appropriate aquatic species.

A targeted bioindicator/biomarker approach based on the geospatial database of known anthropogenic variables can be used to develop hypotheses specific for management needs. Bioindicators are measures of variables that respond in quantifiable ways to changes in the environment. The choice of bioindicators at specific biological levels of organization (such as genetic, cellular, tissue, hormonal, and organismal levels) is dependent on the resource management need. Applying geospatial data sets to quantify anthropogenic impacts has the potential for simplifying complexities of interacting biological and environmental effects.

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Poster

Hydrogeology, Water-Level Altitudes and Changes in the Chicot, Evangeline, and Jasper Aquifers; Land-Surface Subsidence in the Chicot and Evangeline Aquifers in the Houston-Galveston Region, Texas

Mark C. Kasmarek and Natalie A. Houston

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The Chicot aquifer (in Holocene- and Pleistocene-age sediments), Evangeline aquifer (in Pliocene- and Miocene-age sediments), and Jasper aquifer (in Miocene- and Oligocene-age sediments) are the three primary aquifers in the Gulf Coast aquifer system in Texas. The hydrogeologic units are laterally discontinuous, fluvial-deltaic lenticular deposits of gravel, sand, silt, and clay that dip and thicken from northwest to southeast. The units thus crop out in bands inland from and approximately parallel to the coast, becoming progressively more deeply buried and confined toward the coast. The Chicot aquifer outcrop, which comprises the youngest sediments, is the closest of the aquifer outcrops to the coast, followed farther inland by the Evangeline aquifer outcrop and then farthest inland by the Jasper aquifer outcrop.

The U.S.G.S., in cooperation with the Harris-Galveston Subsidence District, the City of Houston, the Fort Bend Subsidence District, and the Lone Star Groundwater Conservation District, publishes an annual report on the water-level altitudes and water-level changes for the Chicot, Evangeline, and Jasper aquifers and compaction of subsurface sediments in the Chicot and Evangeline aquifers in the Houston-Galveston region. The 2008 report (Scientific Investigations Map 3031) shows potentiometric surfaces as low as 200 feet below sea level for the Chicot aquifer in central Harris County; 300 feet below sea level for the Evangeline aquifer in northern Harris County, and 150 feet below sea level for the Jasper aquifer in southern Montgomery County. Additionally, for the period 1977–2008, the report shows water-level rises of as much as 200 and 260 feet in the Chicot and Evangeline aquifers, respectively, in southeast Harris County.

The Houston-Galveston region is the largest urban area in the U.S. affected by land-surface subsidence caused by ground-water withdrawals. Sustained withdrawals cause water levels in the aquifers to decline, which in turn causes depressurization and dewatering of the clay lenses. Subsequently, the individual grains of the clay lenses begin to realign and compress. Measured subsidence data using spirit-leveling and GPS techniques indicate that as much as 10 feet of subsidence has occurred in areas of southeastern Harris County. For the same area, data derived from subtraction of a 1915–17 DEM from a 2001 DEM show that land-surface elevation has declined as much as 13 feet. Land-surface subsidence is especially problematic for coastal areas having low topographic relief. Impervious land-surface cover, surficial clay in the Chicot aquifer, and Gulf of Mexico low-pressure systems with storm surge and high rainfall, combine to make areas affected by subsidence more flood prone.

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Poster

USGS Research Activities in Coastal Forest Ecosystems of the Northern Gulf of Mexico

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Coastal forests along the northern Gulf of Mexico are among the most sensitive ecosystems to climate change. While tidal freshwater forests are undergoing dieback and decline at the upper intertidal ecotone in coastal areas, saltwater forests (i.e., mangroves) are migrating landward and poleward under general warming conditions and sea-level rise. Recent evidence suggests that hurricane surge events and sea-level anomalies during drought episodes contribute to increasing soil salinities that progressively eliminate certain freshwater tree species with different thresholds of tolerance within riverine outlets near the estuarine interface. This process of soil salinization of freshwater habitats along the upper estuary is related to land elevation and tidal influence on the short-term and relative sea-level rise and hurricane events over the long-term. A number of coastal forest types have exhibited similar die-off behavior and episodes in the last few decades including slash pine forests of the Florida Keys, coastal cabbage palms and hammock ecosystems of the Big Bend region of Central Florida, and bottomland hardwood and bald cypress dominated tidal forests of the Louisiana Deltaic region. Contrastingly, mangrove species also serve as an outstanding environmental indicator and sentinel tree species of climate change. Lapses in freeze events and extreme drought events related to recent warming trends account for increased mangrove establishment and expansion into subtropical salt marsh and freshwater ecosystems over the past decade. Historically, the ecological range of mangroves along the northern Gulf of Mexico have expanded and contracted, but populations in Florida, Louisiana, and Texas are currently undergoing unprecedented expansion landward and in latitudes above the tropical Everglades region. USGS field and modeling studies of tidal freshwater and mangrove forests predict that climate change impacts may lead to extensive shifts in habitat conditions along the northern Gulf of Mexico. Coastal parks and refuges, State and Federal, are at risk to coastal forest retreat and habitat shifts across the pan-Gulf region under changing climate that could have significant ecological and economic implications.

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Oral

Ocean Acidification and Coral Reef Communities

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Laboratory studies predict that calcification rates of reef organisms will decrease within the next century due to ocean acidification (OA). The effects of OA on ecological processes, such as recruitment and competition for space, are relatively unstudied. Theoretically, calcifying organisms will be less competitive in a high-pCO_2 world because the rate at which they build their skeletons to occupy space will be reduced. We conducted a nine-month experiment to measure the effects of OA on Hawaiian reef community development, including corals and other calcifying and non-calcifying algae and invertebrates. Six outdoor mesocosms continually received non-filtered seawater from the adjacent reef flat. Three were controls with ambient seawater only, and three were with pCO_2 levels exceeding ambient daytime conditions by 365 ±130 μatm. The treatment mesocosms experienced daytime levels of pCO_2 predicted for the year 2100 under a business-as-usual climate-change scenario. Recruitment rate and space occupation by crustose coralline algae were severely inhibited in high-pCO_2 mesocosms, with a 78% and 92% reduction, respectively, compared to control mesocosms. We propose that accounting for the replacement of calcifying organisms by those that do not calcify, rather than simply extrapolating measurements of decreased calcification rates, will be necessary to predict future carbonate-accretion rates in the face of OA. The results of our study are relevant to carbonate production on Florida reefs and other carbonate-producing systems.

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Poster

Unsupervised classification of vegetation communities using airborne LiDAR data at Naval Live Oaks Reservation, Florida

Monica Palaseanu-Lovejoy[1], Amar Nayegandhi[1], John C. Brock[2] and David Nagle[1]

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This study evaluates the capability of NASA Experimental Advanced Airborne Research Lidar (EAARL) to delineate vegetation communities in Naval Live Oaks Reservation (NLO), Florida using unsupervised k-means clustering. Five-meter-resolution grids of bare earth (BE), canopy height (CH), canopy-reflection ratio (CRR), and height of the median energy (HOME) were derived from spatially dense EAARL data acquired in 2005 and 2007.

The NASA EAARL is a temporal waveform green-laser (532 nm), small-footprint airborne lidar instrument. To describe the vertical structure of vegetation, several individual small-footprints are combined to make a composite "large-footprint" waveform. The size of the composite footprint is a variable determined in the post-flight processing software. BE is derived directly from the small footprints, while CH, CRR and HOME are derived from the composite footprints. CRR represents a relative measure of the canopy closure, while HOME is sensitive to changes in vegetation structure and the degree of canopy openness.

A principal component analysis (PCA) of the four lidar metrics was performed and the k-means clustering was conducted on the PCA components weighted by their respective proportion of explained variances. A majority filter was applied on the vegetation classification map in order to increase class cohesiveness. Both filtered and unfiltered classifications were compared with the color infrared imagery obtained during same EAARL flight mission to assess the reliability of the vegetation classification categories.

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Poster

Monitoring Inland Storm Surge and Flooding from Hurricane Rita

Benton D. McGee, Roland W. Tollett, and Robert R. Mason

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Pressure transducers (sensors) and high–water marks were used to document the inland water levels related to storm surge generated by Hurricane Rita in southwestern Louisiana and southeastern Texas. On September 22–23, 2005, an experimental monitoring network of sensors was deployed at 33 sites over an area of about 4,000 square miles to record the timing, extent, and magnitude of inland hurricane storm surge and coastal flooding. Sensors were programmed to record date and time, temperature, and barometric or water pressure. Water pressure was corrected for changes in barometric pressure and salinity. Elevation surveys using global–positioning systems and differential levels were used to relate all storm–surge water–level data, reference marks, benchmarks, sensor measuring points, and high–water marks to the North American Vertical Datum of 1988 (NAVD 88). The resulting data indicated that storm–surge water levels over 14 feet above NAVD 88 occurred at three locations and rates of water–level rise greater than 5 feet per hour occurred at three locations near the Louisiana coast.

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Poster

Biophysical Controls on Response of Coastal Wetlands to Climate Change, Elevated CO_2, and Sea-Level Rise

Karen L. McKee

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Global changes in climate, atmospheric CO_2, and sea-level rise (SLR) will have multiple and complex effects on coastal wetlands. Assessments of vulnerability to submergence are typically based on simple physical models of projected sea-level intersecting with land topography and do not consider biological feedbacks that allow wetlands to maintain their elevations. This presentation (1) reviews how external drivers and internal biological feedbacks may interact to influence the capacity of coastal marshes to keep pace with SLR and (2) presents new data showing how CO_2 enrichment may alter elevation dynamics. Soil accretion in most coastal wetlands occurs through both physical and biological processes, but in sediment-deficient systems, accumulation of organic matter through plant processes is an important contributor to soil volume. Thus, factors that influence plant processes (CO_2, salinity, flooding) have the potential to alter soil volume and vertical land-building. An understanding of biological processes influencing elevation dynamics is especially important in subsiding and low-sediment geomorphic settings such as the Mississippi River deltaic complex. Field studies have identified the plant root zone as a key stratum where vertical adjustment to counter submergence occurs. Greenhouse studies have quantified interactive effects of atmospheric CO_2 with edaphic factors of flooding, salinity, and nutrients to increase soil volume and upward soil expansion in freshwater, brackish, and saline plant communities. In addition, large disturbance events such as hurricanes deliver sediment to subsiding marshes, adding directly to soil volume and stimulating plant production, setting back the clock on elevation loss. These results show that as sea-level rises, biophysical processes and interactions with other global drivers may alter elevation dynamics in coastal marshes, in some cases improving their capacity to keep pace with SLR.

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Oral

Aerial Rapid Assessment of Hurricane Damages to Northern Gulf Coastal Habitats

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Hurricane Katrina made landfall in southeast Louisiana on August 29, 2005, and Hurricane Rita made landfall in southwest Louisiana on September 24, 2005. United States Geological Survey (USGS) scientists flew aerial surveys to assess damages to natural resources and to lands owned and managed by the U.S. Department of the Interior and other agencies. Flights were made on eight dates from August 27 through October 4, including one pre-Katrina, three post-Katrina, and four post-Rita surveys. The total geographic area covered by all flights extended from Galveston, Tex., to Gulf Shores, Ala., and from the Gulf of Mexico shoreline inland 5 to 75 mi (8-121 km). Scientists flew 5,003 mi (8,050 km; 64.4 flight hours), recorded 657 observations on hurricane impacts, and took 3,856 high-resolution digital oblique photographs. Each observation and photograph was georeferenced as to spatial coordinates and marked with a time stamp, using a DOI aircraft that is specially configured to collect and integrate spatial, videographic, photographic, and audio data. Impacts to barrier island habitats were severe, especially at the Chandeleur Islands, which were reduced in land area by roughly 50 percent. Barrier islands and shorelines west of the Mississippi River were impacted to a lesser degree, similar to recent storm effects. Marsh impacts varied but were greatest in Saint Bernard and Cameron parishes where much emergent vegetation was scoured or killed. Forested wetlands were impacted heavily, especially in the Pearl River basin and on the cheniers of southwest Louisiana. These data were provided and made available to other scientists as well as to land managers and the general public through being served on the NWRC web site, press realeases, distribution of CD/DVD to managers/partners, and publication of a peer-reviewed scientific article.

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Oral

Freeze Tolerance of Mangroves and Their Distribution Along the Northern Gulf of Mexico Coast in Response to Climate Change

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Three species of mangroves occur in North America: black mangrove (*Avicennia germinans*), white mangrove (*Laguncularia racemosa*) and red mangrove (*Rhizophora mangle*). All three species are highly adapted to intertidal flooding regimes and have occurred historically throughout the Caribbean and into the southern Gulf of Mexico. Mangroves are largely freeze intolerant; thus their northern distributions are limited to subtropical, pan-Gulf environments. The southern Florida Gulf coast consists primarily of mangrove forests of all three species, with trees typically reaching 10-20 m in height. The general northward trend is toward trees of shorter stature and sparse coverage up to the northernmost range extent of the black mangrove in coastal Louisiana where, until recently, the plant rarely attained two meters in height. Historically, the northward decrease in mangrove abundance and stature is correlated with increased abundance of *Spartina alterniflora* and other salt marsh species. We have noted, however, an increase in coverage and height of mangroves since the last hard freeze in coastal Louisiana occurred in 1989. We hypothesized, therefore, that Global Climate Change is having a direct effect on mangrove distribution because increasing temperatures and changing freeze/drought cycle patterns allow a northward expansion of mangroves into the salt marsh zone. This expansion is a major landscape change that will likely have a significant impact on birds, fish and other species that rely on coastal vegetation, including the human population culturally and financially dependent on the subtropical marsh ecosystem.

Our study consisted of three portions: (1) an aerial survey of mangrove distribution along transects in southeastern Louisiana over a 13-month period, 2001-2002, (2) ground surveys of a single site (near Fourchon, Louisiana) over a 10-year period, 1996-2006, and (3) a greenhouse and freeze chamber experiment to investigate plant response to various temperature and duration regimes, in 2008. Our aerial survey was conducted during a period of salt marsh dieback that resulted in areas of bare, unvegetated substrate where the *Spartina* died back and disappeared. Many of those areas were quickly vegetated with mangroves, as our results show that the number of sample sites vegetated with *Avicennia* more than doubled from October 2001 (22 sites) to August 2002 (55 sites). At our Fourchon ground site we have documented that the areal coverage of *Avicennia* increased from approximately 7% of the vegetated area in 1993 to approximately 92% in 2000, at a rate of 4 ha/y. In our freeze chamber experiment we used at least three replicates each to test black and red mangroves at three temperatures (-5^{o}C, 0^{o}C, and +5^{o}C) for five durations (1, 5, 10, 24, and 48 h). Both species had 100% survival at +5^{o}C, all durations, although some damage was sustained for the 24 h and 48 h groups. At 0^{o}C black mangroves showed some damage at 24 and 48 h duration but no complete mortality, whereas the red mangroves showed complete mortality at 48 h and partial damage at shorter durations of exposure. Both groups showed complete mortality at -5^{o}C for 48 h, and mixed results for the shorter durations at -5^{o}C. We plan to expand our studies to other parts of the Gulf coast pending future funding.

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Poster

Diurnal Time-activity Budgets of Redheads Wintering in Seagrass Beds and Coastal Ponds in Louisiana and Texas

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ABSTRACT: Diurnal time-activity budgets were determined for wintering redheads (*Aythya americana*) from estuarine seagrass beds in Louisiana (Chandeleur Sound) and Texas (Laguna Madre), and from ponds adjacent to the Laguna Madre. Activities differed significantly ($P < 0.0001$) by location, month, and diurnal time period. Resting and feeding were the most frequent activities of redheads at the two estuarine sites, while drinking there was almost nonexistent. Birds on ponds in Texas engaged most frequently in resting and drinking, but feeding was very infrequent. Redheads from the Louisiana estuarine site rested less than birds in Texas at either the Laguna Madre or freshwater ponds. Redheads in Louisiana fed more than birds in Texas; this was partially due to weather differences (colder temperatures in Louisiana), but the location effect was still significant even when weather effects were adjusted for in the model. Redheads in Louisiana showed increased resting and decreased feeding as the winter progressed, but redheads in Texas did not exhibit a seasonal trend in either resting or feeding. Males and females at both Chandeleur Sound and Laguna Madre showed statistical differences in their activities, but the absolute difference seldom exceeded 2% for any single activity. Diurnal time-activity budgets of redheads on the wintering grounds may have been influenced by water salinities and the use of fresh water, and by weather conditions, tides, and vegetation differences (patch size) between sites.

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Poster

Climate change, carbon storage and function of *Taxodium distichum* swamps

Beth A. Middleton

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Predictions can be made about the potential effects of climate change on wide-ranging ecosystems based on shifts in their function across their geographical range. *Taxodium distichum* is a forested wetland type that spans the southeastern part of North America, and a good candidate for climate analysis. Study sites were established in similar swamps at each of 7 latitudes in the Mississippi River Alluvial Valley from Illinois to Louisiana, to make comparisons of carbon storage and production across the climate gradient. Swamp leaf production, root production and tree height were highest in mid-range, and lower in the northern and southern parts of the range, i.e., a curvilinear pattern. Seed bank densities are generally related to temperature and precipitation levels, so that regeneration patterns may shift with climate change. A climate change model suggests that climate warming and drying could decrease the range of swamps in the western and southern part of the range. Knowledge of the response of baldcypress swamps to differences in climate across the latitudinal range can give evidence of the response of these species to climate change, and thus help lead to models that more accurately predict the distribution of these wetlands in the future.

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Poster

High-Resolution Coastal Land-Cover Classification in the Northern Gulf of Mexico

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The northern Gulf of Mexico landscape contains about 30 percent of the Nation's wetlands, but accounts for 90 percent of annual wetland losses. Several remote-sensing-based studies in the northern Gulf of Mexico region have been conducted to refine quantification of these losses. Most of these studies have been based on moderate resolution (30-m) Landsat imagery. Although Landsat imagery provides excellent results at a reasonable cost for large-scale mapping, the land-cover classification map from a 900-m^2 Landsat pixel is not designed to capture local change from catastrophic storm events, such as Hurricanes Katrina and Rita, or small-scale anthropogenic influences. The objectives of this research are two fold: 1) to use high-resolution Quickbird (2.4-m multispectral) imagery to improve the specificity of the current Landsat-based post-Hurricane Katrina land-cover classification map and 2) to investigate the effects on classification accuracy by combining advanced image-segmentation techniques and high-resolution Lidar-derived elevation data with established National Land Cover Database (NLCD) classification methods. Three pilot regions were chosen in the coastal regions of Louisiana and Mississippi: an ~776-km^2 region in the Delacroix river basin, an ~346-km^2 region covering the lower Pearl River basin, and an ~75 km^2 region encompassing the Barataria Preserve at Jean Lafitte National Park. The land-cover classification maps developed for the three study areas had a final target spatial resolution of 5 m and a suitable classification legend that represents the biophysical structure of wetland and coastal areas.

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Poster

Understanding Water Availability

Kenneth R. Odom

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Over recent years the term "water availability" has become very important as concerns grow about our ecosystem health, the effects of climate change, and the expanding population. But what really is water availability and how do we determine its present state? How do we predict future water availability?

Water availability is not only a question of water quantity, but also one of water quality. From a water quantity perspective, a hydroelectric power generation facility may be mainly concerned with the projection of monthly water volumes on a river system for predicting electrical power generation. Depending on other uses of the water, however, the quality can be as much a limiting factor as quantity. For example, the quantity of water available in an ecosystem for an endangered species may be ideal, but if some aspect of water quality is poor, the species' survival may be in jeopardy.

Although water quality is essential to the determination of available water, the first step should be one of quantity. Indeed, if water is not available then how can water quality be measured in the first place? This presentation will focus more on the determination of water availability in terms of water quantity; however, this is not meant to downplay the importance of water quality but to provide a starting point for quantifying water resources.

Determination of water availability is usually multi-objective and multi-disciplinary, and requires a number of tools that can be modified, or customized, to site-specific conditions. No single method or model can be applied to all situations unless it is applied under broad-scale conditions. Determination of water availability, in general, requires expertise in a number of areas, including model building and calibration, statistics, geographical information systems, database design and management, and computer programming. Also, depending on the objectives of the water availability tool, one or more disciplines are required from geography, water, geology, and biology.

Successful determination of water availability is also time and space dependent. From the aspect of time, one particular study may require daily mean flows, while another study may require an annual water balance. Spatially, an ecosystem study may require water availability estimates at a stream-reach level while studies used for power generation and navigation may need quantity forecasts at a major river basin level.

Recent and ongoing water availability work in the Upper Flint River basin of Georgia is focusing on ecosystem flows. Coarse and fine resolution hydrologic models are being coupled with biological models to estimate the effects of changing water availability on fish populations at a stream reach level. Two hydrologic models are being used: TOPMODEL (TOPography-based MODEL) and PRMS (Precipitation-Runoff Modeling System). Both are physically-based models that can be customized to fit an array of scales in time and space. These are two tools that not only have the capability of simulating current conditions, but also are able to build scenarios for future predictions. TOPMODEL will also be used in a statewide water availability study in Alabama that will focus on daily mean flows at the spatial scale of 12-digit HUCs.

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Oral

20th Century development and expansion of Louisiana shelf hypoxia, Gulf of Mexico

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Hypoxia occurs in continental-shelf subsurface waters when the uptake of oxygen by respiration exceeds its resupply. Systematic measurements of Louisiana continental-shelf waters were initiated in 1985, and since then hypoxia (oxygen content <2mg/L) has increased considerably in an area now dubbed the "dead zone." Several monitoring and modeling studies have concluded that the expansion of the Louisiana shelf dead zone is related to increased nutrient delivery (primarily nitrogen, but possibly also phosphorous) from the Mississippi River drainage basin. The source of the nutrients is believed to be anthropogenic (fertilizer, sewage, and livestock-derived runoff, etc.) and is responsible for the degradation of Gulf of Mexico marine habitats. Our research investigates the record of temporal and geographic extent of low-oxygen bottom-water conditions recorded in Louisiana shelf sediment cores prior to 1985.

