Dawn Lavoie
USGS Science Coordinator:
Gulf of Mexico

April 23, 2009
Florida Integrated Science Center
Gainesville
St. Petersburg
Ft. Lauderdale

Science Centers
Upper Midwest Environmental
Patuxent Wildlife
Leetown
Wisconsin Water
National Wetlands Research
Louisiana Water
Columbia Environmental Research
Colorado Water
Mississippi Water
Texas Water
Menlo Park CMG
Santa Cruz CMG

Reston Teams
CMG Regional Investigations
Earth Surface Processes
Energy Resources Team

Hydrologic Instrumentation Facility

Regional Research Branch (W and E)

EROS Data Center

USGS Science Groups working on Gulf Coast Issues
Long term critical parameters:

- Coastal geomorphology & tide range.
- Wave height, relative SLR & coastal slope
- Subsidence

Short-term critical parameters:

- Erosion and accretion rates,
* Northern Gulf Coast Ecosystem Change and Hazard Susceptibility (NGOM) Project (USGS)

National Assessment of Coastal Change Hazards (USGS)

Barrier Island Comprehensive Monitoring (BICM: LCA S&T/ USGS)

Predicting the Resilience of the Chandeleur Islands (FWS)

Barrier Island Mapping: subaerial and submarine (NPS)

Coastal Vulnerability (NPS/USGS)

Marine Aggregate Resources and Processes (USGS)

Regional Sediment Transport & Modeling (USGS)

Gas Hydrates (USGS/DOE)
USGS R/V Gilbert With vibracore

Along Track Imaging System (ATRIS)
USGS Experimental Advanced Airborne Research Lidar (EAARL)

- Cross Environment Topo/Bathy Capabilities

- Detailed topography of Shallow Marine Substrates & Vegetated Canopies

- Precision navigation

- Digital camera photography (RGB and CIR)
A better understanding of the northern Gulf of Mexico coastal system, including human activities, is a basic requirement for sustainable restoration, redevelopment, and sound natural resource management strategies.

John C. Brock, John Barras, Charles Demas, James Flocks, Joyce Frye, Ioannis Georgiou, Dean Gesch, Collin Homer, Mark Kulp, Dawn Lavoie, Michael Miner, Robert Morton, Amar Nayegandhi, Richard Poore, Gregory Steyer, David Twichell, S. Jeffress Williams, and C. Wayne Wright
Goal - Determine the susceptibility of northern gulf region ecosystems and human communities to landscape change, and hazards due to severe storms now and into the next 100 yrs

Project Objectives

- **Past** - Reconstruct the Holocene geologic stratigraphy, paleoenvironments, climate, and sea-level histories. Evaluate the evolution of the NGOM landscape as a function of SLR, subsidence, storms & humans.

- **Present** - Provide a regional synthesis of present day NGOM ecosystems including human communities.

- **Future** - Forecast the vulnerability of NGOM ecosystems and human communities to severe storms (100 yrs)
Extreme coastal change

Island Area and Volume (% change)

\[ \Delta A = -84.4\% \]
\[ \Delta V = -91.7\% \]
EROSION

- 2 d to 2 m -> 53%
- 2 m to 12 m -> 57%
- 12 m to 22 m -> 69%
- 22 m to 34 m -> 54%

Post-Katrina Island Surface Area

<table>
<thead>
<tr>
<th>Time</th>
<th>Survey Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post Katrina</td>
<td></td>
</tr>
<tr>
<td>34 months</td>
<td>June 24, 2008</td>
</tr>
<tr>
<td>22 months</td>
<td>June 27-28, 2007</td>
</tr>
<tr>
<td>12 months</td>
<td>September 20-21, 2006</td>
</tr>
<tr>
<td>6 months</td>
<td>March 14-15, 2006</td>
</tr>
<tr>
<td>2 months</td>
<td>October 28-29, 2005</td>
</tr>
<tr>
<td>2 days</td>
<td>September 1&amp;4, 2005</td>
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</tbody>
</table>

Base photograph January 20, 2004
USGS DOQQ

0 100 250 500 meters
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Accretion:
- 2 d to 2 m -> 45%
- 2m to 12 m -> 43%
- 12m to 22m -> 30%
- 22m to 34m -> 46%
Data Coverage: seismics, cores, & bathymetry
Surficial Sediment Distribution

- 8 m isobath
- 2005 LIDAR
- Unit 1 - prodelta and delta-front
- Unit 2 - distributary channel
- Unit 3 - barrier island lithosome

Scale: 0 - 5 - 10 KILOMETERS

B - Unit 1 - Laminated facies

C - Unit 2 - Distributary channel facies

D - Unit 3 - Surficial sand facies

E - Gas horizon

Distributary channel facies
Base of channel
Chandeleur Islands
Seafloor Change:
1870s to 2007