We use a specific low-oxygen faunal proxy termed the PEB index based on the cumulative percentage of three species of benthic foraminifers (= % *Protononion atlanticum*, + % *Epistominella vitrea*, + % *Buliminella morgani)* that has been shown statistically to represent the modern seasonal Louisiana hypoxia zone. Our hypothesis is that the increased relative abundance of PEB species in dated sediment cores accurately tracks the development and expansion of seasonal low-oxygen conditions on the Louisiana shelf. Fourteen box cores contain PEB records and excess ^{210}Pb-derived chronologies. This network of core records reveals a consistent pattern showing the establishment of modern hypoxia over a large portion of the dead zone between 1950 and 1960. From 1960 to the present, the percentage of PEB species has steadily increased, indicating stronger or more frequent hypoxic episodes. These data also indicate that the occurrence of hypoxia hotspots, similar to those of today, existed much earlier on the shelf and as far back as 1920. Additional data support expansion of the modern dead zone to the south, where hypoxia has impacted the benthic foraminiferal faunas outside of the monitored area. Our results support the interpretation that modern hypoxia is related to human activities and subsurface low-oxygen conditions were occurring seasonally over at least two-thirds of the geographic distribution of the modern measured hypoxia zone by 1960.

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Oral

Holocene Evolution of Apalachicola Bay, Florida

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In order to understand the Holocene evolution of Apalachicola Bay in Florida better, a program of geophysical mapping was followed by sedimentological and faunal analyses of vibracores. Ten vibracores, collected in two to four meters of water, contain chronologies provided by 34 AMS ^{14}C dates on shells and wood. As sea level rose after the last glacial maximum, fluvial deposits filled in the Apalachicola River paleo-channel, which extended southward across the central part of the bay. Sediment cores to either side of the paleo-channel contain abundant wood fragments documenting forested areas on the shelf at 8,000 ^{14}C years. Marsh sediments with agglutinated foraminifers and diatoms overlie the wood-bearing sediments and indicate that the initial marine transgression occurred at about 7,000 ^{14}C years. After the initial flooding of the area presently covered by the bay, the Apalachicola paleo-delta readvanced onto the inner shelf west of the filled paleo-channel after 7,000 ^{14}C years. Later, a shift in the path of the river system allowed the establishment of an eastern deltaic lobe at 5,600 ^{14}C years.

The timing of barrier-island formation is based on establishment of estuarine conditions in Apalachicola Bay. Estuarine benthic foraminiferal assemblages occurred as early as 6,500 ^{14}C years in the western bay and after 5,200 ^{14}C years in the eastern bay. The faunal assemblage supports the interpretation that the barrier islands developed from sand reworked from the paleo-delta lobes and expanded first in the western bay and later in the eastern bay. In addition, at the base of two cores, open-marine benthic foraminifers record an older marine highstand that indicates the absence or more landward occurrence of an earlier barrier-islands system.

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Poster

Real-time Data Collection Networks

Leroy Pearman

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The need for readily available water data has increased dramatically within the past 10 years. Data historically was disseminated using annual publications done on a National basis for each State. The States that rim the Gulf of Mexico all have viable data collection programs which collect continuous streamflow and water quality parameters in real-time. Stations exist on the major rivers and many of the smaller streams that enter the Gulf of Mexico. The discharges from month to month can vary by as many as three orders of magnitude which can cause major shifting in the saltwater-freshwater interface. The discussion will give the locations and types of data available throughout the TX, LA, MS, AL, and FL coastal areas. This data is invaluable in assessing the current and long-term changes occurring in the Gulf of Mexico.

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Oral

Natural Climate Variability in Northern Gulf of Mexico: Implications for the Future

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Human activities and natural processes are currently influencing climate variability. Better information on past natural climate variability and its impact on ecosystems are needed to help discriminate between natural variability and human-related changes and to improve forecasts of future change and its societal impact. Better understanding of variability in the Gulf of Mexico is important because the Gulf of Mexico is a significant source of moisture for a large area of North America.

Researchers at the USGS, the University of Texas, Austin, and the University of South Florida are collaborating to establish a network of marine records of climate variability in the northern Gulf of Mexico for the last few thousand years. The marine records are based on analyses of microfossil assemblages and variations in the isotopic and trace-element content of microfossil shells in AMS ^{14}C-dated sediment cores from the continental slope and shelf. Previous studies have established relations between shell chemistry and seawater characteristics such as temperature and salinity; however, these relations have not been defined for the Gulf of Mexico. Thus, part of the collaborative effort involves a sediment-trap experiment to provide a direct calibration of variations in microfossil assemblages and shell chemistry to seawater characteristics in the northern Gulf of Mexico. The northern Gulf of Mexico marine climate records resolve multi-decadal and centennial-scale variability, and these records are being integrated with coastal terrestrial climate records to develop a history of climate variability along the northern Gulf Coast.

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Oral

Holocene Climate and Variability in the Northern Gulf of Mexico and Adjacent Northern Gulf Coast

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Marine records from the northern Gulf of Mexico indicate that significant multidecadal and century-scale variability was common during the Holocene. Mean annual sea-surface temperature (SST) during the last 1,400 years may have varied by 3°C, and excursions to cold SST coincide with reductions in solar output. Broad trends in Holocene terrestrial climate and environmental change along the eastern portion of the northern Gulf Coast are evident from existing pollen records, but the high-frequency details are not well known. Continuous and well-dated records of climate and climate variability in the western portion of the northern Gulf Coast are essentially lacking. A network of records from the northern Gulf Coast with sufficient age control and sampling density is needed to resolve multidecadal to century-scale features. High-resolution well-dated marine records from the northern Gulf of Mexico are also needed to determine the magnitude and spatial coherence of Holocene climate variability in this region.

Information on Holocene floods, droughts, and storm frequency along the northern Gulf Coast is limited. Records of floods may be preserved in continental-shelf sediments but establishing continuity and chronologies for sedimentary sequences on the shelf presents challenges due to sediment remobilization and redeposition during storms and floods. Studies of past storm and flood deposits in coastal lakes and marshes show promise for constructing records of past storm frequency but additional work is needed to evaluate techniques and develop regional patterns.

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Poster

Data Integration in the Water Resources Discipline

Brian Reece

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One of the core data integration activities in the Water Resources Discipline (WRD) is the National Water Information System (NWIS). NWIS stores data collected, analyzed, and reported at more than 1.7 million sites by the USGS and other agencies, including many Gulf Coast agencies. NWIS contains billions of time-series records for surface water, groundwater, water quality, and atmospheric data; discrete ground-water levels / well construction information; and discrete water-quality samples. Water use data are almost entirely integrated into NWIS from various state and local agencies.

NWIS is a major information system investment, making it a critical database for the nation and serving as a permanent archive for this integrated information. NWISWeb is the web interface of NWIS and includes many integrated, derived products such as WaterWatch, GroundWaterWatch, and WaterQualityWatch. Comprehensive web services are planned for NWISWeb to support numerous third-party data integration efforts.

WRD integrates NWIS data with data from other Federal agencies such as the National Weather Service and US Army Corps of Engineers, and numerous State and local agencies to facilitate USGS science. For example, USGS and EPA are working to better integrate STORET and NWIS and provide an integrated web service. USGS is working with the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) to facilitate the overall acquisition of hydrologic data. An aquatic ecological data storage and retrieval system is being developed to integrate ecological information, most of which exists in many individual project files.

Numerous state and locally-based data integration projects supporting Gulf Coast science rely on WRD national programs such as NWIS. Several of these projects will be highlighted including demonstration of the importance of spatial / tabular data integration and the scientific benefits this type of integration allows.

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Oral

Monitoring and Modeling of Florida Shelf Carbonate Saturation State

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Empirical data to evaluate how ocean chemistry is changing due to the absorption of anthropogenic carbon dioxide is severely lacking. How these changes will affect biogenic calcification rates in coastal waters is also unknown. Lack of baseline data on carbonate saturation state and pCO_2 on the inner west Florida shelf, a low gradient calcium carbonate platform, inhibits the ability of managers and scientists to predict ecosystem change resulting from ocean acidification. Current saturation state models using remote sensing data are generally too coarse to be useful for the Gulf of Mexico, do not include nearshore and inner-shelf data, and lack information for specific important ecosystems, such as Florida's coral reefs. Maps depicting pCO_2 and carbonate saturation states over large latitudinal gradients are needed on the Florida shelf and for specific localities where significant decline of carbonate ecosystems, habitats, and calcifying organisms are predicted over the next decade.

To address critical information gaps and nearshore variability of carbon fluxes, the US Geological Survey (USGS) is working with the University of South Florida (USF) and NOAA to acquire baseline pCO_2, pH, and alkalinity data to create a nearshore to offshore regional carbonate saturation state model for the west Florida shelf. These data are being used in conjunction with habitat data to monitor habitat change over time. Using the Multiparameter Inorganic Carbon Analyzer (MICA) developed by USF, data on air and sea pCO_2, pH, and total carbon were collected during a pilot cruise west of Tampa Bay. Maps depicting carbonate saturation state of the marine water, underlying sediment, and habitat data show varying relationships in specific localities. Additional cruises are planned for summer and winter of this year.

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Poster

Primer on Harmful Algal Blooms in the Gulf of Mexico

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Harmful algal blooms (HABs) in the Gulf of Mexico (GOM) have a long history of causing fish kills, shellfish poisonings and other health hazards. Their toxins cause a variety of impacts to humans, wildlife, shellfish and fish that range from irritation to mortality. Ingestion of contaminated shellfish and breathing of aerosolized toxins are the most common exposure routes. Among the phytoplankton species that are present in the GOM, there are approximately 300 species that form blooms and 100 species that produce algal toxins. Although these organisms are microscopic, when they are at high concentrations in the water they impart color to the water and their pigments can be detected by satellite imagery.

One of the most common toxins, paralytic shellfish poison (PSP), is produced by the dinoflagellate *Karenia* and there are at least 7 species of this organism in the GOM. In Florida, *Karenia* blooms are initiated offshore (18-64 km) and then winds and currents move the blooms toward shore. *Karenia* population growth is a result of nutrients, such as nitrogen and phosphorus. These nutrients are more readily available near shore due to upwelling as well as surface-water and ground -water sources in the coastal marine habitats. Blooms of *Karenia,* which only occur above the salinity of 24 ppt and in the temperature range of 17-32^{O}C, typically last three to five months during late summer through the fall. Between 1994 and 1996, a *Karenia* bloom lasted 21 months in Florida. When the population density is above 5000 cell/mL, shellfish beds are closed due to the likelihood of PSP accumulation. In 1996, the death of 151 endangered Florida manatees was attributed to a *Karenia* bloom on the Southwest coast of Florida and over 650 fish kills were reported.

Other genera are also known to form blooms in the GOM. In 2008, *Dinophysis acuminata* bloomed in Port Aransas, Texas, which led to the closure of Corpus Christi, Aransas and Copano bays to the harvest of oysters, clams and mussels. This was the first time the Texas shellfishing was closed due to okadaic acid. Okadaic acid accumulates in bivalves and causes diarrhetic shellfish poisoning. Over the next month, the population of *Dinophysis* declined and the toxin rapidly decreased and allowed subsequent reopening of the shellfish beds.

Techniques for the detection of HABs have been deployed from Texas to Florida and are mostly in the experimental stage. Satellite imagery of phytoplankton pigments is widely used to detect and track HABs. Molecular and optical probes attached to fixed locations or mobile units are showing some measures of success. New instruments under development are smaller, less expensive, faster, more accurate, and will be equipped to provide integrated and automated simultaneous measurements.

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Poster

The Delta Research and Global Observation Network

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The USGS National Wetlands Research Center (NWRC) has initiated an effort to understand biological and hydrological processes and management outcomes for massive deltaic coastal systems like that of the Mississippi River Delta. The Delta Research and Global Observation Network (DRAGON) is a science framework initiated to establish an international community of practice, to develop new visualization tools, and to compare and predict outcomes of various management scenarios.

Hurricanes Katrina and Rita have prompted the construction of new flood protection systems in the Mississippi River delta. Now, more than ever, there is a critical need to share information from deltas around the world and to develop models that guide and inform decisions, management, and policy.

The goal of the web-based DRAGON is to facilitate information sharing and predictive model development. The network will benefit the international community by providing tools for data integration and modeling, such as an extensive digital library focusing on 12 globally important deltas, a map viewer, a data repository, and a database of scientists involved in delta-related research to stimulate collaboration.

The community of practice concept is also applicable to scientists working along the Mississippi River. With monitoring and research activities occurring along the length of the Mississippi, there is a need to integrate data analysis across such systems as the Coastwide Reference Monitoring System (CRMS) in Louisiana and the Long Term Resource Monitoring Program (LTRMP) in the upper Mississippi River. Given the proper tools, scientists could use these long-term data sets to model complex systems, such as the entire Mississippi River.

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Poster

Can the Coastal Everglades Persist with Rising Seas and More Hurricanes?

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Restoration of the Florida Everglades is proceeding in a changing climate. The ability of coastal wetlands to maintain elevation in a time of rising sea-level is critical for their continued persistence. Sea level, at Key West, has increased 20 cm since 1913. Hurricanes are predicted to be more frequent and intense. Analyses of historical documents (photos, charts and journals) have been combined with field observations of vegetation, sedimentation and surface elevation changes to gain insight into the stability and persistence of mangrove forests in southwest Florida.

Over the past 70 yrs, hurricanes have resulted in a conversion of mangrove forests into inter-tidal mudflats and open water. Recent hurricanes (e.g., Wilma) caused large-scale erosion of these mudflats. Hurricane Wilma also drastically set-back the regeneration of mangroves that followed Hurricane Andrew. In some plots 98% of the regeneration from Andrew was destroyed by Wilma. Continuing mortality of mangroves since Hurricane Wilma is being observed in many forest plots. This mortality is directly related to measured decreases in forest sediment surface elevations. Conversely, Hurricane Wilma deposited large amounts of sediment over the coastal Everglades, from 20-60 mm of sediment in many forests and maximum deposition >200 mm in some areas. It is still unclear how the interacting effects of sea-level, sediment deposition and continuing tree mortality will affect long-term persistence of these forests.

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Oral

The USGS Role in Mangrove Ecosystem Research at Global Scales

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Mangroves dominate the quiescent coastlines of the world's tropical and sub-tropical regions. These forested ecosystems provide valuable goods and services to human societies, including forest products, serving as habitat for commercial and recreational fisheries, stabilization of shorelines, and interception and sequestering of nutrients and pollutants from upland runoff. Additionally, mangroves are home to numerous critically endangered species worldwide including: the Proboscis Monkey (Malaysia), American Crocodile (Florida and the Caribbean), Scarlet Ibis (Trinidad), and the Bengal Tiger (Bangladesh) to name a few. Mangrove forests are under threat from both natural and anthropogenic forces. Natural forces include sea-level rise and increasing frequency of tropical cyclones. Human impacts include coastal development (e.g., for ports), conversion into ponds for aquaculture and pollution (e.g., oil spills). USGS scientists are studying mangrove ecosystems around the world including in the United States, Mexico, the Virgin Islands, Belize, Honduras, Panama, Federated States of Micronesia, Palau, Australia, New Zealand, Papua New Guinea and Malaysia. The research focuses on a variety of topics and covers scales from an individual organism to the landscape. A major theme of USGS research in mangroves is their response to disturbance and global climate change, and consequent effects on the diverse and important animal life that depends on mangrove forests. The approaches taken by USGS scientists are varied and include intensive field surveys, the use of permanent plots / sampling sites to record long-term change, geochemical techniques to interpret foodweb relationships, field and laboratory experiments, and modeling studies of hydrology and vegetation dynamics. The USGS will continue to conduct studies of mangrove ecosystems to provide resource managers around the world with information upon which sound decisions can be made.

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Oral

Louisiana's Coastwide Reference Monitoring System: Using Web Services to Integrate and Visualize Data for Assessing Restoration Effectiveness

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The Coastwide Reference Monitoring System - Wetlands (CRMS- Wetlands) is collecting, analyzing and reporting on a consistent suite of water, vegetation, soil and spatial variables at 390 sites across coastal Louisiana. These data are used to evaluate coastal baseline conditions as well as restoration and rehabilitation efforts. These evaluations can occur over a multiple scales, ranging from site-specific scales of less than1 km^2 to tens of thousands of km^2 over a 20-yr period. CRMS-Wetlands uses coastal scientists to develop analytical tools in partnership with database managers and information technology specialists such that they can be visualized through web services (http://www.lacoast.gov/crms2/). This partnership allows for the development of data automations that optimize data processing and maximize analytical flexibility of large datasets. It also provides opportunities to present and synthesize scientific data in a manner that is visually informative. The development of a hydrologic index that describes the suitability of hydrologic characteristics to specific wetland habitat will be presented to illustrate how large datasets are integrated and visualized. The hydrologic index is used with other ecological indices as a report card to assess the effectiveness of restoration efforts and provide an overall indication of wetland condition at various spatial and temporal scales.

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Oral

Monitoring Coastal Louisiana Wetland Impacts from 2005 Hurricanes Using Multi-Temporal MODIS NDVI Data

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The coastal landscape of Louisiana was subjected to severe environmental stress from hurricanes Katrina and Rita in August and September 2005. The impacts from storm surge, which included physical conversion of marsh to open water, extensive flooding and salt water intrusion effects, varied greatly over time and space. We used a Normalized Difference Vegetation Index (NDVI) calculated from MODerate-resolution Imaging Spectroradiometer (MODIS) imagery to quantify the extent and severity of damage to vegetative communities and subsequent recovery. Species composition and total live cover field data were collected within 232 unique 4m^2 plots in multiple time periods across coastal Louisiana to corroborate changes in NDVI over time. A pre-hurricane baseline dataset, using monthly average composites from February 2000 through February 2005 MODIS imagery, was created. The use of multi-year composites minimizes effects of seasonal variations and better isolates post-hurricane effects. Data from March 2005 to November 2006 were compiled on a monthly basis and compared to the baseline average to create a departure from average statistic. NDVI departures suggest over 35% of the pre-storm coastal wetland area (representing 5,009 km^2) experienced a substantial decline in the density and vigor of vegetation in October 2005, with greatest amounts of damaged vegetation in the east and west regions of the Louisiana coast, corresponding to hurricane Katrina and Rita landfall areas. New open water areas formed from the immediate removal of wetland or flooding of burned marsh represent approximately 17.4%, 6.6%, and 28.2% of the immediate damage in the east, central and west regions, respectively. The percentage of area of persistent (November 2006) NDVI damage accounted for by persistent new open water in the east, central and west region was 91.8%, 81.0%, and 29.0%, respectively. The remaining damage was likely associated with other factors including saltwater intrusion, flooding and burial by wrack. These factors were most significant in the west region where hydrologic restrictions and drought conditions contributed to 1,045.7 km^2 of persistent damage through the observation period. Although below average NDVI values were observed in most marsh community types through November 2006, recovery of vegetation was evident. NDVI provides a useful tool for tracking marsh changes, especially when integrated with physical landscape change assessments and field verifications as conducted in this study.

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How Does Restoration Affect the Resiliency of Coastal Louisiana Marshes?

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Wetlands of the Mississippi River delta plain in coastal Louisiana currently are eroding at annual rates of less than 15 km^2, less than the rates of between 45-75 km^2 measured in the previous 30 years, but still substantial. The loss threatens New Orleans and other human settlements along the coast, an oil and gas infrastructure that delivers > 25% of the energy needs of the United States as well as the second ranked commercial fisheries in the United States. To mitigate the loss of the economically and ecologically valuable wetlands, large-scale restoration projects are being proposed and implemented.

One restoration approach integral to all coast-wide restoration plans for Louisiana is to divert freshwater from the Mississippi River across flood-control levees and into adjacent marshes to recreate the natural springtime overbank flooding that occurred before the levees were built. However, river water quality has changed appreciably since the river last flowed unencumbered into the estuaries, with nitrate and sulfate concentrations 2-3 x higher than in the early 1900s. Herbicides were only introduced in the 1950's. How this shift in water quality may affect the marshes being restored currently is not well known. In co-operative studies with the National Park Service, and through a USGS Venture Capital Collaborative effort, we are studying the soil biogeochemical response both of organic-rich freshwater marshes and more brackish marshes. Results suggest river water introductions may enhance soil organic matter decomposition, resulting in a more degraded and weaker root mat than marshes not receiving this river water subsidy. Such a change makes these marshes more susceptible to erosion during infrequent high-energy events (for example hurricanes) and regular low-energy events, such as tides and the passage of weather fronts. In effect, freshwater diversions appear in some cases to weaken marshes and make them less resilient to extreme weather events.

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Oral

The Gulf Intracoastal Waterway as a Distributary of Freshwater to Coastal Louisiana Wetlands

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Since the early 1900's, an extensive network of levees built for flood control has prevented the direct inflow of Mississippi River water into most deltaic wetlands in south Louisiana. The supply of freshwater and sediment needed by these wetlands to flourish and keep pace with sea-level rise has been reduced and, in many places, completely eliminated. In its place, within the last 50 years, the GIWW (Gulf Intracoastal Waterway) has become the largest distributary of Mississippi River water to coastal Louisiana wetlands. The GIWW is a major east-west trending ship channel traversing the entire Louisiana coast. Following natural hydraulic gradients, the GIWW captures water and sediment from the southward flowing Lower Atchafalaya River and Wax Lake Outlet, and distributes this river water to wetlands up to 30 to 50 miles east and west of the intersections. Most of the water in the Atchafalaya River originates from the Mississippi River. The passive GIWW flow is controlled by seasonally changing differences in water surface elevations between the Atchafalaya River and adjacent watersheds and becomes predictable when stage of Lower Atchafalaya River at Morgan City is above 3 ft NAVD88. The GIWW has become the largest and frequently only source of Mississippi River water to many parts of coastal Louisiana. The ship channel functions as the hydrologic and ecological equivalent of a freshwater diversion. The reach of the flow in the GIWW is much greater than most constructed diversions.

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Poster

Subsurface Control on Sea-Floor Erosional Processes Offshore of the Chandeleur Islands, LA

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The Chandeleur Islands lie on the eastern side of the modern Mississippi Delta, near the edge of the St. Bernard delta complex of the Mississippi River. The St. Bernard Delta was active from about 4,000-2,000 yr BP; presently it is undergoing subsidence and erosion. Erosion of this delta complex produces different surficial expressions controlled by differences in the shallow stratigraphy. A detailed bathymetric, geophysical and sampling survey of the inner shelf offshore of the Chandeleur Islands reveals two distinct populations of shallow depressions: subcircular and linear. Subcircular depressions are concentrated in 9-12 m water depths, and have 7-340 m diameters, steep edges, and 0.5-1.5 m relief. Sidescan sonar imagery shows that the floors of some subcircular depressions are smooth, others are interrupted by small arcuate scarps, and others have vent-like structures in them. Seismic profiles and cores show that subcircular depressions are concentrated in areas where delta-front deposits are exposed on the sea floor, and occasional seismic blanking in these areas indicates that gas is present. Vibracores taken through delta-front deposits are composed of clayey silts interrupted by thin sand beds. Linear depressions occur in 3-15 m water depths, and have 600-3000 m lengths, widths less than 550 m, and relief less than 1.5 m. Seismic profiles and cores show that linear depressions occur in areas where sandy distributary channel deposits are exposed on the sea floor. This difference in erosional signature suggests that distributary channel deposits respond differently than delta-front deposits to present oceanographic conditions. The linear depressions may form in sandy distributary channel deposits due to their being more vulnerable to scour by waves and coastal currents than the surrounding delta-front deposits where collapse due to liquefaction or gas discharge may dominate.

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The Development of Oyster Beds in Apalachicola Bay, FL during the late Holocene

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Apalachicola Bay harbors the largest oyster fishery in Florida, and the development and distribution of its oyster beds are products of late Holocene geologic evolution and subsequent estuarine conditions. The bay is shallow, having an average depth of approximately 2.5 m. Salinity is variable, but averages 6-20 ppt where oyster beds are found. Currents are primarily driven by tides, but are strongly affected by winds and river discharge. Net water movement is to the west, and velocities in the bay rarely exceed 0.5 m/sec, except near inlets.

Sidescan-sonar imagery, bathymetry, high-resolution seismic profiles, and sediment cores have been used to map the geologic evolution of a large part of Apalachicola Bay and St. George Sound. These data show that oyster beds occupy the crests of a series of shoals that are mostly 1-7 km in length, trend roughly north-south perpendicular to the long axis of the bay, and are asymmetrical with steeper sides facing to the west. Surface sediment samples show that the oyster bars consist of shelly sand, while much of the remainder of the bay floor is covered by mud delivered by the Apalachicola River. High-resolution seismic profiles and cores show two delta systems that advanced southward across the bay during the late Holocene when sea level was lower. Radiocarbon dates indicate that they initiated between 7,000 and 5,600 yr BP when sea level was 4-7 m lower than present. They were abandoned about 4,000 yr BP when deltaic deposition retreated landward of its present location in response to sea level rise. Oysters started colonizing sandy parts of these late Holocene deltas between 1,200 and 1,500 yr BP. Seismic profiles and cores indicate that oyster beds have been more extensive in the past, but some have been buried by the muddy prodelta deposits of the modern Apalachicola delta. Oyster bars that are still active have grown vertically and become asymmetrical, and internal bedding indicates they have migrated westward, presumably in response to the net westerly currents. The lithologic matrix of some oyster bars fines upward, suggesting that the sediment available for their development is becoming finer with time. Whether the increasingly limited availability of coarse-grained sediment will lead to eventual demise of the oyster bars is unknown.

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Poster

Internet Map Serving the Hurricane Katrina Maximum Storm Tide in Alabama, Mississippi, and Louisiana

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In the months that followed the Hurricane Katrina devastation in the Central Gulf of Mexico region of the United States, the U.S. Geological Survey (USGS), in cooperation with the U.S. Army Corps of Engineers (USACE), developed an Internet Map Server (IMS) that enables a user to determine flood depths above the North American Vertical Datum of 1988 (NAVD88) for the Hurricane Katrina maximum storm tide in the affected states. The server includes a comprehensive geospatial information system allowing free access to many digital layers and GIS tools for this region which includes:

- Pre-Katrina Light Detection and Ranging (LiDAR) digital elevation model (DEM) with 1/9th arc-second (3-meter) grid resolution served as the base for the mapping furnished by USGS; FEMA; USACE; Baldwin and Mobile Counties, Alabama; and others;
- GIS layer with 842 high-water marks (HWMs) that were used to generate the maximum storm tide surface;
- Katrina Maximum Storm Tide Surface generated from the HWMs for areas outside of the New Orleans, Louisiana, levees to approximate the maximum storm tide that approached the levees;
- Cultural boundaries;
- Hydrography;
- Transportation;
- Orthoimagery;
- Land cover/use;
- Elevation Query Tool; and
- Elevation Profile Comparison Tool

The seamless DEM across the coastal areas of Alabama, Mississippi, and Louisiana was created from LiDAR data that were obtained from multiple sources and were collected independently in various file formats, projections, and levels of processing. The task of producing a seamless DEM, used as the map base for projecting the Katrina maximum storm tide in the affected coastal region, required extensive research, coordination, and revision.

The 842 HWMs used to generate the IMS representing the Katrina maximum storm tide were processed and filtered from more than 1,500 HWMs that were flagged, surveyed, and documented by teams representing the Federal Emergency Management Agency (FEMA), USGS, USACE, and others. The maximum storm tide elevations of about 29 feet were documented near Bay St. Louis, Mississippi, confirming that Katrina was more than 4 feet greater than storm tide caused in 1969 by Hurricane Camille (highest previously known storm tide to inundate the region).

The Website is available to the public at *http://gisdata.usgs.gov/website/gulf/*

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Oral

A Geologic-Based Evaluation of the Potential for Undiscovered Oil and Gas Accumulations in Paleogene Strata of the Gulf of Mexico Coastal Plain and State Waters

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The U.S. Geological Survey (USGS) recently conducted an assessment of the technically recoverable undiscovered conventional oil and gas resources in Paleogene sediments underlying the U.S. Gulf of Mexico Coastal Plain and State waters. For purposes of the assessment, an Upper Jurassic-Cretaceous-Tertiary total petroleum system (TPS) was defined for the Gulf of Mexico basin. Paleogene strata were divided into the following stratigraphic study intervals: 1) Wilcox Group (including Midway Group and the basal Carrizo Sand of the Claiborne Group; Paleocene-Eocene); 2) Claiborne Group (Eocene); 3) Jackson and Vicksburg Groups (Eocene-Oligocene); and 4) Frio-Anahuac Formations (Oligocene). Based on a generalized structural and stratigraphic model, each assessed Paleogene stratigraphic interval was subdivided into an updip, stable shelf assessment unit (AU), a middip, expansion (extension) zone AU, and a downdip, slope and basin floor AU. A significant controlling factor for the location of the middip expansion zone AU is the location of underlying, stratigraphically older shelf margins. Using the geology-based assessment methodology, the USGS estimated mean a of 83.8 trillion cubic feet of undiscovered natural gas, a mean of 396 million barrels of undiscovered oil, and a mean of 3.1 billion barrels of undiscovered natural gas liquids in the assessed Paleogene strata. A significant portion of the undiscovered resources (53 % or 48.7 trillion cubic feet of gas) is estimated to occur in Paleogene slope and basin floor AUs. The Wilcox Slope and Basin Floor AU is estimated to hold about one third of the undiscovered hydrocarbon resources for the assessed intervals.

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Oral

Winter Roost Sites of Western Burrowing Owls in Coastal Texas

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Coastal Texas provides a diversity of habitats, including estuaries, lagoons, tidal flats, grasslands, and wooded riparian corridors, that are important to hundreds of bird species. These habitats offer refuge to endangered species (e.g., whooping cranes, piping plovers, and Attwater's prairie chickens), provide critical stopover habitat for coastal and trans-gulf migrants, and are the final destination of migrants arriving on their winter ranges in coastal Texas. From 1999-2004, we investigated the winter ecology of western burrowing owls, a declining subspecies which winters in grasslands and farmlands of the Texas coastal plains and on barrier islands. Our objectives were to: 1) describe winter roost sites, 2) examine selection of artificial burrows, and 3) determine extent of roost site fidelity. We located owl roosts by presence of feathers, feces, regurgitated pellets, and flushing of roosting owls. For each roost site, we assigned habitat type (grassland, farmland, woodland, barrier island); roost site type (culvert, natural burrow, other); and measured diameter of openings. Of 46 roost sites we located, 40 (87%) were in agricultural areas. Three were in grasslands, and three were on barrier islands. Thirty-four (74%) were at culverts, whereas only five were natural burrows. Mean diameter of openings was 22 ± 1.5 cm (SE). To determine burrowing owl use of artificial burrows, we installed 72 artificial burrows of polyethylene tubes (18 at each of four different sites) in southern Texas: 1) in grasslands at Naval Air Station-Kingsville, Naval Auxiliary Landing Field Orange Grove, and at Welder Wildlife Foundation near Sinton, and 2) in vegetated dunes on Mustang Island. All burrows were 2.4 m long and covered with soil. At each site, three clusters of six tubes each, all in an east/west orientation, were installed. Each cluster of six artificial burrows had two tubes of each of three sizes (15-, 20-, and 25-cm diameters). We monitored owl use for two winters. Burrowing owls occupied burrows at the barrier island site and the Orange Grove site. Burrowing owls preferred (46 of 58 detections) small-diameter burrows ($P = 0.05$). To examine roost site fidelity, we trapped and banded 15 burrowing owls, which we monitored during subsequent winters. Of the 15 owls, 8 (53%) returned the next winter, and three (20%) for the third winter, to the same roost site at which they were banded.

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Poster

Impact of Ocean Acidification on Rates of Community Calcification and Dissolution in Coral Reef Ecosystems of South Florida, the Caribbean, and Hawaii

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The severity of the impact of elevated atmospheric pCO_2 and ocean acidification to coral reef ecosystems depends, in part, on how seawater pCO_2 affects the balance between calcification and dissolution of carbonate sediments. Presently, there are insufficient published data that relate concentrations of pCO_2 and CO_3^{2-} to *in situ* rates of reef calcification for accurately predicting the impact of elevated atmospheric pCO_2 on calcification and dissolution processes.

Rates of community calcification were measured, *in situ*, on representative habitat types of coral reef ecosystems in Florida Bay, Biscayne National Park, the Molokai reef flat in Hawaii, and the U.S. Virgin Islands using a benthic incubation chamber called the Submersible Habitat for Analyzing Reef Quality (SHARQ). Carbonate system parameters including total alkalinity, pH, and total carbon dioxide were measured every four hours during 24-hour incubation periods, and calcification rates were calculated using the alkalinity anomaly method. Habitat types included patch reef, seagrass, hardbottom, coral rubble, and mud substrates.

Diurnal trends in calcification rates were observed for all substrate types with calcification occurring primarily during daylight hours and dissolution of carbonate sediments observed during dark hours. Average rates of calcification for substrate types in Florida and the U.S. Virgin Islands during 24-hour incubation periods were 0.47 and 1.18 g $CaCO_3$ m^{-2} for patch reefs and hardbottom communities, respectively. Seagrass and mud bottom communities showed equivalent rates of net carbonate sediment dissolution of -0.22 g $CaCO_3$ m^{-2}. Rates of calcification on the Molokai reef flat ranged from 0.003 to 0.23 g $CaCO_3$ m^{-2} h^{-1}, and dissolution ranged from -0.005 to -0.33 g $CaCO_3$ m^{-2} h^{-1}.

Linear correlations were calculated between calcification rates and pCO_2, and calcification rates and CO_3^{2-} concentrations for each substrate type. Carbonate ion and pCO_2 thresholds were estimated as the concentrations of CO_3^{2-} and pCO_2 at which rates of calcification and dissolution were equivalent, respectively. The average pCO_2 threshold for all substrate types was 585 µatm, and the average CO_3^{2-} threshold was 203 µmol kg^{-1}. Threshold values varied considerably among substrate types and on similar substrate types during different time periods. Currently, atmospheric pCO_2 is approximately 380 µatm and is predicted to reach 700 µatm by the year 2100, surpassing the average pCO_2 threshold for these substrate types. The results of this study indicate that a significant amount of sediment in coral reef ecosystems may be lost due to carbonate sediment dissolution.

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Poster

ABSTRACTS
Florida Integrated Science Center

In Alphabetical Order by Author

Crab Burrows and Their Contribution to Surface Elevation in Mangrove Forests of Tampa Bay and Everglades National Park, Florida

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Fiddler (*Uca* spp) and mud (*Eurytium* spp) crabs are among the most common and abundant animals in mangrove forests. Their burrows are an important functional component of sediment structure. This study investigates the importance of crab burrows in mangrove forests and their impact on sediment structure. Burrow density and entry-hole diameters were measured from 60 0.25m^2 plots. Casts collected from a sub sample of burrows within the plots were used to calculate burrow length and volume.

Based on our measurements the volume of crab burrows ranged 3 to 6 L/m^2 in the upper 25 cm of sediment. Density of burrows ranged from 4 to 180 per m^2. Assuming burrow volume represents the total volume of sediment redistributed by crab burrowing activities, and all re-mobilized sediment is available for deposition on the soil surface, the maximum potential contribution of crab burrowing to sediment surface elevation in these mangrove forests is 0.3 - 0.6 cm. This result raises questions for future research: How long did it take for this volume of burrows to be constructed and what is the potential rate of soil deposition related to crab burrowing activity? What is the rate of burrow turnover? Is remobilized sediment removed from the system by tidal action? and What is the influence of burrowing on nutrient availability and hydrology in mangrove forests? By answering these questions scientists will be able to understand the role of burrowing crabs in mangrove forests.

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Aquifer Studies in the Southeastern United States with Emphasis on Contaminant Occurrence in the Upper Floridan and Biscayne Aquifers

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A major focus of the National Water-Quality Assessment (NAWQA) in its second decade (2002-2013) is on regional- and national-scale assessments of ground-water status and trends in principal aquifers. Goals of these regional studies are to better understand how natural features and human activities affect water quality and why some aquifers are more vulnerable to contamination than others. The information will help local, State, and regional decision makers in source-water protection of important drinking-water resources. The Floridan, Biscayne, and surficial aquifers in Florida systems were among the principal aquifers selected for study. Studies in these aquifers are based on samples collected from nearly 400 wells, including those used for monitoring, domestic purposes, and public-supply. Samples were collected from 1994 through 2005 and analyzed for nutrients, major ions, radon, and selected pesticides and volatile organic compounds. An additional 45 wells are being sampled in the surficial aquifer system in 2008.

The Floridan aquifer system is a highly productive carbonate aquifer that provides drinking water to approximately 10 million people in Florida Georgia, and South Carolina in 2000. Water samples were collected from 148 household, or domestic, wells in the Upper Floridan aquifer in these three States from 1998 through 2005. Results showed that no drinking-water standards were exceeded. The median nitrate concentration was 0.12 mg/L, but nitrate concentrations greater than 1.0 mg/L were common in unconfined parts of the aquifer where agricultural land use was common and dissolved oxygen concentrations were greater than 1.0 mg/L. Low level concentrations (less than 1 micrograms per liter) of pesticides were detected in about 20 percent of wells. Detection frequencies were highest (69 percent) in unconfined areas where nitrate concentrations were mostly greater than 1.0 mg/L. Atrazine, deethylatrazine, and metolachlor were the most frequently detected pesticides. Low-level concentrations (less than 0.5 micrograms per liter) of volatile organic compounds were detected in about 60 percent of samples.

About 4 million people in southeastern Florida rely on public-water supplies from the Biscayne aquifer, a highly permeable sand and limestone aquifer which is vulnerable to contamination by human activities. A total of 30 public-supply wells were sampled in Broward, Miami-Dade, and Palm Beach Counties (prior to treatment) and 32 shallow monitoring wells were sampled in urban areas in Broward County. Results from sample analyses had few relatively high (greater than 2 milligrams per liter) concentrations of nitrate in water from public-supply wells near agricultural lands and a few relatively high concentrations of arsenic (greater than 10 micrograms per liter) in water from some shallow urban wells near golf courses. Low level concentrations of pesticides were detected in 100 percent of public-supply wells and in 78 percent of the shallow, urban monitoring wells; however, no pesticide concentration exceeded any drinking-water standard. The most frequently detected pesticides were atrazine and tebuthiuron. Volatile organic compounds (VOCs) were detected in 77 percent of the public-supply wells and in 91 percent of

the shallow, urban wells. The most frequently detected VOCs were in the public-supply wells, followed by cis-1,2-dichloroethene, methyl *tert*-butyl ether (MTBE), 1,4-dichlorobenzene, toluene, and p-isopropyltoluene. Concentrations of all VOCs were less than the maximum contaminant level (MCL) for public drinking water, except in two samples from public-supply wells near industrialized areas that had vinyl chloride concentrations (3 and 5 micrograms per liter).

The surficial aquifer system is also used for public supply and for domestic supplies, but to a lesser extent than the Biscayne aquifer. Studies in public supply and domestic wells began in 2008 in this aquifer and results will be used to determine the distribution of contaminants in the surficial aquifer in Martin, Palm Beach, Indian River, and St. Lucie Counties.

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Manatee Genetic Studies at Crystal River, Florida

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Manatees have had an uncanny ability to establish new populations within their subtropical range, as evidenced by their evolutionary history and genetic traits. Although vicariance separated the taxa over time, the vagility of this unique group of aquatic mammals enabled populations to disperse through deliberate migration or stochastic events. This phenomenon of population expansion is characteristic when the core population is large enough to act as a source to populate new habitats. Although these adjacent habitats are not always biologically suitable, the sirenians have persisted due to their ability to adapt to the new surroundings. For example, specific but subtle morphological characteristics have evolved within each species/subspecies. Florida is an example of a more recently established population (within the last 20,000 years) and the northwest Florida group of manatees that overwinters at Crystal River is an example of a new subpopulation. Within Florida there are several distinct habitat types that require different survival strategies for the resident manatees.

Previous analyses have examined the genetic diversity of the Florida population. Early studies using allozymes and nuclear microsatellites suggest that Florida manatees have low to average genetic variation and are a relatively homogeneous population. Mitochondrial DNA analyses also suggest low genetic diversity among Florida manatees, which may have been caused by inbreeding, a bottleneck event, or the founder effect.

The Crystal River manatee population is well established and has increased in numbers over the last 30 years. Long-term data sets (over 35 years) using photo-identification of distinct individuals (n=417) from Crystal River exist for this well-studied winter population of manatees; furthermore, an aerial survey recorded the highest count of 438 manatees in this region in 2006. Although an increase in this subpopulation has occurred in recent decades, the possible genetic impacts of the accelerated growth of such a homogeneous subspecies may affect the well-being of the Florida population as a whole. Genetic connectivity and pedigree studies can provide information on breeding among different population units. Knowledge of the genetic composition of this group will determine whether breeding with parapatric populations is occurring, and may play a role in understanding the population structure by complementing efforts to model various life history strategies. To date, 700 samples (550 from calves and 150 from adults) have been collected from the Crystal River winter resident manatee population, providing a good base for future fine-scale genetic applications. This effort will allow for inferences about Florida manatee life history and population structure, including reproductive and breeding potential, migration and movements, and overall population size.

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The FISC Library: Integrating FISC Bibliographic Resources

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FISC library resources support the research and information needs of scientists, managers, and support personnel. USGS libraries and the FISC librarian provide reference and information services to all FISC staff. Located in the St. Petersburg office, the FISC librarian provides support for accessing USGS resources, including the USGS online catalog, research databases, and other electronic resources. The librarian can also assist with obtaining research materials and accessing digital and print resources available via university resources. Current awareness and alerting services are provided through email. The FISC librarian is available to facilitate interlibrary loans for staff and to act as liaison with personnel at the Headquarters library. USGS resources are also available to partners and the general public through efforts of the FISC librarian.

With the growing body of research produced by FISC scientists, the librarian is currently working with EPN to compile a comprehensive digital reprint collection focusing on FISC science. This collection will include USGS series publications as well as journal articles and conference proceedings, and will be searchable by multiple criteria including topic and keyword as well as author, title, etc. This will facilitate the gathering of integrated FISC research across disciplines, highlighting the many connections and collaborations among FISC scientists.

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Can Lake Istokpoga be a Model for the Future of Lake Okeechobee?

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Lake Istokpoga , a large lake northwest of Lake Okeechobee and west of the Kissimmee River, shares the same type of land use as Lake Okeechobee, mainly improved pasture and orange groves. The water quality in both lakes is determined by the concentration of total Kjeldahl nitrogen (TKN), total phosphorous (TP), and dissolved phosphate (PO_4). Nitrogen and phosphorous are the basic building blocks for life and the Redfield ratio for N:P is 16:1. A lower ratio may be indicative of a phosphorous limited system, and higher ratio nitrogen limiting. Growth of aquatic life is often limited by availability of an essential nutrient. The ratio of TP:PO_4 is also an important measure since the dissolved phosphate is the form of phosphorous that is easiest to assimilate by organisms. Data collected at Lake Istokpoga shows that Arbuckle Creek, the inflow point to the lake, has a TKN:TP ratio higher (14:1) than that of C41A Canal (20:1), the outflow point, or that of the lake itself. These data also show the ratio of TP to dissolved phosphate (PO_4) in the water entering Lake Istokpoga is higher (7:10) than the water leaving the lake (1:10). Analysis of these data suggests that Lake Istokpoga is a phosphorous limiting system, with most bio-available phosphorous eliminated before the water leaves the lake.

The tributaries on the eastern side of the Kissimmee River exhibit much higher ratios of TKN:TP (5:1), and TP:PO_4 (8:10). These tributaries are ineffective in reducing phosphorous, mainly due to the abundance of phosphorous. The concentrations of TKN are similar on both sides of the Kissimmee River. Managers must determine the source of the excess phosphorous on the eastern side of the Kissimmee River and reduce the importation.