Hewes Point:
150 x 10^6 m^3

South of Breton Is.:
155 x 10^6 m^3

Updrift of MRGO:
80 x 10^6 m^3

Shoreface:
-790 x 10^6 m^3

Backbarrier:
160 x 10^6 m^3

1870-2007 Totals:
erosion: -975 x 10^6 m^3
accretion: 680 x 10^6 m^3
Net change: -295 x 10^6 m^3
Summary and Implications

Sediment distribution
- Present islands ~ 28%
- Behind islands (shoreward) ~ 24%
- Northern spit (alongshore) ~ 48%

• Alongshore transport dominates over shoreward transport
• Relative importance of fair-weather transport vs. storm transport needs to be assessed
• Geologic setting provides accommodation space north of the islands for alongshore transported sediment that then is lost to the system

Isopach interval 2 m
Longshore transport rates from Ellis and Stone, 2006
Implications for Island Management

1. Spit growth narrowed inlet
2. Onshore bar migration closed inlet
3. continued sand nourishment from onshore bar migration

Quiescent Period: 1855 to 1996
1988 - begins a period of increased storm frequency

Increased Frequency Period: 1996 to 2005

Forecast Period: 2005 to 2037

\[ R^2 = 0.8468 \]
\[ R^2 = 0.7671 \]
Barrier Island Management Approach

- Lateral Spit Accretion Barrier Retreat
- Transgressive Submergence
- Natural Reworking Backbarrier Marsh Expansion
- Restoration

Map:
- Hewes Point Sand Thickness
  - 6-8 m
  - 8-10 m
- Sand reserve placement sites
- Initial nearshore sand infusion zone
- Dominant Longshore Sediment Transport

Legend:
- 2005 land
- 1922 land

USGS
Land Area Change in Coastal Louisiana: A Multidecadal Perspective (from 1956 to 2006)

- 1956 to 1978 Land Loss
- 1956 to 1978 Land Gain
- 1978 to 1995 Land Loss
- 1978 to 1995 Land Gain
- 1990 to 2001 Land Loss
- 1990 to 2001 Land Gain
- 2001 to 2004 Land Loss
- 2001 to 2004 Land Gain
- 2004 to 2006 New Water Areas
- 2004 to 2006 New Land Areas

- 2005 Land
- 2005 Water
- Fastlands: Agricultural, developed, and upland areas that are generally considered non-wetlands (Barras, 2006) and that are excluded from calculations of net land area change.
- LCA Area Not Included in the 1956 Data Coverage
- 2005 Hurricane Track

Physiographic Province Boundary

1 Data were filtered to depict larger areas of loss and gain greater than 3.5 acres (1.4 ha) in size and to remove noise and increase the confidence of the depicted trends.

2 Data were filtered to depict areas of loss and gain greater than 2.8 acres (1.3 ha) in size to remove noise and to increase confidence in the depicted trends.
Multi-temporal & Multi-scale Assessment

Landsat TM Path 22 Rows 39-40
• Acquired in 30-40 seconds
Marine Aggregates

usSEABED/LASED Cores & Samples

Legend:
- Gravel/Sand/Mud Data
- Drilled Data
- Geophysical Data
- USSEABED Data

Gravel/Sand/Mud Percentage

Texas
Louisiana
Mississippi

Texas
Louisiana
Mississippi

Shoestring Classification - Pored/Unporeded Data

Gulf of Mexico
Barrier Island Comprehensive Monitoring (BICM)

Shoreline Change/Land Loss  Habitat Change  Bathymetric Change

Trinity & East Islands, east half
Green colors represent accretion while
red colors represent erosion.
Gray color represent the 2002 lidar
data in gray scale.

Topographic Change

Topo/Bathy Surveys
Habitat Mapping
Land Loss
Sediment Characterization
Vegetation Characterization

SHORELINE CHANGES OF NORTH CHANDELEUR ISLAND, LOUISIANA, FROM 1855 TO 2005
Louisiana Barrier Island Comprehensive Monitoring Program (BICM)
2006
Moving East

From Bob Morton, Historical Changes in the Mississippi-Alabama Barrier Islands and the Roles of Extreme Storms, Sea Level and Human Activities
Gulf Islands National Seashore, Mississippi. 2008 USGS bathymetric/subbottom coverage, East and West Ship Islands, Dog Keys Pass, and Horn Island

High-resolution swath backscatter imagery

Submerged aquatic vegetation, East Ship Is.

Horn Island prograding into Dog Keys Pass

High-resolution single-channel seismic profile
Post hurricanes Gustav/Ike storm-impact resurvey

NOAA imagery of East Ship Island following Hurricane Gustav

Post Hurricanes Ike and Gustav bathymetric survey tracklines, completed September, 2008

Seafloor swath imagery: sand waves

View of photograph (below)

East Ship Island after Hurricanes Gustav and Ike

overwash
Ship Island: habitat classification

Ship Island: preliminary seafloor characterization (e.g. seagrass)
Moving East

Planned NGOM 2009 survey area

Potential resources sites (shoals, spoil banks)

Proposed MsCIP placement site

2008 survey area

Planned 2009 survey area