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Modeling the Fish Community of the Freshwater Everglades

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Models used in applied aspects of ecology, such as dealing with specific questions of environmental conservation, assessment, and restoration, are usually far different from models used to elucidate theoretical issues. Temporal variability and spatial heterogeneity characterize the environments of most real ecological problems, whereas theoretical models tend to avoid such complexities and are kept as simple as possible to reveal theoretical insights. However, as ecological theory is extended to more and more complex phenomena in which spatial heterogeneity and temporal fluctuations play a role, its potential applications to real ecosystems and to specific applied issues are increasing. In this paper, we develop a model, Greater Everglades Fish Model (GEFISH), for the dynamics of the small fish community in the freshwater Everglades that can be used in both applied and theoretical frameworks. This model is part of the Across Trophic Level Systems Simulation (ATLSS) set of models, but is designed to examine fish dynamics on sub-regions within the Greater Everglades, rather than the entire South Florida Water Management Model region. We examine the dynamics of a small food web in which nutrients are recycled. The members of the food web include primary producers, detritus, invertebrate detritivores, several fish species including fish consumers of detritivores and periphyton as well as piscivores, and nutrients. The local food web model is contained in every cell of a two-dimensional topography 10,000 cells (100 x 100 grid), in which water levels rise and fall sinusoidally through the year. The fish are assumed to be migratory in that they follow the advancing wetting front when water levels increase, and move to areas that are still flooded when water levels decrease. In the model some of the fish are allowed to move up the elevation gradient during rising water and down the gradient during falling water. The model is used to show how details of hydrology can affect both biodiversity of the fish community and its productivity over the year. For example, decreases in water level fluctuations below the natural levels can lead to exclusion of some species that are strongly adapted to seasonal dispersal. If water level fluctuations are too low, biomass production of many of the small fishes may decline, as the area over which they forage decreases. The model is applied to specific areas of the Everglades for which monitoring data on small fishes are available. These include research sites (e.g., Dr. J. C. Trexler of FIU) in Water Conservation Area 3 and in Shark River Slough.

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Predicting Hydrologic Changes to West Indian Manatee Habitats in Southwest Florida Due to Proposed Restoration Projects

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The Picayune Strand Hydrologic Restoration Project (PSRP), which is part of the larger Comprehensive Everglades Restoration Plan (CERP), is focused on restoring an over-drained, 85-mi^2 rural area in western Collier County, Florida. The ultimate goals of the project are to reestablish predevelopment hydrologic patterns and to improve the downstream coastal flows. To fulfill these goals, proposed changes include the removal or modification of existing roads and canal networks, as well as the construction of several pumping stations and spreader canals. The purpose of the current study is to determine whether the proposed changes will adversely affect the primary habitats of West Indian manatees and other temperature- and salinity-sensitive species in the region.

With the addition of Heat transport capabilities within the FTLOADDS (Flow and Transport in a Linked Overland Aquifer Density Dependant System) coupled hydrodynamic, 2-D surface-water and 3-D ground-water modeling code, model simulations can now be used to predict changes in both temperature and salinity caused by hydrologic alterations. This formulation has most recently been applied to the Ten Thousand Islands (TTI) area in southwestern Florida where the PSRP is planned. The model was initially constructed to represent existing conditions, with several north-south oriented canals that connect to the Port of the Islands marina, and then to the coast. Alterations were incorporated to represent the proposed restoration changes, which include (1) filling in or plugging canals, (2) creating spreader canals, and (3) building levees and pump stations.

Simulation results demonstrate how freshwater flows may be redistributed as well as potential changes to seasonal inundation patterns. Salinity differences appear to be greatest in coastal areas west of the Port of the Islands marina, and there is evidence of substantial salinity and temperature differences within the marina itself, which could adversely affect the manatee habitat. Simulation results have also been compared to specimen tracking locations to determine how environmental changes may affect animal behavior during high thermal stress periods. The results for both current and post-restoration conditions have been integrated into ecological models, including a nodal network model that can be used to predict manatee responses to environmental changes.

In addition to the model described above, a secondary, 3-D sub-model of the Port of the Islands marina is being constructed using the EFDC (Environmental Fluid Dynamics Code) modeling tool. Incorporating output from the larger (TTI) model as boundary conditions, the refined 3-D model will be used to study the passive thermal refuge present within the Port of Islands marina due to vertical stratification of temperature and salinity. Proposed alterations can then be modeled to determine their potential effects on this critical manatee habitat.

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High-Resolution Single-Beam Bathymetry of Camille Cut, Ship Island, Gulf Islands National Seashore, Mississippi: Assessing Short-Term Bathymetric Change

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The Gulf Islands National Seashore (GUINS) is a series of barrier islands that provides protection along the Mississippi – Alabama coastline. These barrier islands archive 300 years of human history that the National Park Service (NPS) is responsible for preserving and protecting. The largest structure within GUINS is Fort Massachusetts, which was built on Ship Island in 1861 and is located offshore of Biloxi, MS. Due to the historical significance of the Fort and other sites on Ship Island, NPS is dedicated to preserving the structural integrity and stability of the adjacent shoreline, dunes, and vegetation. Previous studies indicate that Ship Island has continually undergone significant change. In particular is the formation of Camille Cut, an initial product of Hurricane Camille in 1969, which breached the island into what is now West and East Ship Islands. Hurricane Katrina, which passed nearby in 2005, doubled the breach in size. To provide a post-Katrina assessment of Camille Cut, the U.S. Geological Survey (USGS) conducted high-resolution single-beam bathymetry to identify, compare, and contrast shot-term bathymetric change and the influence it has on long-term bathymetric changes. High-resolution single-beam bathymetry offers a cost-effective and efficient way to measure seafloor change in shallow-water (2-3 m) areas such as Camille Cut. Over 165 km of single-beam lines were surveyed in the summer of 2007 and replicated in the summer of 2008. This report outlines the methodology for data acquisition, processing, and reports the results.

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Comparison of Foraminiferal Biofacies in Modern Deltaic Environments: Proxies for Coastal Change

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Foraminiferal biofacies in the coastal zone can provide a proxy for environmental conditions. Statistical analysis of agglutinated foraminiferal populations in marsh sediments correlate with sediment grain size, salinity, and elevation. An initial study by Dreher (2006) described improved preparation techniques, modern taxonomy, and quantitative analysis of environmental variables that refined marsh foraminiferal biofacies of the Mississippi River Delta region. Elevation, porewater salinity, total carbon, and mean grain-size were compared with foraminiferal distributions in a transgressive marsh system of the lower Lafourche headland in the south-central delta plain. Cluster analysis identified two biofacies, one in the marsh interior and the second at the marsh edge. The marsh-edge biofacies was further subdivided into bayou-levee crest and bayou-margin biofacies. Correlation analysis indicated that seven of the 21 most common foraminifers correlated significantly with physical variables. Juvenile *Trochammina inflata* correlated positively with salinity; *Ammotium crassus* and *Ammonia parkinsoniana* correlated negatively with elevation; *Polysaccammina ipohalina* and *Miliammina fusca* correlated positively with mean grain size; and *Miliammina fusca* correlated positively with organic carbon. The trends are consistent with correlations observed in many other coastal regions.

This study introduced a refined marsh foraminiferal biofacies of the Mississippi River Delta region that can be used as a proxy for subenvironment control by elevation, salinity, and grain size within the Gulf of Mexico coastal zone. The next phase of the study is to compare 1-m post-Rita mainland-marsh cores and post-Katrina back-barrier Chandeleur Island cores to the results from the Lafourche headland. Downcore comparison of foraminiferal biofacies will characterize the environmental conditions that existed at time of deposition and will provide information about past landscapes. Surface comparison among the previous marsh location and two post-2005-hurricane marsh environments should provide information on the relative environmental conditions that existed in marsh and back-barrier environments before and after storm impact. Results will be used to create a more robust cluster analysis and to refine the biofacies within these subenvironments. The appeal of this ongoing research is to discover if correlations between the agglutinated foraminifera and the environmental parameters of grain size, salinity, and elevation are comparable among Mississippi Delta subenvironments. This correlation can be used to detect environmental response to sea-level rise and storm impacts.

Dreher, C.A., 2006, Modern foraminiferal bio-facies within a transgressive saline influenced deltaic headland, south-central Louisiana: Thesis University of New Orleans, LA, December 2006, *http://louisdl.louislibraries.org/u?/NOD,443.*

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"Do it Yourself" Remote-Control Boat for ADCP Measurements—A Low-Cost, Lightweight Alternative for ADCP Remote Control Boat Deployment

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The USGS has been interested in acoustic technology to measure water velocity and stream flow since the late 1960s. Beginning in the early 1980s, the USGS has worked cooperatively with manufacturers to develop and enhance the application of acoustic Doppler instruments to improve the accuracy and efficiency of stream flow measurements. Acoustic Doppler Current Profilers (ADCP), the processing software, and techniques have greatly improved to measure a wide range of water velocities and stream discharges with good accuracy.
The best deployment platform to make stream flow measurements with an ADCP is dependent upon site characteristics. Each site will differ from other sites in characteristics such as water velocity, channel width, depth, and access considerations, such as the presence of boat ramps, bridges, or cableways. Three common types of deployment platforms for the ADCP are manned boats, tethered boats, and remote-control boats. A manned boat deployment requires at least two personnel with one operator trained in boat safety, and access to a boat ramp. The tethered boat deployment generally requires a bridge or access to both sides of the stream. To deploy a remote control-boat, the operator only needs access to the stream.

The advantage of a remote-control boat is that the ADCP can be deployed in situations where a manned or tethered boat may not be feasible or ideal. The remote-control boat eliminates the safety risks associated with a manned boat. The hydrographer remotely maneuvers the boat across the river or lake, allowing the technician to collect data by radio communications.

South Florida has many streams and deep canals with low velocities where remote-control deployments are ideal. In these types of streams, a remote-control boat can be deployed quicker than a manned boat which increases the number of measurements a team can collect.

Commercially available models of remote-control boats, however, are costly, large, and heavy. The Ft. Lauderdale office designed and built a remote-control boat that operates well in the low velocity streams of South Florida. Smaller and lighter than commercially available remote-control boats, the Ft Lauderdale boat is easier to handle. The cost is significantly less than commercially available models.

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Organic Wastewater Compounds, Antibiotics, Hormones, and Pharmaceuticals in Wastewater, Drinking Water, Canals, and Ground Water in Miami-Dade County

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Pharmaceuticals and other organic wastewater compounds present in treated wastewater discharged to the land surface in Miami-Dade County may be transported to the highly transmissive Biscayne aquifer, and may ultimately enter water-supply wells or sensitive coastal and surface-water ecosystems. Furthermore, pharmaceuticals and other wastewater organics that potentially have been transported to ground water from surface-water sites or through direct treated wastewater injection may not be completely removed by drinking water treatment facilities (WTFs), and therefore, may be present in the drinking water supply for Miami-Dade County. The current study will assess 1) the occurrence of pharmaceuticals and other wastewater organics in treated wastewater, finished drinking water, ground water, and surface-water in Miami-Dade County, and 2) the removal efficiencies of these compounds through drinking WTFs and wastewater treatment plants (WWTPs) in the county.

Water samples will be collected from the influent and effluent of four WWTPs, as well as from five locations within a wastewater treatment pilot plant located at one of these facilities. Within the pilot plant, samples will be collected from deep bed filter influent, deep bed filter effluent, membrane filter/ultrafiltration (MF/UF) effluent, reverse osmosis (RO) product, and RO concentrate. These samples will be analyzed to determine which pharmaceuticals and other wastewater organics are present, and to determine the removal efficiencies of the various processes. Samples will be collected once during the rainy season and once during the dry season to document any seasonal differences in constituent occurrence.

Water samples have been collected from the raw and finished waters at seven drinking WTFs and analyzed for pharmaceuticals and other wastewater organics. These data will provide information about the removal of these constituents through the drinking water treatment process and their presence, persistence, and distribution in the drinking water supply.

The water samples will be analyzed for approximately 220 constituents, including pharmaceuticals, pesticides, antibiotics, hormones, semivolatile compounds, 1,4-dioxane, and other wastewater organics.

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Flood Hardening of USGS Streamflow Gages along the Gulf Of Mexico Coast

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Hurricanes destroyed or damaged several USGS hydrological monitoring stations along the entire Gulf of Mexico coast within the last five years. In response to the damage produced by Hurricanes Katrina and Rita, the USGS received a supplemental appropriation to assist in the rebuilding of gages destroyed by the storms and to harden stream gages against future hurricane activity. Flood hardening was carried out on National Streamflow Information Program (NSIP) gages and on select tidal gages with an emphasis on those gages used by the National Weather Service for flood forecasting. During 2007 and 2008, 134 gages were flood hardened along the Gulf of Mexico coast including 44 in Florida. The primary objectives of this project were to flood harden continuous stream gages, relocate or replace and upgrade equipment in select continuous record streamgages, and flood harden select open-water tidal/water quality stations.

During 2007, stage for the 200-year flood recurrence interval was chosen as the primary criteria for the flood hardening for the NSIP flood forecast stations. The stage for the 200-year flood recurrence interval was determined for each NSIP gage using the existing stage-discharge rating where available, or if the rating was not high enough to cover this recurrence interval, by extending the existing ratings.

Several methods were used to strengthen stream gages to withstand the water level and stream velocity of the 200-year flood discharge. These methods included strengthening existing structures, raising existing stilling wells to an elevation exceeding the 200-year flood stage, and establishing auxiliary instrumentation to provide backup data if the primary gage failed as a result of flooding.

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American Crocodile Spatial and Age-Structured Population Model for Comparison of CERP Restoration Alternatives

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As part of the U.S. Geological Survey's Priority Ecosystems Science (PES) initiative to provide the ecological science required during Everglades restoration, we are integrating regional hydrology models with American Crocodile (*Crocodylus acutus)* research and monitoring data. The result will be a model of the impact of various CERP restoration scenarios on the American crocodile.

A list of indicators was created by the Restoration Coordination and Verification (RECOVER) component of the Comprehensive Everglades Restoration Plan (CERP) to help determine the success of interim restoration goals. The American crocodile was established as an indicator of the ecological condition of mangrove estuaries due to its reliance upon estuarine environments characterized by low salinity and adequate freshwater inflow.

The spatial and age-structured population model for the American crocodile is based on code from the recently developed landscape-level CERP Alligator Population Model. The model couples local age-structured models into a spatial dispersal model incorporating crocodile movement behavior. A crocodile habitat suitability index and spatial parameter maps that reflect salinity, water depth, habitat, and nesting locations are used as driving functions to construct crocodile finite rate of increase maps under different management scenarios.

The crocodile simulation model makes use of the new application of FTLOADDS (Flow and Transport in a Linked Overland/Aquifer Density Dependent System) to TIME (Tides and Inflows in the Mangroves of the Everglades). TIME has the capability to link to the SFWMM (South Florida Water Management Model), which is the primary regional tool used to assess CERP restoration scenarios. By applying the crocodile model to proposed restoration alternatives and predicting population responses, we can choose alternatives that approximate historical conditions, enhance habitat for multiple species, and identify future research needs. Future modeling efforts include the incorporation of the Biscayne and Florida Bay model to assess climate change scenarios throughout the entire range of crocodiles in south Florida.

Restoration efforts will likely cause changes to salinity levels throughout the habitat of the American crocodile. The response of the crocodile to restoration efforts will provide a quantifiable measure of restoration success. This modeling effort will examine how CERP restoration alternatives that allow greater freshwater flow into Florida Bay during the critical post-hatching period (Sept-Dec) will affect:

- Growth and survival rates of hatchling and juvenile crocodiles
- Hatchling dispersal distance to suitable nursery habitat
- Survival rates of hatchlings originating from nests within Florida Bay
- Overall crocodile density and distribution

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Microbiological Perspectives—The Impact of Wastewater Disposal Systems on Florida's Coastal Waters

Dale Warren Griffin

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Florida's coastal waters are an important resource for recreation, tourism and fisheries and have great ecological significance. Florida contains the full spectrum of aquatic systems, which include freshwater springs, rivers, lakes, brackish waters, estuaries, vast expanses of both shallow and deep water marine systems and the only reef system of any significance within the boundaries of the continental United States. Human wastewater contamination of coastal water in the State of Florida is a significant problem that affects both ecological and public health. Management decisions regarding wastewater treatment, use of wastewater systems and disposal of black water and sludge will have economic impacts on communities and the State. This presentation will provide a summary of the types of wastewater disposal systems Floridians utilize within their coastal environment and the scientific evidence to date which demonstrates a significant human and environmental risk from wastewater associated microorganisms, nutrients, and chemicals.

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Ecological Comparisons of Natural and Augmented Freshwater Marsh and Cypress Wetlands in the Northern Tampa Bay Area

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The ecology, water quality, and hydrology were compared in 10 freshwater marsh and cypress wetlands in the northern Tampa Bay area. The hydrology of marsh and cypress wetlands is directly affected by rainfall patterns, and since the early 1970s it has been affected by development, particularly ground-water withdrawals. Withdrawal of ground water in regional well fields has lowered the water levels in the Floridan aquifer. As a consequence, water levels in many wetlands have declined, and the frequency, duration, and areal extent of seasonal flooding have decreased. Augmentation of some marsh and cypress wetlands with ground water has been used to mitigate the effects of ground-water withdrawals in well fields, causing changes in wetland hydrology, water quality, and ecology.

The hydrology of augmented wetlands differed from natural wetlands in several fundamental aspects, including the size of the flooded areas, residence times of water in the wetlands, leakage rates, the magnitude of runoff, and the water-table configuration. The relatively constant flooded area in three of the four augmented wetlands was well within the wetland perimeter, leaving the remainder of the wetland bottom subject to invasion by upland vegetation. However, perennial standing water in augmented wetlands increased their primary productivity compared to natural wetlands, as indicated by the higher periphyton and vegetation biomass. The greater primary productivity of the augmented wetlands, combined with infrequent drying, probably accelerated the accumulation of organic material in all but one augmented wetland, which repeatedly dried out.

The wetlands augmented with ground water were ecologically similar to the natural wetlands in many respects. Most of the biotic community measures in the augmented wetlands, including abundance, taxa richness, and diversity, were within the existing range for natural wetlands of the same type (marsh or cypress). The distribution of wetland periphyton species was related to pH and conductivity, but differences related to nutrient concentrations were not distinct. Biomass of herbaceous vegetation was higher in augmented wetlands, and may be related to availability of nutrients released from the accumulated partially decayed vegetation. The relative abundance of plant types (obligate, facultative wet, facultative) was not substantially different among wetland groups (augmented or natural), most likely because many of these plants have broad tolerances for water depth and occur across a gradient of hydrologic conditions. The occurrence of snails and mussels was confined to augmented wetlands where the concentration of calcium carbonate was sufficient for shell formation. With the exception of one augmented marsh (where snails were abundant), the biomass and density of macroinvertebrates at augmented sites was within the range found at natural wetlands.

The variability of periphyton, herbaceous vegetation, and macroinvertebrates in wetlands is inherently high, and ecological comparisons of natural and augmented marsh and cypress wetlands would improve if a larger population of wetlands were available for study.

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Movements, Habitat Use, Diet, Thermal Biology, and Trapping of Burmese Pythons in the Southern Everglades

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Native to Southeast Asia, Burmese pythons (*Python molurus bivittatus*) are a recently established invasive species in South Florida. Burmese pythons have the potential to adversely affect their new environment. The release of Burmese pythons in South Florida is especially troublesome because they appear to thrive in both disturbed and undisturbed habitats within the Everglades. The purpose of this project is to provide science support to develop control measures for Burmese pythons and to evaluate impacts of pythons on native biological diversity. We are using radio telemetry to determine habitat use, extent and timing of movements, and find aggregations of pythons during the breeding season. Since December 2005, 17 adult pythons have been captured and surgically implanted with VHF radio transmitters in Everglades National Park and on lands owned by South Florida Water Management District. Distances traveled by the pythons varied from shorter movements of several hundred meters associated with breeding, to distances greater than 78 kilometers for pythons that had been relocated. The unique dispersal capabilities of Burmese pythons and affiliation with water indicate that effective management of the rapidly expanding python population in south Florida requires cooperation and involvement of all land managers and relevant agencies.

Burmese pythons are generalist predators that consume a wide variety of mammal and bird species, as well as reptiles, amphibians, and fish. Prey species in the digestive tracts of Burmese pythons were identified by examining hair, bone, and teeth. Fourteen species of mammals, five species of birds, and one species of reptile have been found in the digestive tracts of pythons collected and examined in Florida, including several federally endangered Key Largo woodrats (*Neotoma floridana smalli*); one threatened species, the American alligator (*Alligator mississippiensis*); and two species of special concern, the limpkin (*Aramus guarauna*) and the white ibis (*Endocemus albus*).

Because temperature affects nearly all aspects of the biology of ectotherms, examining patterns of body temperature variation can often provide insight into their activity and behavior. To better understand the ecology of introduced Burmese pythons in ENP, we initiated a radiotelemetry study of pythons within and adjacent to the ENP and monitored their temperatures using surgically implanted micro-dataloggers. We simultaneously monitored environmental temperatures.

Using these data, we hope to provide information on python thermal biology, behavior, and activity that will assist in a better understanding of their overall ecology and development of effective population controls.

Trapping is one control method currently under development. The purpose of trapping is to remove pythons from the Everglades system. We are currently testing various trap and trap door designs. We intend to synthesize the knowledge gained from radio-telemetry, diet, and thermal studies to increase trapping success. This multi-faceted approach should increase success in reaching our primary goal of developing control methods for Burmese pythons.

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The South Florida Information Access (SOFIA) System

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The South Florida Information Access (SOFIA) system was created by the U.S. Geological Survey (USGS) in 1995. Its mission is to provide easy access to information about research projects and products generated as part of USGS Greater Everglades Priority Ecosystems Science (PES) and other Federal, State, and local science providers. SOFIA provides this service by integrating information systems and tools enabling efficient storage, organization, and search and retrieval of scientific information about the south Florida ecosystem. SOFIA was designed to benefit three major user groups: USGS program managers and scientists working with the Greater Everglades PES Program, managers and scientists working for other organizations involved with Everglades restoration, and members of the public interested in USGS research and the science behind the Everglades restoration effort.

SOFIA is an evolving and dynamic system that builds on the ever-increasing sophistication of new information technology. The current architecture consists of four integrated components: website, data, FGDC-compliant metadata, and database. The SOFIA website *(http://sofia.usgs.gov/)* provides links to all of these components including project descriptions, proposals, publications, data (via our Data Exchange website), metadata, presentations, and contact information, as well as items of general interest, such as photographs and posters.

The SOFIA site also hosts the website for the Everglades Depth Estimation Network (EDEN) (http://sofia.usgs.gov/eden). EDEN is an integrated network of real-time water-level monitoring, ground-elevation modeling, and water-surface modeling that provides scientists and managers with current (1999-present), on-line water-depth information for the entire freshwater portion of the Greater Everglades. Presented on a 400-m^2 grid spacing, EDEN offers a consistent and documented dataset that can be used by scientists and managers to: (1) guide large-scale field operations, (2) integrate hydrological and ecological responses, and (3) support biological and ecological assessments that measure ecosystem responses to the implementation of the Comprehensive Everglades Restoration Plan (CERP). The target users are biologists and ecologists examining trophic level responses to hydrodynamic changes in the Everglades.

On the EDEN website, users can download data, documentation, publications, as well as tools that provide access and manipulation of the data produced by EDEN. Please see the EDEN abstract for further information about this project.

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The Florida Evapotranspiration Data Portal, a Web-Based Archive and Distribution System for Satellite-Based Solar Radiation, Net Radiation, and Potential and Reference Evapotranspiration Estimates Over Florida

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Evapotranspiration (ET) is a term used to describe the sum of evaporation and plant transpiration from the Earth's land surface to the atmosphere. Evaporation accounts for the movement of water to the air from sources such as the soil, canopy interception, and water bodies. Transpiration accounts for the movement of water within a plant and the subsequent loss of water as vapor through stomata in its leaves. Potential evapotranspiration (PET) represents the evapotranspiration rate from a given surface without moisture limitation. Reference evapotranspiration (RET) is a representation of evapotranspiration from a hypothetical reference crop such as a green grass surface with a uniform height of 12 cm, actively growing, well-watered, and com-pletely shading the ground. PET is used extensively in hydrologic modeling whereas RET is used primarily in agricultural, irrigation and regulatory applications. Solar radiation is the primary driving force in the ET process.

A model has been developed to produce PET and RET estimates over Florida using solar radiation obtained from Geostationary Operational Environmental Satellites (GOES) and climate data from the Florida Automated Weather Network, the State of Florida Water Management Districts and the National Oceanographic and Atmospheric Administration. The Priestley-Taylor and American Society of Civil Engineers reference ET equations provide daily PET and RET estimates, respectively, on a 2 km grid spatially distributed over the State of Florida from 1995 to 2007.

The Florida Evapotranspiration Data Portal serves as a web-based storage and distribution system for modeled and measured ET data providing a variety of output formats and spatial representations. Text and graphic interfaces are available to retrieve data by county, hydrologic unit or water management district or by user defined coordinates of latitude and longitude or pixel ID. The data is useful as input to ground-water models and surface-water models and can be used as virtual climate stations in watershed studies. The data can also be imported into GIS for spatial analysis applications and animated to show changes over time.

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Simple Models of Time-Dependent Dune Erosion

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The response of our sand-fronted coasts to extreme storms has been predicted, with statistical skill, by the Sallenger scale of coastal vulnerability in a series of papers by Stockdon and coauthors. This response classification scheme compares the extremes of the highest runup (tide+surge+ setup+ swash) to the pre-storm elevations of the dune toe and dune crest to predict one of four response categories for the dune – no change, scarping, overwash, and total inundation. While this simplistic model has been shown to have predictive skill, we recognize that changes to the beach and dune, and the timing of those changes during the storm, may provide important feedback to the observed response. Accurate representation of the beach-and-dune response should improve our skill in predicting coastal vulnerability.

An ongoing research topic is the usefulness of time-dependent dune-erosion models in improving the statistical accuracy of our vulnerability predictions. Available models for this task range from highly parameterized and very fast implementations such as EDUNE and SBEACH, to much more complete (and slower) XBEACH and Delft 3D. This presentation will evaluate the skill of the simple models in predicting the post-storm beach-and-dune profile, followed by an unverified XBEACH model simulation of Hurricane Ivan's landfall on the Florida Panhandle in 2004. We will conclude with a brief discussion of the types of field observations needed to properly evaluate the time-dependent model skill (i.e., the observations we must make during the storm itself).

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Dynamic Simulation of Canal Stages and Surface-Water Structure Operations in SEAWAT to Evaluate Conjunctive Water Use in Miami-Dade County

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The Biscayne aquifer is currently the sole source of potable water in Miami-Dade County, Florida. Overlying the Biscayne aquifer is an extensive man-made network of canals that are in close hydraulic-connection to the ground-water system and managed using a system of operable control structures. During the wet season, the canals mitigate urban flooding and route excess water into Biscayne Bay. Conversely, the canals are used during the dry season to meet water-supply needs and to control saltwater intrusion in coastal areas by maintaining relatively high aquifer levels. With an increasing population and the proposed hydrologic changes as part of Everglades Restoration, Miami-Dade County is facing numerous hydrologic challenges that require a numerical modeling tool capable of simulating conjunctive use of surface-water and ground-water.

Although numerical models have been developed for the Biscayne aquifer in Miami-Dade County, these models either lack the ability to dynamically represent surface water flow through the canal network, do not consider density-dependent surface-water and ground-water flow, or do not contain the resolution necessary to address water resource issues at the county scale. As a result, an integrated surface-water/ground-water model that considers density-dependent surface-water and ground-water flow is being developed from an existing SEAWAT model. This model was originally developed to quantify rates of submarine freshwater discharge to Biscayne Bay but did not consider flow through the canal network. The numerical model will be used to determine 1) the impact of municipal well fields on surface- and ground-water levels and environmental conditions, 2) the location of well-field recharge areas, 3) the effect of well-field withdrawals on Everglades National Park and Biscayne Bay, 4) the effect of the Lake Belt Region on ground-water flow, and 5) the degree to which sea-level rise will cause saltwater intrusion into coastal well fields.

A modified version of the MODFLOW stream-flow-routing (SFR) package is being developed to dynamically represent canal routing and structure operations in Miami-Dade County. The modified SFR Package will permit simulation of seasonally-varying structure operations designed to control ground-water seepage from Everglades National Park and freshwater flow to Biscayne Bay. Approaches being considered to simulate stream flow range from a simple “level-pool” approach to numerical approximation of the St. Venant equations. Structures are being implemented in a general fashion so that structure flows based on canal stages, other operating rules, observed flows, or combinations of operational approaches can be simulated. Structures being considered in the modified SFR package include a simple, design discharge constrained excess volume based structure, gated spillways, gated culverts, and pumps. The modified package will use a simple mixing approach to simulate solute transport in the canals and account for the dependence of fluid density on canal concentrations when used with SEAWAT.

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Seed Bank and Regeneration Ecology of an Annual Invasive Sedge in Florida Wetlands

Colette C. Jacono

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Scleria lacustris is an introduced sedge initially discovered in south central Florida wetlands in 1988. Growing to two meters in height, this nonnative plant has invaded and dominated large portions of local wetland communities. Unlike dominant native species, it is annual in habit, dying at the end of the growing season and depending on seed for repopulation. Occurrence of this species appears to be restricted to natural areas that have maintained, or are managed for, surface water fluctuation. Seed banks and their function in seedling regeneration are crucial in the perseverance of annual species, regardless of their status as weeds or rare plants. Seed banks may interact with the hydrologic regime of particular wetlands and influence standing plant composition. Researchers consider hydrologic fluctuation to be a type of natural disturbance, important in maintenance of biological communities. However, in Florida the function of seed banks within wetlands characterized by hydrologic change is only beginning to be understood. I present evidence that supports the hypothesis that the seasonal wet/dry hydrologic cycle of Florida wetlands controls the incidence of an invasive species by selecting for strategies integral to seed dormancy break, seed bank longevity, and seedling regeneration.

In 2004, within-population random sampling of the *S. lacustris* seed bank and its seedlings was conducted at a lakefront marsh south of Kissimmee and at a depression marsh west of Vero Beach (VB). Results indicated that *S. lacustris* created an extensive soil seed bank with a high viability which, though shallowly buried and resulting in significant transition to seedlings, persisted beyond one year.

The 2004 findings were fundamental in testing the influence of seasonal hydrology on *S. lacustris* seed bank function and regeneration. In 2005 and 2006 seed bank and vegetation evaluations were conducted along three transects of the VB marsh gradient. Results from field sampling in conjunction with greenhouse trials, demonstrated that specific hydrologic conditions were required for seed bank survival and seedling regeneration. Regeneration of *S. lacustris* was restricted to bare, drained soils following surface water dry down in spring. Recent lower than average rainfall and receding water tables likely exacerbated the spring recession of surface water and promoted colonization from seed banks. Seed storage experiments clarified the significant influence of wet season flooding on both dormancy break and seed bank survival. Furthermore, seedling regeneration, seedling survival and adult productivity were significantly different along the marsh gradient as indicated by an uphill cut off from the optimum conditions provided in the previously flooded zone. The unique specificities required by this species at crucial life stages were shown to be met by the fluctuating wet/dry environment of the seasonal marsh, explaining in part the advantage of this annual sedge to proliferate in wetlands of Florida.

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Hydrogeology, Water-Level Altitudes and Changes in the Chicot, Evangeline, and Jasper Aquifers; Land-Surface Subsidence in the Chicot and Evangeline Aquifers in the Houston-Galveston Region, Texas

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The Chicot aquifer (in Holocene- and Pleistocene-age sediments), Evangeline aquifer (in Pliocene- and Miocene-age sediments), and Jasper aquifer (in Miocene- and Oligocene-age sediments) are the three primary aquifers in the Gulf Coast aquifer system in Texas. The hydrogeologic units are laterally discontinuous, fluvial-deltaic lenticular deposits of gravel, sand, silt, and clay that dip and thicken from northwest to southeast. The units thus crop out in bands inland from and approximately parallel to the coast, becoming progressively more deeply buried and confined toward the coast. The Chicot aquifer outcrop, which comprises the youngest sediments, is the closest of the aquifer outcrops to the coast, followed farther inland by the Evangeline aquifer outcrop and then farthest inland by the Jasper aquifer outcrop.

The USGS., in cooperation with the Harris-Galveston Subsidence District, the City of Houston, the Fort Bend Subsidence District, and the Lone Star Groundwater Conservation District, publishes an annual report on the water-level altitudes and water-level changes for the Chicot, Evangeline, and Jasper aquifers and compaction of subsurface sediments in the Chicot and Evangeline aquifers in the Houston-Galveston region. The 2008 report (Scientific Investigations Map 3031) shows potentiometric surfaces as low as 200 feet below sea level for the Chicot aquifer in central Harris County; 300 feet below sea level for the Evangeline aquifer in northern Harris County, and 150 feet below sea level for the Jasper aquifer in southern Montgomery County. Additionally, for the period 1977–2008, the report shows water-level rises of as much as 200 and 260 feet in the Chicot and Evangeline aquifers, respectively, in southeast Harris County.

The Houston-Galveston region is the largest urban area in the U.S. affected by land-surface subsidence caused by ground-water withdrawals. Sustained withdrawals cause water levels in the aquifers to decline, which in turn causes depressurization and dewatering of the clay lenses. Subsequently, the individual grains of the clay lenses begin to realign and compress. Measured subsidence data using spirit-leveling and GPS techniques indicate that as much as 10 feet of subsidence has occurred in areas of southeastern Harris County. For the same area, data derived from subtraction of a 1915–17 DEM from a 2001 DEM show that land-surface elevation has declined as much as 13 feet. Land-surface subsidence is especially problematic for coastal areas having low topographic relief. Impervious land-surface cover, surficial clay in the Chicot aquifer, and Gulf of Mexico low-pressure systems with storm surge and high rainfall, combine to make areas affected by subsidence more flood prone.

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Subsurface Attenuation of Nutrients and Organic Wastewater Compounds Beneath Septic Tank Drainfields in the Woodville Karst Plain, Florida

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Effluent from about 18,000 septic tanks is a potential source of nitrogen loading in the Woodville Karst Plain (WKP), an area in northern Florida where numerous sinkholes and a thin veneer of sands and clays overlying the Upper Floridan aquifer (UFA) make ground water vulnerable to contamination. Water samples were collected from three septic-tank systems in the WKP during dry and wet periods to investigate the subsurface movement of chemical constituents [nutrients, organic wastewater compounds (OWCs), pharmaceutical compounds] and microbiological indicators (bacteria and viruses) to the UFA. Each sampled system included septic tank effluent (STE), shallow and deep lysimeters, a drainfield well, and a background well. In addition, water extracts of core material from the unsaturated zone from various depth intervals beneath each drainfield were analyzed for nitrate, chloride, ammonium, OWCs, and pharmaceuticals. Of the 64 OWCs analyzed, 24 were detected in STE samples in low micrograms per liter (mg/L) concentrations; whereas only six OWCs (flame retardants and fragrance compounds) were detected in water samples from lysimeters or drainfield wells. Concentrations (in mg/L) of caffeine (42-130), paraxanthine (7-30), acetominaphen (0.4-3.5), and cotinine (0.03-1.1) in the STE were higher than sporadic detections of these compounds in water samples from lysimeters and drainfield wells (<0.1 mg/L). Sulfamethoxazole was detected in two drainfield wells, but not in their corresponding STE samples. Wastewater indicator bacteria and human enteric viruses were detected in STE samples from each site and intermittently in the lysimeter and drainfield samples. Nitrogen loading rates to ground water were highly variable (3 to 25 kg/yr) at each site along with different nitrogen and chloride profiles with depth in the unsaturated zone. Movement of contaminants to ground water beneath each septic-tank system was related to differences in water use, soil characteristics, depth to ground water, and chemicals used at each site.

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A Plant Phenology Network for the Southeastern United States

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Plant phenology is increasingly recognized as a vital aspect of understanding how ecosystems will respond to climatic change. Climate variability has been closely linked to spatially extensive patterns of observed phenological changes; several studies have demonstrated a trend of earlier leaf emergence and bloom dates over the last several decades for lilac and cloned lilac species in the northern U.S.

The USA National Phenology Network (USA-NPN) has been established to integrate phenological event observations on a national level with remotely-sensed weather and vegetation data. The network focuses on the north-central portions of the continental U.S. An extension of the USA-NPN is underway for the southeastern U.S. to provide a link to the national network and a framework for addressing climate change effects unique to the Southeast.

The Intergovernmental Panel on Climate Change (IPCC) projections applicable to the southeastern U.S. indicate future periods of warmer summer maximum temperatures, higher evapotranspiration, and more intense rainfall periods with longer dry periods between rainfall events.

Projected climate change effects of particular importance to ecosystems for the southeastern U.S. are: (1) accelerated wildfire frequency – a warmer climate encourages wildfires through a longer dry season, (2) reduced availability of soil moisture to plants, (3) increased insect epidemics in southern forest stands by pine bark beetles, and (4) changes in ecosystem community dynamics.

The Southeastern Coastal Plain is relatively flat; a significant portion of the landscape serves as water-storage areas in the form of swamps, marshes, and wetlands in floodplains of slow-moving streams. Plant community structure and ecosystem dynamics have developed around the availability of water close to the land surface. Prolonged droughts, warmer summer maximum temperatures, and higher evapotranspiration may stress plant communities resulting in shifts in the range of sensitive species, changes in community structure along hydrologic gradients, and changes in diversity and ecosystem function.

Establishing the network in the southeastern United States is of utmost importance as the Southeast is probably the most difficult of regions in the United States to distinguish regional climate change effects from the variability imposed by local weather effects. Climate change effects in the Southeast will likely be less dramatic than in colder regions, but no less important to ecosystem dynamics.

A plant phenology network for the southeastern U.S. will consist of a tiered approach consistent with the USA-NPN: (1) intensive sites focused on process studies, (2) spatially extensive environmental networks focused on standardized observations, (3) scientific networks with educational components (college campuses, nature preserves with educational programs, etc.), and (4) remote-sensing products that can be assimilated to extend surface observations.

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Lidar-Derived Data Products for Coastal Parks, Sanctuaries, and Preserves

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The USGS Coastal and Marine Geology (CMG) Program, through partnerships with the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the National Park Service (NPS), is involved in the creation of Open-File Reports and Data Series products that consist of remotely sensed, geographically referenced elevation measurements of Lidar-derived topography. These products are used for monitoring geomorphic changes, habitat mapping, ecological monitoring, classification, and event assessment through analysis of the data. The raw data are acquired by the Experimental Advanced Airborne Research Lidar (EAARL) system, a waveform-resolving, green-wavelength laser-ranging system capable of mapping submerged and subaerial topography in a single overflight. The data are processed, filtered, and manually edited to remove any outliers or other false returns. The data are stored in a GIS-ready GeoTIFF, LAS, and xyz data format indexed through an HTML interface and are distributed on a CD/DVD and made available online. Currently, 16 of these products have been published, with six more planned for publication by the end of fiscal year 2008. The products include locations surveyed within the boundaries of the NPS Inventory & Monitoring Program for the Northeast Coastal and Barrier, Gulf Coast, and South Florida and Caribbean Networks and include any combination of bare-earth, first-surface, and submerged topography with associated metadata.

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Effects of Increased pCO_2 on Aragonite Crystal Morphology in *Halimeda* spp.

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Atmospheric CO_2 concentrations are expected to be double pre-industrial levels before the end of this century. The ocean CO_2 reservoir is simultaneously absorbing increased quantities of CO_2, with concomitant increases in carbonic acid and decreases in pH. Open-ocean pH values have decreased by 0.1 since 1980 and are predicted to decrease 0.3 to 0.5 in the next 80 years. This process of ocean acidification will likely modify the biogeochemical processes of calcification and carbonate sediment production. Members of the genus *Halimeda* spp., a calcareous green segmented macroalgae, are important producers of carbonate sediments in tropical, shallow-water, carbonate settings. Aragonite crystals begin to precipitate approximately 36 hours after the growth of a new segment and continue until available space within the segment is completely filled. *Halimeda* spp. were grown in sealed aquaria containing an aragonite substrate, air bubbler, temperature and pH probes, and a CO_2-injection apparatus. The water in the aquaria was maintained at pH values of 8.1 (control), 7.9, 7.7, and 7.5 by controlling the levels of pCO_2 in the water. Scanning electron microscopy was used to study ultrastructural details of aragonite crystal morphology. As levels of pCO_2 increased, changes in crystal growth density and individual crystal size were noted. This work should provide the foundation for an index linking atmospheric CO_2 concentrations to unaltered *Halimeda* spp. crystal morphology.

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Mercury Sources, Cycling, and Bioaccumulation in the Gulf of Mexico: Research and Understanding Needs

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Mercury is a potent neurotoxin and its contamination of the environment has been a high-profile issue for the past two decades, as evidenced by issuance of widespread advisories (nearly all US states) for unsafe mercury levels in sport fish from inland waters and coastal regions. Based on rapidly improving scientific understanding of this problem for inland systems, many states are now moving forward with proposing mercury TMDLs. The same cannot be said for coastal and marine ecosystems, where far less mercury research has occurred; as a result, our scientific understanding of the critical factors controlling nearly ubiquitous elevated mercury levels in marine food webs remains poor. Especially wanting is a basic understanding of the sites and controlling factors of methylmercury, the most toxic and bioaccumulative form of mercury in the environment. This observation is especially noteworthy because a vast majority of human exposure to methylmercury results from the consumption of marine fish and shellfish. At the present time, the entire US coastline for the Gulf of Mexico is listed under a mercury advisory, yet very little is know regarding the important mercury sources, cycling, and bioaccumulation. Thus, a coordinated, multidisciplinary, and integrated mercury research program is needed for the Gulf of Mexico. Elements of such a program would include assessments of sources and transport (atmospheric, tributaries, and point sources), controls on methylation, and bioaccumulation pathways. Although some recent mercury research in this region has provided some insights into potentially important factors such as the hypoxic zone, exacerbated atmospheric loading rates, and elevated methylmercury abundance in coastal streams, we still lack an overall coordinated plan for scientific investigation. Such a program could ultimately address the question of whether it is feasible to reduce mercury concentrations of Gulf of Mexico food webs using human intervention.

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A Coupled Surface-Water and Ground-Water Model to Simulate Past, Present, and Future Hydrologic Conditions in Federally Managed Lands

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As proposed Everglades restoration scenario(s) are implemented, the hydrology and ecology of ENP and BNP may be affected substantially. To protect sensitive ecosystems, model-predicted hydrologic conditions that result from restoration need to be evaluated prior to implementing substantial changes in water delivery. The development of a numerical model that can simulate salinity and surface- and ground-water flow patterns under different hydrologic conditions is fundamental to this effort.

Two local USGS hydrologic models have been linked to create a larger, sub-regional model of southern Florida that includes Everglades National Park (ENP) and Biscayne Bay National Park (BNP). Because surface-water flows in the study area have been compartmentalized extensively by levees and canals, scientists are able evaluate surface-water restoration effects on these parks individually. In contrast, ground-water flow within the Biscayne aquifer, present beneath both parks, is continuous and not constrained by man-made boundaries. This interconnected system complicates the evaluation of restoration effects, because modifications in one park can affect conditions in the other. The USGS sub-regional model is designed to address this issue by providing a comprehensive assessment of the effects of changes to ground-water flow and surface water conveyance on both National Parks.

The USGS model consists of the Tides and Inflows in the Mangroves of the Everglades (TIME) model and the Biscayne Bay model. The TIME model was developed to simulate the potential effects of various restoration scenarios on the southern Everglades, and the Biscayne Bay model was developed to identify causative factors for Biscayne Bay hypersalinity. The combined model domain encompasses all of ENP and Miami-Dade County, and is solved using the Flow and Transport in a Linked Overland/Aquifer Density Dependent System (FTLOADDS) modeling code. The FTLOADDS code has been updated to simulate heat transport in wetlands and offshore areas. When complete, the sub-regional model will provide deterministic estimates of freshwater flow to the bays, bay salinity, water levels, surface- and ground-water leakage, ground-water flow paths, and temperature. The combined model will also be able to provide predictive hydrologic data to ecological models in the study area. The heat transport component will provide water temperature and salinity predictions that can be used to assess habitat suitability for different aquatic species, such as the West Indian manatee. The sub-regional model will be linked with the South Florida Water Management Model (SFWMM) in order to simulate selected restoration scenarios, and with the Natural Systems Model (NSM) to hindcast pre-development hydrologic system conditions.

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Water Withdrawals and Trends in Florida, 2005

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The estimated amount of water withdrawn in Florida in 2005 was 18,354 million gallons per day (Mgal/d), of which 63 percent was saline and 37 percent was fresh. Ground water accounted for 62 percent of freshwater withdrawals and surface water accounted for the remaining 38 percent. Palm Beach County withdrew the largest amount of freshwater, Pasco County withdrew the largest amount of saline water in 2005.

Overall, agricultural irrigation accounted for 40 percent of the total freshwater (ground and surface) withdrawn in 2005, followed by public supply with 37 percent. Total ground-water withdrawals during 2005 were made for public supply (52 percent), followed by agricultural self-supplied (31 percent), commercial-industrial-mining self-supplied (8.5 percent), recreational irrigation and domestic self-supplied (4 percent each), and power generation (0.5 percent). Agricultural self-supplied accounted for 56 percent of fresh surface water withdrawn in 2005, followed by power generation (20.5 percent), public supply (13 percent), recreational irrigation (6 percent), and commercial-industrial-mining self-supplied (4.5 percent). Saline water withdrawals (99.9 percent) were from surface water for power generation and were used for once-through cooling.

In Florida during 2005, ninety percent (16.15 million) of the 17.9 million population relied on ground water for their drinking water needs. About 60 percent of the total ground water withdrawn in 2005 was obtained from the Floridan aquifer system; 19 percent was from the Biscayne aquifer. The remainder was withdrawn from the surficial aquifer systems (12 percent), the intermediate aquifer (6 percent), and the sand-and-gravel aquifer (3 percent). Most of the surface water withdrawn in Florida was from managed and maintained canal systems or large water bodies. More than 40 percent of the fresh surface water withdrawn was in southern Florida and is associated with irrigated sugarcane and vegetables acreage in the Lake Okeechobee and the Everglades Agricultural Area of Glades, Hendry, and Palm Beach Counties. Miami-Dade County withdrew the largest amount of fresh ground water, Palm Beach County withdrew the largest amount of fresh surface water in 2005.

Total water (fresh and saline) withdrawn in Florida increased 15,700 Mgal/d (600 percent) between 1950 and 2005, while the population of Florida increased by 15.15 million (550 percent). Between 1990 and 2005, total withdrawals increased 400 Mgal/d (2 percent) while the population increased 4.98 million (38 percent). Ground water withdrawn in 1950 was 614 Mgal/d, compared to 4,242 Mgal/d in 2005. Ground water was the primary source of freshwater in Florida between 1980 and 2005, supplying about 60 percent of the total freshwater withdrawn. Surface water withdrawn in 1950 was 840 Mgal/d, compared to 2,626 Mgal/d in 2005. Between 1950 and 1980, surface water was the primary source of freshwater in Florida, supplying more than one-half of the total freshwater withdrawn.

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Surface-Water/Ground-Water Interactions between Lake Panasoffkee and the Upper Floridan Aquifer, West-Central Florida

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Lake Panasoffkee is the largest body of water in the Withlacoochee River basin and is a major source of water to the Withlacoochee River. Diffuse ground-water seepage and spring flow have been estimated to account for roughly 40% and 35%, respectively, of total inflow. A cooperative study between the United States Geological Survey (USGS) and the Southwest Florida Water Management District (SWFWMD) is currently being conducted to assess and quantify the hydraulic connection between Lake Panasoffkee and the underlying Upper Floridan aquifer. The study will also refine an existing water budget by incorporating on-site estimates of evaporation and ground-water seepage.

The Ocala Platform is a major structural feature in the study area and has many associated faults and fractures that trend from northwest to southeast. It is thought that the location of Lake Panasoffkee is related to the preferential dissolution of limestone along these fractures. A seismic survey of the lake bottom was completed, but the results did not reveal any clear structural or karst features.

The two major surface water inflows to Lake Panasoffkee are Little Jones Creek and Shady Brook. Multiple springs of second- and third-order magnitude constitute the headwaters of both of these streams. The sole surface-water outflow from the lake is Outlet Canal, which drains from the western lake shore to the Withlacoochee River. Streamflow gaging stations have been established on these water bodies to measure daily discharge. An effort also has been made to measure ungaged over-land flow through swamplands adjacent to the lake.

A climatologic data collection raft was deployed over open water in the middle of Lake Panasoffkee to record wind speed and direction, relative humidity, lake temperature, and net solar radiation. These data will be used to quantify outflow from the lake through evaporation. A network of meteorological stations in the State provides data for estimating recharge to the lake through rainfall.

Surface- and ground-water quality are being characterized through analysis of major ions, selected nutrients and trace elements, stable isotopes of oxygen ($^{18}O/^{16}O$) and hydrogen ($^{2}H/^{1}H$), and strontium ($^{87}Sr/^{86}Sr$). The radiogenic Sr isotope ratio should provide some insight into the relative depths from which ground-water discharge is originating. Shallow ground water should have a significantly different signal than deeper ground water from the Tertiary carbonate Upper Floridan aquifer. The oxygen and hydrogen isotope analysis will help to determine the degree of ground-water and surface-water mixing.

Detailed maps of the potentiometric surface of the Floridan aquifer in the study area have been constructed during dry season (May) and wet season (September) conditions. Piezometers located around the lake measure the head gradient between the lake and the shallow ground-water system. Head gradients between the Floridan and surficial aquifer provide information on the potential for upward ground-water flow.

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Origins of Production and Trophic Placement of Biota in Mangrove-Forest Food Webs using Stable Isotopes – Shark River, Everglades National Park

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Southern Florida is the focus of a major hydrological restoration of a vast wetlands ecosystem, the Greater Florida Everglades. The overriding principle of this restoration is that reconstruction of the basic hydrological patterns of water quality and flow will facilitate ecological recovery of populations and communities of freshwater and estuarine animal consumers. A major goal of restoration is to prolong the period of low-salinity conditions in the upper reaches of tidal rivers and streams, a condition historically correlated with the occurrence of large numbers of nesting colonial wading birds in riverine headwater reaches. Given that estuarine trophic pathways are, in part, driven by salinity regimes, we collected baseline data on food-web relationships along a salinity gradient in Shark River, a major conduit of freshwater outflow from the Greater Everglades Ecosystem. Using stable isotopes of carbon and nitrogen, our objectives were to: (1) identify the major sources of organic matter for representative consumers along the salinity gradient; (2) determine if the relative contribution of organic-matter sources differs over seasons and years; and (3) identify those pathways and sites most likely to reflect trophic changes that could conceivably occur with modified freshwater inflow. Spatial and temporal expansion of the freshwater and low-salinity zones of the estuary would be expected to be reflected in the pool of dissolved inorganic carbon, and thus the phytoplankton carbon isotopic values. Additionally, nitrogen isotopic values in phytoplankton might also display enrichment as a result of increased nitrogen availability in inflow. This Priority Ecosystem Science study provided information on the structure of that food web, including such basic questions as: what species use the fringing forests, what groups constitute the major biomass pools, and which primary producers support those communities.

We collected representative plant and animal taxa from three fixed locations along the salinity gradient on Shark River three times a year, from 2005-2007. All samples originated from fringing mangrove forests or adjacent subtidal waters. Following initial processing, all samples were sent to the stable isotope laboratory at Florida International University for analysis.

Preliminary analyses across river locations indicate that both red mangroves and BMA (benthic microalgae) were enriched in $\delta^{15}N$ and depleted in $\delta^{13}C$ at the most upriver site at Tarpon Bay (mean annual salinity = 5 psu). These unique values at the upriver site are indicative of its location at a salinity ecotone where freshwater influence dominates marine influence. The major *in situ* primary producers (red mangrove, benthic microalgae) overlapped considerably in both $\delta^{13}C$ and $\delta^{15}N$ at the upriver location, making it impossible to tease apart the relative contributions of the two identified potential organic matter sources there. Preliminary data indicate that

inferences will be possible at the two downriver locations, however, as the values of the two sources are consistently different at those locations.

At the upriver location, the overlapping potential sources of organic matter (red mangrove, BMA) appear to be incorporated into resident killifishes, grass shrimp, and mud crabs, as well as into young life-history stages of snook and gray snapper, both recreational-fishing species. At the upriver location, both fish and invertebrate data suggest the presence of an unidentified source of organic matter that is much depleted in $\delta^{13}C$ and enriched in $\delta^{15}N$ relative to both red mangroves and BMA. The source is hypothesized to be phytoplankton. This source appears to be incorporated into pink shrimp, water-column forage fish (anchovies), and filter-feeding clams.

Invertebrates from the upriver site were predictably intermediate in $\delta^{15}N$ values, an indication of a trophic level between plants and fishes. An exception was grass shrimp (*Palaemonetes* spp.) which had relatively enriched (high) values. Grass shrimp in other south Florida systems are one of the highest trophic-level invertebrates, indicating a diet rich in animal material. There were four consumer levels at the upriver location. Low-level consumers included filter-feeding clams and combination detritivorous-herbivorous amphipods and coffee bean snails. Second-level consumers included mud crabs, blue crabs, pink shrimp, grass shrimp and the small killifish, mangrove rivulus. Gray snappers and juvenile snook constituted the top-level consumers.

- These data provide baseline data on fringing-mangrove-forest food webs that will be useful for post-CERP restoration comparisons.
- Salinity regimes of coastal habitats will be altered because of increased freshwater flow or because of saltwater encroachment from sea-level rise. Changes in salinity will alter aquatic-community structure and therefore food webs.
- Top predators in the food web associated with the mangrove forest were gray snapper and snook, important gamefish species.

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Streamflow Losses through Karst Features in the Upper Peace River Basin, Polk County, Florida

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In October 2001, the U.S. Geological Survey, in cooperation with the Southwest Florida Water Management District, began a study to evaluate the distribution, timing, and volume of surface-water/ground-water exchange in the Upper Peace River Hydrologic Area in Polk County, Florida. Historically, ground-water levels in this area were above the river levels, signifying a gaining stream. Wells and second-order magnitude springs flowed at the surface and tributaries drained the surrounding scarps. Today, because of ground-water development in this area, the Upper Peace River is a losing stream and streamflow losses are predominately through karst features found in the river channel and the flood plain.

During the dry season, the locations of prominent karst features, surface orientations, and dimensions were measured in selected reaches of the river and flood plain. These karst features were characterized as a coalescing group of vertical pipes, collapsed sinkholes, and numerous interconnected horizontal and vertical fractures that show evidence of scouring by moving water. Some of the openings are large enough for a person to enter. To quantify the streamflow losses to these karst features, measurements were made during the dry seasons (late spring) of 2002, 2003, and 2006.

In May 2002, streamflow ceased along an approximate three-mile segment of the river, with losses to karst features ranging from about 2 to 30 cubic feet per second (ft^3/s). In May 2003, streamflow losses did not exceed 16 ft^3/s. During 2004 and 2005, because of three hurricanes that affected this area, the river flowed up into the flood channel most of the time. During 2006, streamflow again ceased in the river along an approximate three-mile section, and streamflow to the karst features did not exceed 12 ft^3/s.

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Integrated Remote-Sensing Applications for the Ecosystem-Based Management of Coastal Parks, Sanctuaries, and Preserves

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The USGS Coastal and Marine Geology Program is supporting the creation of new capabilities for the synoptic remote sensing of coastal-marine and terrestrial environments based on aircraft and satellite sensors. Special emphasis has been placed on the use of aircraft-mounted light detection and ranging (lidar) and multi-spectral imaging to map coral reef ecosystem geomorphology, topographic roughness, and habitats at spatial scales finer than 2 m. Through partnerships with the National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), and National Park Service (NPS), these capabilities have been applied to create highly detailed benthic and submerged topography maps of portions of the Florida reef tract and the U.S. Virgin Islands. In a similar collaboration between the USGS and NPS, aircraft lidar and color-infrared imaging have been acquired and processed to create high-resolution subaerial topographic maps of barrier island geomorphology and vegetated habitats for NPS Inventory and Monitoring Programs along the Northeast Atlantic and the Gulf Coast. The Experimental Advanced Airborne Research Lidar (EAARL) system, used in these data-acquisition efforts, is a unique waveform-resolving, green-wavelength lidar system capable of mapping subaerial and submerged topography simultaneously. The EAARL sensor records the time history of the return waveform within a small footprint (20-cm diameter at nominal flying altitude of 300 m) for each laser pulse, enabling characterization of vegetation canopy structure and "bare earth" topography under a variety of vegetation types. EAARL surveys conducted over coastal-vegetation communities at Gulf Islands National Seashore and Jean Lafitte National Park were used to develop and evaluate the capability of lidar waveform data to determine the vertical distribution of canopy characteristics across a diverse set of vegetation classes. In total, these new coastal remote-sensing, mapping, and point-monitoring tools constitute a unique integrated package of instrumentation and software that may be deployed in support of appropriately timed and scaled zoning decisions by management authorities in order to conserve and sensibly exploit nearshore coastal and marine ecosystems.

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Eradication of Non-native Tilapia from Laguna El Junco, a Natural Crater Lake in the Galapagos Archipelago, Ecuador

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The Galapagos Archipelago of Ecuador, a World Heritage site, is located in the eastern Pacific Ocean. Despite conservation efforts, native species and habitats of the Galapagos have been subjected to an increased number of diverse threats. One of the most significant has been the introduction and establishment of non-native species. In 2006, Galapagos National Park (GNP) personnel discovered introduced Nile Tilapia (*Oreochromis niloticus*) in Laguna El Junco, a natural crater lake (4.9 hectares) on the island of San Cristobal. The largest body of freshwater in the Galapagos, El Junco, was naturally devoid of fishes. We were invited by the International Affairs Office, U.S. Department of the Interior and the office of U.S. Agency of International Development in Ecuador to assist GNP personnel in developing a plan to eradicate the tilapia. Two of us (LGN and DC) visited the site in August 2007 to verify the identity and status of the tilapia population and survey surrounding areas for other tilapia populations. Surveys indicated that tilapia were reproducing but likely restricted to El Junco Lake and, following months of detailed planning, a decision was made by GNP to eradicate the population by application of rotenone, a commonly used fish poison. Eradication was justified for a number of reasons. Predation by tilapia probably changed composition and abundance of the lake's native invertebrate community. Moreover, if any tilapia escaped or were moved by humans from El Junco, they were capable of invading other freshwater and marine environments, thereby endangering other aquatic organisms and habitats. The longer the tilapia population persisted in El Junco, the greater the likelihood of dispersal and further adverse impacts. In early 2008, three of us (LGN, WFL, and HLJ) traveled to the Galapagos, and on 25 January 2008, assisted GNP in applying liquid rotenone (5 ppm) to Laguna El Junco. Following rotenone treatment, approximately 40,000 dead and dying tilapia, consisting of a wide range of juvenile and adult sizes, were removed from the lake. Prior to application of rotenone, aquatic invertebrates were collected and held in nearby refuge tanks. After removal of the tilapia and once all residual rotenone in the lake had degraded sufficiently, captive invertebrates were released back into El Junco to speed recovery of invertebrate communities that might have been impacted by the chemical. The renovation project was declared a success because no live tilapia have been collected or observed since 31 January 2008.

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Transport of the Cyanotoxin Microcystin in Ground Water Beneath Stormwater Ponds

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As the demand for fresh water increases in central Florida to meet both public supply and irrigation needs, stormwater is increasingly being managed as a resource to help offset possible future declines in aquifer water levels. Water quality is an important consideration when using stormwater for recharge or reuse. A constituent of recent concern is cyanobacteria (popularly known as blue-green algae) because some of these can produce toxins (cyanotoxins) that are detrimental to animal and human health. Microcystins are the most commonly found type of cyanotoxin in Florida and have been detected in a variety of rivers, natural lakes, and stormwater ponds. Microcystin-containing genera of cyanobacteria retain the toxin within healthy cells; toxin is released when cells lyse. Once released into the water, the dissolved microcystins can potentially move with the prevailing hydraulic gradient through the water-body bed sediments and into adjacent aquifers. Little is known about the transport and fate of microcystin in soil and ground water. Microcystin that reaches the ground-water flow system could adversely impact the quality of water withdrawn for irrigation as well as drinking water purposes. The potential for transport of microcystin in soil and ground water is being investigated by using laboratory soil column experiments.

The first soil column experiment was performed using microcystin-LR (MC-LR) and a clean sand media. Natural stormwater spiked to yield a MC-LR concentration of 4 mg/L was continuously applied to 2 (duplicate) columns (5 feet tall and 12-inch diameter) for 75 hours. Samples were collected from 6 sampling ports (0.5, 1, 1.5, 2, 3, and 4.5 feet deep) on each column in addition to the ponded water at the top of each column. Sampling time intervals ranged from 0.5 to 14 hours; a total of 120 samples were collected. These samples were quantitatively analyzed using enzyme-linked immunosorbent assay (ELISA) to provide an estimate of the degree of microcystin attenuation/degradation in ground water. Microcystin removal efficiencies up to 30% in one column and 70% in the second column were identified. Clear breakthrough curves were identified at the shallowest sampling port. Analysis of these data indicated that the microcystin was likely moving at or slightly slower than the pore-water velocity, suggesting adsorption was minimal. Substantial degradation of microcystin (likely microbiologically mediated) occurred after breakthrough at each sampling port. A subset of samples is being analyzed with liquid chromatography tandem mass spectrometry (LC/MS/MS) to confirm results by ELISA. A second soil column experiment is planned to further investigate the potential for microcystin degradation over a longer time period.

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A 1000-year record of low-oxygen bottom water on the Louisiana shelf, Gulf of Mexico

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Hypoxia (dissolved oxygen <2 mg l^{-1}) occurs annually on the Louisiana shelf and has been linked to increased transport of anthropogenic nutrients (fertilizer, feed lots, etc.) by the Mississippi River. The relative abundance of three species of low-oxygen-tolerant benthic foraminifers, the PEB index, in sediment cores is used to trace the initiation, spread, and spatial distribution of hypoxic conditions prior to the start of the systematic monitoring efforts begun in 1985. Nine box cores, with excess ^{210}Pb chronologies, were collected throughout the modern "dead zone." The PEB from the box cores indicate that the chronic seasonal hypoxia began to develop round 1920 and was well established by 1960.

The PEB results from three gravity- and box-core pairs (PE0305-1, MRD05-4 and MRD05-6) provide a cross-shelf transect of the history of earlier low-oxygen events on the continental shelf. Gravity-core chronologies are established by two basal 1000 ^{14}C dates on foraminiferal tests. The two cores collected from within the area of the modern hypoxia "dead zone" contain multiple peaks of elevated PEB species, interpreted as naturally caused episodes of low-oxygen water on the shelf over the last 1000 ^{14}C years. The gravity core collected outside of the monitored area of hypoxia contains elevated PEB values only in the last ~50 years, indicating that anthropogenically caused low-oxygen conditions have affected the benthic fauna outside of the monitored "dead zone."

These results support the hypothesis that naturally occurring low-oxygen bottom-water events have taken place periodically on the Louisiana shelf over the last 1000 C^{14} years as a result of episodes of increased Mississippi River discharge and associated wetland export. The results also indicate that modern hypoxia is greater in frequency or duration and more extensive geographically than earlier naturally occurring low-oxygen bottom-water events. We conclude that the development of low-oxygen bottom water on the continental shelf is a natural process that has been significantly modified by human activities during that last ~50 years.

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Poster

Monitoring of Surface-Water and Ground-Water Resources in Florida

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The Florida Integrated Science Center (FISC) has four 'water' offices located in Tallahassee, Tampa, Orlando, and Fort Lauderdale. An important component of each of these offices is the collection of continuous basic data throughout the State of Florida in regard to streamflow, stream level, lake level, ground-water level, water-quality parameters, and evaporation. Periodic data are collected on many stream sites, ground-water stations, spring stations, and water-quality sampling locations. Operation and maintenance of the data program in Florida is approximately an $18 million annual effort with about $4 million supplied by USGS and $14 million by the cooperators. Approximately 65 percent of the budget is related to surface water, 20 percent is ground-water activities, and 15 percent is water-quality data collection.

During the 2008 fiscal year, the Florida water offices operated 428 continuous discharge sites (discharge and water level), 229 stream level or miscellaneous measurement locations, 407 continuous ground-water level stations, approximately 1,100 periodic ground-water level monitoring sites, 145 continuous water-quality monitoring gages, 125 periodic water-quality sampling locations on streams, springs, and ground-water sites, and 12 evaporation stations. This statewide network consists of over 2,400 individual locations visited at least once on an annual basis.

Basic data are necessary for any type of long-term analysis of water conditions in the State of Florida. Several continuous streamflow stations have record beginning in the late 1920's and early 1930's. The oldest station, Suwannee River at White Springs, has data back to 1906. Ground-water level data collection primarily began in the late 1940's with the oldest site, Orange County Well 47, having record back to 1930. These extensive datasets are necessary in the analysis of long-term climate change, ground-water usage, and changes in water use and the impact upon Florida's water resources. Low-flow statistics, flood-frequency analyses, and flow duration characteristics from streamflow stations are used in the design of highway bridges, wastewater treatment plants, reservoirs, and water intake structures. Incremental values of streamflow, water level, water-quality parameters, and evaporation act as data inputs and calibration targets for hydrologic models used as predictive tools in quantifying how water levels, flows, and water quality are impacted by possible future changes in water use, climatic change and meteorological variability. Additionally, the vast historical and ongoing hydrologic data collection record in Florida can serve as a platform for biological, coastal processes, and climatologic investigations.

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A Bayesian Model for Predicting Barrier Island Response to Hurricanes

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The processes that drive coastal evolution in response to a large variation in weather conditions are extremely sensitive to small changes in bathymetry and topography. This is particularly true for barrier island response. In this case, the local dune height has been identified as a key morphodynamic variable that controls barrier island responses, which range from minor erosion, to massive erosion, even when faced with extreme storms. Even if we had perfect models for predicting flows due to waves and winds and correspondingly perfect models for predicting sediment transport, uncertainties in the initial geomorphic variables would likely lead to large uncertainties in the predicted evolution. Because existing flow and sediment-transport models are not perfect, there are large uncertainties in all aspects of morphodynamic-prediction.

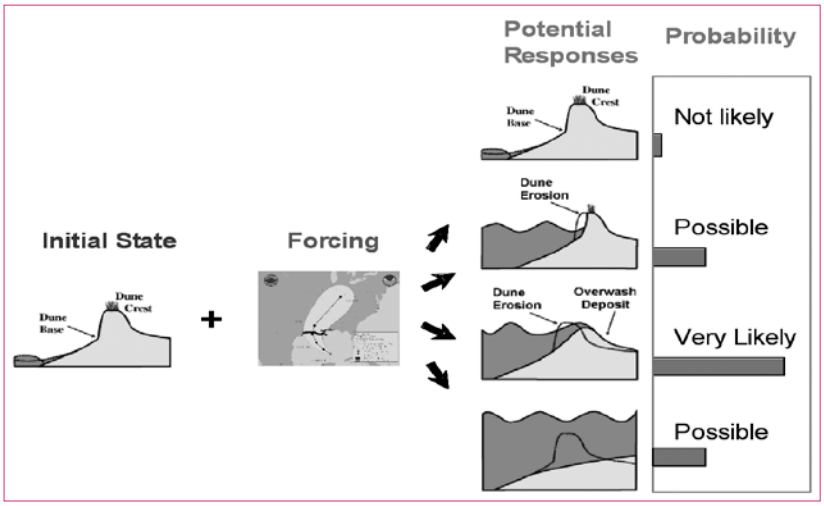

Figure 1. Schematic diagram of probabilistic barrier island prediction.

A probabilistic approach is required to cope with the uncertainties associated with morphodynamic prediction. We use a Bayesian network to learn the predictable part of coastal evolution in a test case based on data collected prior to and immediately after the landfall of Hurricane Ivan. The model predicts both the most likely responses as well as uncertainty of the predictions (Figure 1). The approach assimilates both model predictions and field observations. Predictions take the form of probability distributions for a reduced set of key variables. Dune height was the primary variable, but it was discovered that dune width was also important to accurately predict the response. We demonstrate the model accuracy and some interesting applications.

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User-Centered Design for The National Map

Barbara S. Poore

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Many legacy geodata systems, such as the U.S. Geological Survey's (USGS) *National Map* and databases of the Florida Integrated Science Center (FISC), were conceived in the Web 1.0 era of the mid to late 1990's. They have been upended by new technologies and practices of Web 2.0. These include Google Earth, free online geocoding services, open-source software development, collaborative social tagging of digital objects (folksonomies and geotagging), mash-ups, wikis, and blogs. These innovations allow ordinary users, including those with no training in science, cartography, or geographic information systems (GIS), easily to combine different types of data, layer them on top of maps and images of the Earth and share them with the world.

This research examines the social and organizational challenges posed by technologies of Web 2.0 for *The National Map*, but it has wider implications for other databases produced by the FISC, and for the practices of our scientists. While a recent report by the National Research Council on research priorities for geographic information science at the USGS urged a user-centered approach to future development of *The National Map*, traditional user-centered design methods may prove inadequate to deal with the social characteristics of these emerging technologies. New technologies and practices could expand the user community for existing data services, but new users might require different types of data and presentation methods that are not within the scope of our traditional data formats and presentation methods.

A case study of the use of Web 2.0 technologies during Hurricane Katrina and in the reconstruction of New Orleans shows the potential for these technologies to combine scientific data and USGS base maps with non-traditional data sources and to use online collaborative mapping as a tool to gather and display information on flood damage and to rally neighborhood redevelopment. Research strategies that employ qualitative data techniques to describe how geographic information is actually used in practice may be required to supplement traditional human-computer interface studies that are based on psychometric techniques.

Users of Web 2.0 technologies become co-creators of information. Using volunteered information to enhance scientific collaboration and contribute to digital map revision may pose conceptual and practical problems. Who will be able to access these ways of contributing, how will participation be solicited, and how will unstructured data be normalized? Finally, how will trust and authority be established? Will the collaborative affordances of Web 2.0 usher in an era of Science 2.0 at the USGS (Waldrop 2008)?

Waldrop, M. M. 2008. Science 2.0--Is Open Access Science the Future? *Scientific American Magazine* (April 21).

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Seawater Encroachment threat to Local Well Fields in Southern Florida—Evaluation Methods, Trends, and Spatial Delineation

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In southern Florida, the problem of aquifer contamination from encroaching seawater was caused by the construction of an extensive series of canals during the first quarter of the 20th century as well as groundwater withdrawals. The drainage through the canals was uncontrolled and resulted in water-level declines in local aquifers. Groundwater supply withdrawals near the coast exacerbated this situation by further reducing water levels in the aquifers. The reduced water levels in the aquifers allowed seawater to: (1) encroach along the bases of the aquifers, and (2) migrate inland long distances within unregulated canals and seep into the adjoining aquifers during periods of low rainfall and canal stage and flow.

As a result of unregulated drainage canals, aquifer withdrawals, and droughts, some public water supply well fields were contaminated by seawater and had to be either temporarily shut down or permanently abandoned. For example, the first public water supply well field of the City of Miami was contaminated by seawater in 1925 and was abandoned, and seawater from the Miami Canal contaminated some of the wells in the newly installed Hialeah-Miami Springs Well Field in 1939.

In 1939 the U.S. Geological Survey (USGS), began a cooperative effort with local government to evaluate saltwater intrusion that has aided water-management efforts to reduce and, in some areas, reverse seawater encroachment. In many locations, however, seawater continues to encroach inland or leak from canal systems into aquifers. This continued threat to water supply well fields will become even more serious if sea levels continue to rise. Cooperative network budgetary cuts, however, have reduced the number of monitoring sites by approximately one half within the last 13 years and more reductions are expected.

About two-thirds of the remaining 117 seawater-encroachment monitoring wells are located in Broward and Miami-Dade counties. Encroachment in other south Florida counties is not monitored sufficiently to provide adequate warning. The USGS is working with its cooperative partners in an effort to improve monitoring in areas where insufficient information exists for water-management decisions.

The USGS is mapping seawater encroachment using water quality sampling, electromagnetic induction profiling, ground and airborne Time Domain Electromagnetic Depth soundings, and continuous conductivity logging. Trends are being evaluated using various graphical and statistical approaches. Current studies also use borehole image processing, flow logging, and sequence stratigraphy.

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Climate Change and Coastal Lowlands — Patterns of Long- and Short-Term Change on Florida's Gulf Coast

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The southeast region of the United States boasts many miles of coastal lowlands, buffered by barrier islands, shallow shelf gradients, and estuarine embayments. These coastal lowlands support productive fisheries and tidal wetlands and serve as a primary habitat and food resource for many aquatic and terrestrial species. Warming trends and sea-level rise under the current climate-change scenario pose a very real threat to the status quo of coastal lowland ecosystems. A geographic analysis of historic topographic charts, general land surveys, and maps of modern coastal features provides insights into the types and patterns of long-term change along the central and northern Gulf Coast of Florida. Comparison of a 20-year time series of Landsat satellite imagery sheds light on short-term changes in vegetation, biomass, and recovery patterns. Short-term biomass change seems to be episodic in response to extreme storm events, low winter temperatures, and periods of drought. Since vegetation in the coastal zone is largely resilient to such episodic events, areas lacking recovery indicate that ecosystem tolerance may have been overwhelmed by a combination of forcing factors. Evaluation of long-term change on Florida's Gulf Coast provided verification of permanent area loss in coastal forest at almost three times the rate of area loss in tidal wetlands. Persistent loss of the coastal forest seems to be ameliorated primarily at locations with reliable freshwater flow. Habitat loss or change was exacerbated by logging activities, road construction, and alterations to hydrologic flow. A conversion from tidal marsh to mangrove forests was also documented with long-term change analysis. The tidal marsh-to-mangrove conversion may be attributable to both natural and man-made factors. The presentation will illustrate these changes in maps, diagrams, and photos as developed for several U.S. Geological Survey projects.

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Answering Multiple Research Questions with Electrical Resistivity: Case Studies from an Estuary and Select Freshwater Lakes in Florida

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Florida Bay has been a focus of Everglades restoration because water quality in the bay and Everglades is closely linked. Prolonged algal blooms, which occurred in the 1990s and in recent years, are of particular concern. To understand causes of these blooms and predict future effects of management changes, all major sources of nutrient influx to the system need to be quantified. Quantifying groundwater as a nutrient vector is difficult because groundwater is spatially non-uniform and temporally influenced by tides and meteorological events. Resistivity surveys in Florida Bay were conducted in wet and dry seasons to elucidate fine-scale spatial variability in potential groundwater connectivity by mapping the resistivity of groundwater and surface water. Preliminary results from the wet- and dry-season surveys indicate that little variability occurs in the areas surveyed. This indicates either that water exchange is uniform annually or that the groundwater signal does not vary enough for the resistivity to identify any preferential leakage along the coastline. Continuous resistivity-profile results are comparatively uniform between the northern shore, where fresh surface water flows into the bay, and the area of southern and eastern shores, where tidal pumping drives groundwater/surface-water exchange.

Both land-based and continuous resistivity-profile surveys were conducted in a series of lakes near Orlando, FL. The objective of the lake surveys was to utilize the resistivity data to map underlying geologic lithology and framework. Geologic control on lake hydrology remains poorly understood. Most of the lakes were formed by sinkholes. Composition of the geologic material (clays vs. sand) undoubtedly has an impact on how well a lake holds water. For instance, merged resistivity profiles in Lake Prevatt indicate well-defined zones of highly resistive layers that could be indicative of sands and low resistivity units that may be representative of clays. These units seem to correlate with sediment samples obtained from split spoons in test holes drilled in the lake bottom. Subsurface structure related to karst formation was identified in Lake Prevatt and several other surveyed lakes. Thickness and lateral continuity of the clay and sand units were identified in the resistivity profiles and may be used to estimate hydrologic parameters, such as leakage, once vertical hydraulic conductivity is determined.

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Understanding the Impacts of Extreme Storms on U.S. Coasts

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The USGS National Assessment of Coastal Change Hazards Project investigates the impacts of extreme storms with the ultimate objective of improving predictive capabilities. For the past decade, on the U.S. Pacific, Atlantic, and Gulf of Mexico coasts, we have used airborne lidar to acquire pre- and post-storm topography to quantify changes to impacted beaches, dunes, barrier islands, and sea cliffs. With its rapidity of acquisition and very high density, lidar has revolutionized the quantification of storm-induced coastal change. These data are being used to test state-of-the-art coastal-change models so that the magnitudes and spatial variability of future impacts can be understood and predicted.

Most recently, the National Assessment has focused on understanding hurricane impacts along the southeast coast of the U.S. For example, in 2004, we responded to all four of the hurricanes that made landfall in Florida. Each of these storms and their impacts were unique. Average shoreline change varied from approximately +1 to -20 m, and sand volume change ranged from -11 to -66 m^3/m. This variability in coastal change could not be simply explained by hurricane intensity, as described by the Saffir-Simpson Hurricane Scale. In fact, the most intense storm of the season, Hurricane Charley at Category 4, resulted in the lowest mean shoreline change, while the least intense, Hurricane Frances at Category 2, resulted in the second greatest mean shoreline retreat. In 2005, we determined that a barrier island off the eastern flank of Louisiana lost 86% of its surface area during Hurricane Katrina. Further, over 50% of the island's shore continued to erode rapidly for at least two years after the storm, pushing the island toward failure and ultimate disappearance.

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Flow Generated by a Partially Penetrating Well in a Leaky Two-Aquifer System with a Storative Semiconfining Layer

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The permeability of the semiconfining layers of the highly productive Floridan Aquifer System may be large enough to invalidate the assumptions of the leaky aquifer theory. These layers are the intermediate confining and the middle semiconfining units. The analysis of aquifer-test data with analytical solutions of the ground-water flow equation developed with the approximation of a low hydraulic conductivity ratio between the semiconfining layer and the aquifer may lead to inaccurate hydraulic parameters. An analytical solution is presented here for the flow generated by a partially penetrating well in a leaky two-aquifer system. Flows in the confined leaky aquifer, the overlying storative semiconfining layer, and the unconfined aquifer are derived. Horizontal and vertical flow components are assumed in the semiconfining layer. The boundary-value problem describing is solved analytically to provide a method to accurately determine the hydraulic parameters in the confined aquifer, semiconfining layer, and unconfined aquifer from aquifer-test data. Analysis of the drawdown data from an aquifer test performed in central Florida showed that the flow solution presented here for the semiconfining layer provides a better match and a more unique identification of the hydraulic parameters than an analytical solution that considers only vertical flow in the semiconfining layer.

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Mangrove Forests as Protection from Storm Surges and Tsunamis: Do the Data Support the Paradigm?

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Quiescent coastlines throughout the world's tropics and subtropics are dominated by mangrove forests. Unfortunately, mangroves are disappearing at an alarming rate due to development in the coastal zone, and they are considered a threatened marine ecosystem. Mangroves provide goods and services to humans including: provision of forest products, improved water quality, stabilization of shorelines, and support of commercial and recreational fisheries. Another service claimed for mangroves is that of providing protection from storm surges and tsunamis. Following the 2004 hurricane season in Florida and the tsunami in south Asia, numerous claims of a protective role for mangroves have been made. But is it real? What types of data have been put forward in support of this function?

I conducted a thorough review of the literature concerning mangrove forests to examine the history of the "Protection" paradigm. More importantly, I examined the types of data, and their analyses, that have been put forward to support the paradigm. One recent method of examining this question has involved the use of computer models of tsunamis and tsunami run-up (i.e. how far the tsunami moves inland). These models contain parameterizations of mangrove forest structure, including measures of average stem diameter and stem density, in order to calculate frictional resistance. Do the models accurately capture how real mangrove forests are structured? During the literature review I also searched for papers that reported values for mangrove forest structure, including stem diameters, stand densities, and basal areas.

Results of the literature search were revealing. Older books (prior to 1975) did not mention protection as a role played by mangrove forests. With two exceptions, neither did the early literature. Two short notes, published together in 1971, appear to be the source of the Protection paradigm. The authors had been requested to survey the mangroves in the mouth of the Ganges delta (the Sunderbans) following a catastrophic cyclone which had killed 500,000 – 750,000 people. Both authors very clearly stated that mangroves would not have stopped 9 m storm surges nor have provided complete protection, yet they are routinely quoted as saying the opposite.

Data from >200 mangrove stands world-wide show a fractal geometry: average stem diameter is significantly and negatively correlated with average stem density (r^2=.80). The parameterization of mangroves in hydrodynamic models was found to be unrepresentative of real-world forests. In one of the models that claimed a dampening of a tsunami by mangroves, the forest was modeled with a stem density of 160,000 stems/ha and a basal area of 804 m^2/ha. No mangrove forest anywhere in the world has this structure. I must conclude that the "protective" function of mangroves is unsubstantiated at the present time.

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Use of Microburns to Study Seasonal Effects of Fire on Cape Sable Seaside Sparrow Habitat

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The Cape Sable Seaside Sparrow (CSSS) is a federally listed endangered species whose habitat is the south Florida short-hydroperiod grassland known as marl or muhly prairie. Wildfire is a natural and necessary phenomenon in muhly prairies, but the interactions of fire and flooding can have profound effects on vegetation structure and composition. If fire is followed by flooding, high mortality of plants that normally resprout vigorously may result. Even though prescribed burning has been practiced in these seasonally flooded grasslands for many years, little research has been done to determine the importance of season of burning on post-fire recovery.

We were interested in observing the response of muhly prairie vegetation to experimental burns before, during, and after the CSSS nesting season to examine both community-level responses of vegetation and species-specific responses of sawgrass and muhly grass, often the dominant species. Large-scale prescribed burns are difficult and expensive to use in replicated experimental treatments; instead, we performed a series of micro-burns inside a cylindrical sheet-metal barrier (1.2 m diameter x 0.7 m tall) to constrain the burn area. This procedure enabled us to do a large number of burns in a single day.

In 2006, we carried out three seasonal burning treatments of winter (dry season), spring (transition from dry to wet season), and summer (wet season) burns at three sites in Everglades National Park. At one site, we included three additional burn treatments during the spring to increase the chances of burning near the beginning of the summer rains. Each treatment consisted of burning 15 prairie points and 15 muhly plants at each site. We measured the height of resprouting sawgrass (in the prairie points) and muhly weekly. Post-burn growth rates varied by site and season of burning. Muhly had more rapid initial post-fire regrowth than sawgrass. Sawgrass regrowth was more sensitive to drought than muhly, and muhly regrowth was more sensitive to flooding than sawgrass. Following the 2006 burns, we observed no mortality from flooding so, in 2007, we carried out a second series of eight microburn treatments from February to June at one site. There was little evidence of stress following burns from February through mid May, but there was 80% mortality of muhly plants burned on June 12 because the site was flooded by 12 cm of water within a week of the burn. At the community level, burns during a very dry period in 2006, and those followed soon by flooding in 2007, resulted in reduced total vegetation cover one to two years after burning. Because rapid recovery of vegetation cover after burning is beneficial to the CSSS, prescribed burning should generally avoid the spring, when prairies are likely to get flooded.

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Inundation Potential for Beaches along the United States Gulf and Southeast Atlantic Coasts

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Along much of the East and Gulf Coasts of the United States, hurricanes have been responsible for some of the most dramatic changes to our coastal environments – from the creation of large overwash deposits to the opening of new inlets. Strong winds associated with these tropical storms bring large waves and storm surges that force significant changes on fragile barrier islands. The impact of a hurricane on a beach is highly variable over both large and small stretches of coast. This spatially variable response to storms is partly due to longshore variability of the pre-storm beach morphology combined with variability in the offshore physical forcing. Using a storm-impact scaling model that compares the relative elevations of barrier-island morphology and storm-induced water levels, we can define the potential vulnerability of our Nation's barrier islands to extreme coastal change during a hurricane landfall.

The vulnerability of Gulf and southeast Atlantic barrier-island beaches to inundation and associated extreme coastal change during a direct hurricane landfall is assessed by comparing the elevations of storm-induced mean-water levels (storm surge and wave setup) to the elevations of the crest of the primary sand dune that defines the beach system. Storm-induced mean-water levels for Category 1-5 hurricanes are calculated as the sum of SLOSH (Seas, Lakes, and Overland Surges from Hurricanes) modeled storm surge and parameterized wave setup, based on SWAN models of maximum wave height for each category storm. Dune elevations are measured every 20 m along the coast with lidar surveys of beach topography. Maps detailing the inundation potential, the difference between the water level and dune elevations, for each category storm can be used by coastal managers to determine the relative vulnerability of barrier islands and to assess areas of a coastal community that are more susceptible to inundation and extreme storm-induced change.

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Biology and Geology of *Lophelia* Deep Reef Communities of the Northern Gulf of Mexico Continental Slope

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This study represents the first quantitative analysis of the fauna associated with *Lophelia* reefs in the Gulf of Mexico, and generally in the western North Atlantic. It also provides the first evidence of a distinctive mineralogical regime on Viosca Knoll. The biology and geology of *Lophelia pertusa* coral reefs and associated hard-bottom biotopes were investigated at two depth horizons (325m and 500m depth) on Viosca Knoll in the northern Gulf of Mexico. Megafauna was quantified from high-quality submersible digital video frame grabs using Coral Point Count software. Megafaunal assemblages classified by multivariate analyses of video data were used to characterize and differentiate the key biotopes used by fishes as either *Lophelia* coral 'Thicket', 'Rock' (3-D), 'Plate' (2-D), 'Plate/Chemo' (chemo-seeps) or 'Open' (soft substrate). Basal reef rock was analyzed for mineralogy via x-ray diffraction. Reef sand collected was analyzed to identify major biotic contributors to reef substrate. In striking contrast to *Lophelia* reefs in the Atlantic, 'Rubble' biotope was essentially absent in this study. *Lophelia* coral 'Thicket' biotope was extensively developed on the 500 m site. Mixed species oases comprised of *Lophelia*, black corals, sponges and other taxa occurred primarily on the 325 m site. Among structured biotopes, species richness was highest for 'Rock' biotope, and lowest on *Lophelia* 'Thicket'. Thus, contrary to expectations, *Lophelia* biotope in the northern Gulf of Mexico does not support a particularly rich megafaunal. Indeed, rarefaction analysis suggests species richness is highest on "Open' biotope, again contrary to expectations. The Viosca Knoll fish fauna consisted of at least 54 species, dominated by sit-and-wait and hover-and-wait carnivores and generalized mesocarnivores. Only one specialized microcarnivore, Grammicolepis brachiusculus, appears to be highly associated with *Lophelia* reefs. Radiometric determinations indicate an age of <400 yrs for contemporary *Lophelia* reefs, and of 25.0-26.0 ky for the overall *Lophelia* ecosystem in the northern Gulf of Mexico. These findings indicate that reefs flourished during the low sea-level stand of the Pleistocene Wisconsonian Glaciation. From the young age of contemporary reefs, relative to the much greater age of sub-fossil *Lophelia*, it may be hypothesized that reef-building has occurred episodically over geological time. X-ray diffraction of the typical black substrate rock revealed unexpected goethite mineralogy, whereas methanogenic carbonates had been anticipated in the area of methane seeps. The atypical rock substrate mineralogy, and the exclusive occurrence in the Gulf of Mexico of well-developed *Lophelia* reefs on Viosca Knoll suggest a uniquely favorable environmental context for reef development. The absence of coral mounds and of extensive rubble fields indicates a distinct difference relative to *Lophelia* reefs elsewhere in the world ocean. Soft substrates found on Viosca Knoll are biogenic sands, comprised predominantly of the eroded calcium carbonate shells, spines, and skeletons of reef inhabitants. Thus, *Lophelia* reefs do create a unique sedimentary regime very different from that of the surrounding abiogenic fine sediment of the open slope.

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Water-Quality Data Web Services—A Collaboration between USGS and USEPA

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The U.S. Geological Survey (USGS) and the U.S. Environmental Protection Agency (USEPA) have similar missions to collect and disseminate water-quality data to the Nation. Separate data bases have been created and maintained by each agency, with different public user interfaces. The USGS National Water Information System (NWIS) water-quality data base and the USEPA's STOrage and RETrieval (STORET) data base have fundamental differences in design that make it difficult for users to combine data from each source into a single format. In the past, USGS and USEPA attempted to resolve this problem by importing a copy of the USGS NWIS water-quality data base into USEPA's STORET data base. However, copied data are likely to become out-of-date because updates to the original data may not be made to the copied data set and the frequency the data are copied often is less than the frequency that updates are made in the source data base.

USGS and USEPA reached an agreement in 2003 to share water-quality data in a common format in order to resolve the problems caused by incompatibilities between the data bases. This agreement resulted in a project to create water-quality data web services. The goal of this project is to develop and agree upon a common format and terminology for site information and water-quality data, and to provide web services using this common format.

Once the project is completed, the water-quality data will be retrievable on-demand using the web services, and thus the user will be provided immediate, up-to-date information. Therefore, there will be no delay in obtaining the most recent data, nor risk of obtaining information that has been modified in the source data base subsequent to the copy. Use of consistent nomenclature ensures that identification of the measured substance or property, and the units-of-measure, for example, are consistently represented by each of the two web services. In addition, USGS and USEPA have enhanced the metadata describing the measurement results, leading to an improved ability to incorporate data from other agencies into water-quality studies.

The web services project will be completed by the end of 2008 and will be made available to the public. Once implemented, future projects may be developed that include creating a common web portal to access these services, addition of new data types, application development, and other enhancements.

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Evapotranspiration from Bahia Grass Pastures in West-Central Florida

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Evapotranspiration (ET) is a large, yet poorly quantified, part of the hydrologic cycle. The U. S. Geological Survey operates sites across Florida that measure ET over a variety of landscapes as part of a statewide ET network. Two of these sites, Ferris Farms in Floral City and Starkey Addition near Odessa, are in Bahia grass (*Papsalum notatum* Flugge) pastures. These two sites vary in depth to the water table. The water table at the Ferris Farms site is typically greater than 5 m deep and the water table at the Starkey site is typically less than 1 m deep. Because Bahia grass has roots only within about the top 0.5 m of soil, the location of the water table affects the ability of the grass to transpire. In addition, when the water table is at the surface, as sometimes occurs at the Starkey site, direct evaporation can occur. Bahia grass will go dormant during extended dry periods and during the winter months.

The combined effects of growth cycle, moisture availability, and energy input to the near-surface system control ET rates from pastures. Monthly rates between May 2003 and February 2005 ranged from 23 mm (Jan 2004) to 122 mm (June 2004) at the Starkey site, and from 19 to 97 mm at the Ferris Farms site for those same months. Monthly ET rates were consistently higher at the Starkey site except for July 2004, when ET at Ferris Farms was slightly higher (114 compared to 110 mm). Depending on water availability and the onset of the summer rainy season, peak ET occurs in June, if rains come early or if the water table is already elevated, or in July. Maximum incoming solar radiation, which ultimately drives ET, occurs in May. If water is not available, however, some energy is converted to sensible heat rather than latent heat (the energy equivalent of ET). In other words, energy goes into heating up the air rather than converting water from liquid to gas phase.

Annual ET rates at pastures in west-central Florida range from about 660 to 900 mm. As a percentage of annual rainfall, ET ranges from 46 to 88 percent, with the lower percentages corresponding to wetter years (rainfall exceeding 1600 mm). During droughts (annual rainfall less than 900 mm), annual ET from pastures in this area can be between 80 and 90 percent of rainfall, leaving little water to recharge surface- or ground-water systems.

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Examining Submarine Ground-Water Discharge into Florida Bay using ^{222}Rn and Continuous Resistivity Profiling

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Submarine ground-water discharge (SGD) estimates into Florida Bay remain one of the least understood and poorly constrained components in a water budget for this system. Research activities for this project included two parts. The first involved the use of a natural geochemical tracer (^{222}Rn) to examine potential (SGD) hotspots (^{222}Rn surveys) and to quantify total (saline water + freshwater component) SGD rates at select sites using ^{222}Rn time-series measurements. The second research component utilized marine continuous resistivity profiling (CRP) surveys to examine the subsurface salinity structure within Florida Bay sediments. To obtain a map of the ^{222}Rn distribution within our study site in Florida Bay, we set up a flow-through system on a small boat that consisted of a DGPS (with depth), a calibrated YSI CTD with a sampling rate of 0.5 min, and a submersible pump (z = 0.5 m) that continuously fed water into an air/water exchanger that was plumbed simultaneously into four RAD7 ^{222}Rn air monitors.

In addition to the radon measurements, we also ran continuous resistivity profiles (CRP) within our study site. This system consisted of an AGI SuperSting 8 channel receiver attached to a streamer cable that has 2 current (A,B) electrodes and 9 potential electrodes spaced 10m apart. A separate DGPS continuously sent position information to the SuperSting. To obtain local advective ground-water flux estimates, ^{222}Rn time-series experiments were deployed strategically positioned across hydrologic and geologic gradients within our study site. These time-series stations consisted of a submersible pump, a Solinist DIVER (to record continuous CTD parameters) and two RAD7 ^{222}Rn air monitors plumbed into an air/water exchanger. Time-series ^{222}Rn measurements were conducted for 3-4 days across several tidal excursions. Radon was also measured in the air during each sampling campaign by a dedicated RAD7. We obtained ground-water discharge information by setting up a ^{222}Rn mass balance that accounted for lateral and horizontal exchange and an appropriate ground-water ^{222}Rn endmember activity.

Results indicate that the ^{222}Rn maps provide a useful gauge of relative ground-water discharge into Florida Bay. The ^{222}Rn time-series measurements provide a reasonable estimate of site specific total (saline and fresh) ground-water discharge, and the saline nature of the shallow ground water underneath our study site, as evidenced by CPR results, indicate that most of this discharge must be recycled seawater. The CRP data show some interesting trends that appear to be corroborated with geologic and hydrologic observations. For example, some of the highest resistivity (electrical conductivity^{-1}) values were recorded where one would expect a slight subsurface freshening (e.g., bayside Key Largo, C111 canal).

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Holocene Paleoenvironmental Proxy Record Calibration for the Northern Gulf of Mexico

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A quantitative understanding of natural and anthropogenic influences on the Earth's climate system is necessary to anticipate future changes in climate. While paleoclimate reconstructions provide information regarding the timing and magnitude of natural climate variability, the accuracy of these constructions is dependent largely on the reliability of the proxies. In January 2008, a time-series sediment trap was deployed in the northern Gulf of Mexico at 27° 31′ N and 90° 21′ W in 1,200 m of water to measure the sediment geochemistry (carbonate, biogenic opal, organic carbon, terrigenous material) and planktonic foraminiferal assemblage and shell chemistry (stable isotope, Mg/Ca ratios) and for comparison with concurrent hydrographic and climatic observations. The results of this study will provide improved calibration of standard climate proxies leading to enhanced interpretation and correlation between marine and terrestrial paleoclimate records.

Results will be presented from weekly sediment-trap samples collected over a 6-month period from January through July 2008. Preliminary results for the first 3 months indicate total sediment mass and planktonic foraminiferal fluxes are highest in January and February with values up to 0.30 grams m^{-2} day^{-1} and ~145 shells m^{-2} day^{-1}, respectively. During this winter period, the assemblage is dominated by *Globorotalia truncatulinoides*, which makes up more than 60% of the assemblage, *Globigerina calida*, and *Pulleniatina obliquiloculata*. In the spring, total mass fluxes decrease to 0.07 grams m^{-2} day^{-1} and foraminiferal fluxes to ~30 shells m^{-2} day^{-1} as sea surface temperature increases. In addition, the spring assemblage is more diverse and is composed of *Globorotalia crassaformis*, *Globigerinoides ruber* (pink), *G. ruber* (white), *Globigerina rubescens*, *Globigerinita glutinata*, *Globigerinoides sacculifer*, and *Neogloboquadrina dutertrei*.

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Assessing Everglades Restoration Using Everglades Depth Estimation Network (EDEN)

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Successful restoration of the Everglades depends, in part, on restoring more natural volume, timing, and distribution of sheet flow in the wetlands and the corresponding response of the natural system to these changes. A primary product of the REstoration COordination and VERification (RECOVER) Monitoring and Assessment Plan (MAP) integrated hydrology monitoring effort is the Everglades Depth Estimation Network (EDEN), which provides much of the hydrologic data that underpins many of MAP's restoration hypotheses. Water depth and hydroperiod are important ecological drivers, and EDEN data and tools are used to retrieve, investigate, assess, and compare hydrologic data.

EDEN presents data for an integrated network of 253 gages that records the surface-water levels throughout Big Cypress National Preserve (BCNP), Everglades National Park (ENP), and the Water Conservation Areas (WCA) 1, 2 and 3. Data from multiple agencies, BCNP, ENP, and South Florida Water Management District (SFWMD) are combined with data from the USGS in the USGS National Water Information System (NWIS) database and then served near real-time to scientists, managers and the general public. Water-level data are also used to simulate daily water surfaces covering the greater Everglades. These water surfaces are available as GIS layers from January 1, 2000 through the 2008. These data, along with corresponding documentation, are available on the EDEN website (*http://sofia.usgs.gov/eden/*):

- Daily water surfaces are generated from daily median water level gage data
- Surfaces are created on a 400m by 400m grid in NetCDF and GeoTiff formats
- Water level surfaces are in units of centimeters
- Vertical datum is North American Vertical Datum of 1988 (NAVD 88)

By combining the daily water-level surfaces and the ground surface generated by the EDEN digital elevation model (DEM), a full suite of hydrologic data and formats for the Everglades are made available to scientists and others:

- Water depth
- Hydroperiod (computation of days since last dry)
- Water-surface slope
- Surfaces and landscape transects animated over time

Principal users are biologists and ecologists examining trophic- and landscape-level responses to hydrodynamic changes in the Everglades. EDEN can also be used to inform policy makers, planners, and decision-makers of the potential effects of water management and restoration scenarios on the natural resources of the Everglades.

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FISC Communications Team: Sharing Our Science with the Media, Partners, Educators, and the Public

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Scientists and researchers of the Florida Integrated Science Center (FISC) need to effectively disseminate news of their emerging scientific work and discovery among colleagues, partners, media, and the public. The U.S. Geological Survey (USGS) conducts timely, relevant, and impartial studies of the earth's landscape, natural resources and hazards with the core mission of providing unbiased, multidisciplinary science focusing on biology, geography, geology, geospatial, and water information. Successfully communicating USGS science is critical to supporting management decisions that guide National resource and hazards planning. Sharing the most recent USGS information with partners and the public at all levels is vital to fulfilling mission goals. To support broad international understanding of our scientists' work, it is imperative that USGS scientists successfully communicate with a variety of audiences about the important links between environmental resources, human health, economics, and their effects on society.

Traditionally, USGS studies provided information primarily to other scientists or resource managers. Today, these findings are relevant and helpful to community leaders, educators, and the media to cultivate awareness of earth science issues, and to promote understanding of policy and management decisions. Effective methods of timely communication will convey FISC expertise and capabilities, thus highlighting their scientific relevance and securing partnerships with universities, State and Federal agencies, and non-profit organizations.

The FISC communications team has three focus areas for communications efforts:

- Internal (USGS and FISC),
- External (the media), and
- Community relations (partners, policy makers and the public).

The Internet is the primary resource for externally communicating numerous USGS research topics and capabilities across disciplines to all audiences. Special publications and information products convey major concepts and findings to target audiences including resource managers and policy makers, the media, academia, informal educators, and the general public.

The FISC communications team is prepared to assist with identifying needs, developing approaches, and creating diverse, high-profile communications that put USGS science into relevant context for various audiences. These products include media advisories, news releases, web releases, and other multimedia materials, as well as information resources and fact sheets designed to reach a wide audience. In addition, FISC communications can assist with arranging

media interactions, training staff for effective response to media inquiries, working with partners on topics of shared media interest, developing strategies for handling sensitive topics, facilitating efforts for special events, creating visual products to illustrate scientific concepts, conducting media analysis, providing news briefs, presentations and information materials for decision makers and government officials, designing and reviewing communication materials, and serving as the point of contact with the USGS Regional and National Communications offices.

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Development of a Geodatabase for Preserving, Managing, and Analyzing Information for the Coastal Everglades

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To understand how events such as sea-level rise, recent hurricanes, and human impacts have affected the coastal Everglades, we must first have a basic understanding of historical conditions. To facilitate this endeavor, we have combined a digital archive of historical aerial photographs (1927–35, and 1940s) with 2004 Digital Orthophoto Quarter Quadrangles (DOQQs) for the Greater Everglades. In addition, we have been actively collecting data on mangrove vegetation, hydrology and sediment dynamics since 1992 from a network of co-located coastal sampling sites in Everglades National Park

Managing, analyzing, and manipulating this large dataset has proven difficult. To address these data management issues, we created a geodatabase in ArcGIS containing historic aerial photographs and 2004 DOQQs. We analyzed the historic aerial photos and modern DOQQs, and were able to create historic and modern habitat classification polygons and accompanying topology. By comparing these habitat polygons we were able to quantify the amount of habitat change and/or loss since the 1920s. In MS Access, we created a relational database with a user-friendly graphical user interface (GUI) for storing the mangrove vegetation data. In this relational database, we are able to conduct data QA/QC, query the database for details of vegetation growth, species mortality, recruitment, composition and basal area, and track changes in these parameters over time. In ArcGIS, we plotted individual tree data for each plot for each year sampled. Thereby, we could visually inspect the annual plot configuration and assess changes. To enhance analytical capabilities, we used ESRI's ModelBuilder to construct toolsets and scripts to calculate general statistics (e.g. minimum, maximum, mean, standard deviation) for parameters of interest [i.e. DBH (diameter at breast height) and basal area] for each species, plot and survey. Additionally, we calculated point pattern statistics such as nearest neighbor, and uni- and bivariate K-functions for the vegetation data. By conducting these statistical and spatial analyses, we can gain an insight into the effects that passage of major hurricanes (Andrew 1992, Wilma 2005), sea level rise, and human impacts have on the ecosystems of the Everglades while viewing actual annual vegetation plot configuration in ArcGIS. Collectively, these tools (MS Access database, ArcGIS model builder, and ArcGIS geodatabase) created a user-friendly environment in which to enter, query and analyze data.

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Documenting the Hydraulic Connection between Inland Sinkholes and Springs along Florida's Northwest Coast

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South of Tallahassee, along the coastline of the panhandle of Florida, a series of 13 springs discharge ground water from the Upper Floridan aquifer into Spring Creek, a small tidal creek that flows into the Gulf of Mexico. The freshwater to brackish flow discharging from these springs varies seasonally, altering both the net outflow and salinity of Spring Creek. The discharge from this group of coastal springs is controlled in part by streamflow occurring at two inland streams: Lost Creek and Fisher Creek, two streams in the karstic Woodville Plain of Wakulla County that flow into sinkholes. Ground-water discharge rates at another nearby spring, Wakulla Spring, have been correlated to streamflows into sinkholes in the adjacent area.

The U.S. Geological Survey, in cooperation with the Florida Department of Environmental Protection, began collecting long-term data in 2007 to better understand the relation between the Spring Creek Springs Group, Wakulla Spring, and Lost and Fisher Creeks. Stream discharge and salinity data were collected at the downstream end of Spring Creek, and discharge data were collected at Lost and Fisher Creeks to supplement ongoing data collection efforts at Wakulla Spring. Discharge measurements on tidally affected Spring Creek required Acoustic Doppler Current Profiler techniques. Data from all sites are available in real time at *http://waterdata.usgs.gov/fl/nwis/nwis*.

The timing and magnitude of streamflows following an exceptionally large rainfall event in late February 2008 provided potential evidence of a hydraulic connection between the two creeks and the coastal springs. Following rainfall of about 6.8 inches on February 21-22, streamflow at Lost Creek peaked at 1,900 ft^3/s on February 23, and streamflow at Fisher Creek peaked at 224 ft^3/s on February 26. The following day, on February 27, net daily discharge at the Spring Creek Springs Group peaked at 1,730 ft^3/s, a significant increase over the net daily discharge range from - 442 to 282 ft^3/s during the 3 weeks prior to the event. Dye injected into Fisher Creek emerged at Wakulla Spring, 10 days later, directly linking the two.

The flow increase at the Spring Creek Springs Group was accompanied by a salinity drop from a daily average of approximately 27 ppt before the event to about 2 ppt immediately afterwards. During the entire month of March, salinity at Spring Creek showed daily values of less than 10 ppt and daily discharge of up to 1,330 ft3/s. This increase in flow and decrease in salinity are attributed largely to increased recharge to the Upper Floridan aquifer at the sinkholes downstream of Lost Creek and Fisher Creek. Additional recharge to the Upper Floridan aquifer is occurring at smaller sinkholes in the region, and conduit flow from these karst features may also contribute to ground-water discharge from the Spring Creek Springs Group.

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U.S. Geological Survey, Florida Integrated Science Center, Borehole Geophysical Logging Program

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The borehole geophysical logging program at the U.S. Geological Survey-Florida Integrated Science Center (USGS-FISC) provides data to scientists and managers needed to resolve geologic, hydrologic, and environmental issues in Florida. The program includes the acquisition, processing, display, interpretation, and archiving of borehole geophysical data. Additionally, USGS-FISC can address a wide range of water issues in Florida using other USGS borehole, and land- and water-based near-surface geophysical tools available through the USGS Branch of Geophysics.

Although most borehole geophysical log acquisition is performed from a vehicle, equipment portability also provides for easy transport to remote well sites, such as those located in offshore marine or wetland environments. Well depths up to 3,280 ft and well diameters greater than 2 inches can be accommodated, providing access to all major aquifers in Florida, including much of the Floridan aquifer system.

In addition to acquiring standard borehole log data such as caliper, gamma, spontaneous potential, and electromagnetic induction, USGS-FISC utilizes new technologies and procedures to generate non-standard logs. An OBI-40 Mark IV™ optical televiewer is equipped with a high-resolution digital camera that creates a detailed 360-degree image of the borehole wall. The OBI-40™ digital borehole image can be used for: (1) accurate placement of well completion intervals, (2) positioning recovered core to its exact depth, (3) acquisition of a high-resolution borehole image that serves as a surrogate over those intervals having no core recovery, and (4) characterizing the pore system of aquifers. Fracture and bedding plane orientations can also be determined, as borehole images are oriented to the magnetic north pole. In combination with our new MATRIX™ log acquisition system, a digital borehole image can be acquired at relatively high logging speeds (about 3 to 15 ft/min, depending on desired pixel density).

Log presentation software (WellCAD™) is routinely used by USGS-FISC personnel to create 36-in wide, multilog, paper displays, that also can be viewed on a computer monitor using non-proprietary software readers (for example, Adobe Acrobat™ or WellCAD™ Reader). The USGS-FISC also provides assistance with importing borehole images and logs into reports. Other log processing and display software, such as Viewlog™ and LogCruncher™ are also available.

In addition to logging, USGS-FISC provides interpretive reports for recovered cores as well as construction of conceptual hydrostratigraphic frameworks. Planning, management, and analysis of tracer, aquifer performance, and other hydrologic tests are also available. Further assistance is available from USGS assets nationwide to assist in solution of any hydrologic problem.

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LASED and XSTORMS: Using a Geodatabase to Improve Data Management

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The U.S. Geological Survey, Florida Integrated Science Center - St. Petersburg, has developed a geodatabase system to manage decades of digital and analog data collected from the coastal zone. Presented here are two examples of project data that are managed by the geodatabase system: Louisiana Sediment and Environmental Database (LASED) and hurricane and extreme storm impact studies database (XSTORMS).

LASED is the result of combined efforts of the USGS and academic collaborators to manage geologic data from the Louisiana coastal zone. The database incorporates a wide range of data types (sediment-sample logs and analyses, geophysical profiles, raster-image basemaps, logbooks, etc.), which are integrated with spatial data to provide processing and visualization capabilities using standard GIS and Internet-browsing tools. The LASED data are stored using the ArcGIS Marine Data Model schema. The Marine Data Model was developed by the marine research community and provides templates to store spatial, tabular, and relationship data.

XSTORMS was initially developed to organize and present analog oblique aerial photographs and videos of the coast collected before and after extreme storms. These data are spatially linked so that pre- and post-storm comparisons can be made quickly and the results can be shared electronically via the project website (http://coastal.er.usgs.gov/hurricanes/). XSTORMS has now expanded to manage other project data, including LIDAR missions, and meteorological data associated with extreme-storm events, and to allow access via additional analysis software such as The MathWorks MATLAB.

An Oracle 10*g* database managed by ESRI's ArcSDE 9.1 Spatial Data Server software forms the core of the geodatabase. The database resides on an IBM xSeries server running Red Hat Enterprise Linux with an attached Apple Xserve RAID array. The geodatabase instance stores both raster and vector datasets. Other major components of the solution are numerous Web servers that link the spatial data to non-spatial data such as Web publications, project websites, logbooks, and other supplemental information and data products.

Benefits to storing project data in a geodatabase are numerous and include centralized data storage, routine backups and offsite storage, and integration of different data types. The geodatabase serves as a multi-user online data archive, a project resource and analysis tool. Access to the geodatabase is available to registered users via the USGS Intranet; access to LASED is available via the Internet at the following link: http://coastal.er.usgs.gov/lased/. XSTORMS pre- and post-extreme-storm photo comparisons, and selected post-storm photos are available via the project website. The complete collection of oblique aerial photographs from post-Hurricane Katrina surveys have been developed as compressed KML (.kmz) files and are available via the USGS Coastal Marine Geology Program InfoBank located at http://walrus.wr.usgs.gov/infobank/. The .kmz files can be imported into and viewed in Google Earth, ESRI's ArcGlobe, or NASA's WorldWind software.

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