

Assessment of Beach Erosion and Impacts to Borrow Sites Associated with a Beach Nourishment Project in South Carolina, USA

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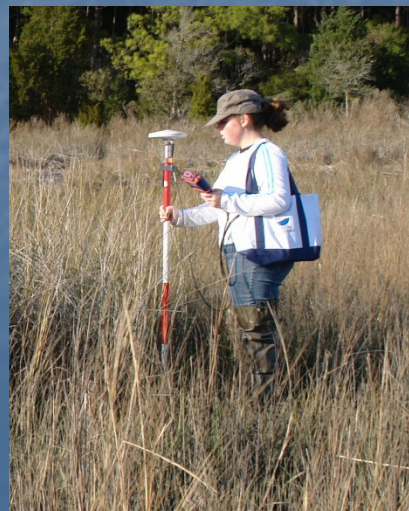
Contributors



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Funding: US Army Corps of Engineers, DHEC Ocean and Coastal Resource Management, Horry County, City of North Myrtle Beach, SC Sea Grant



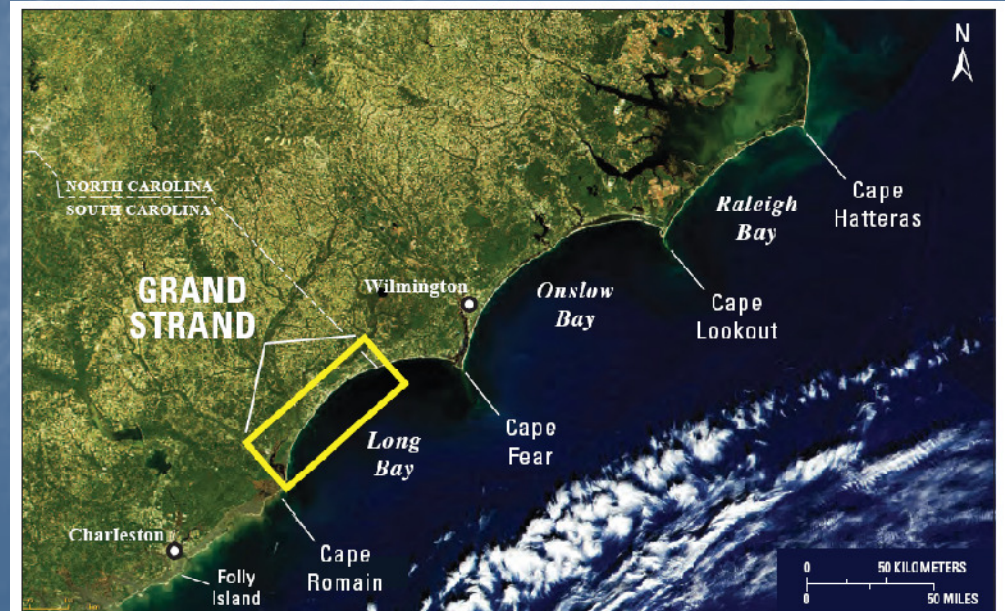
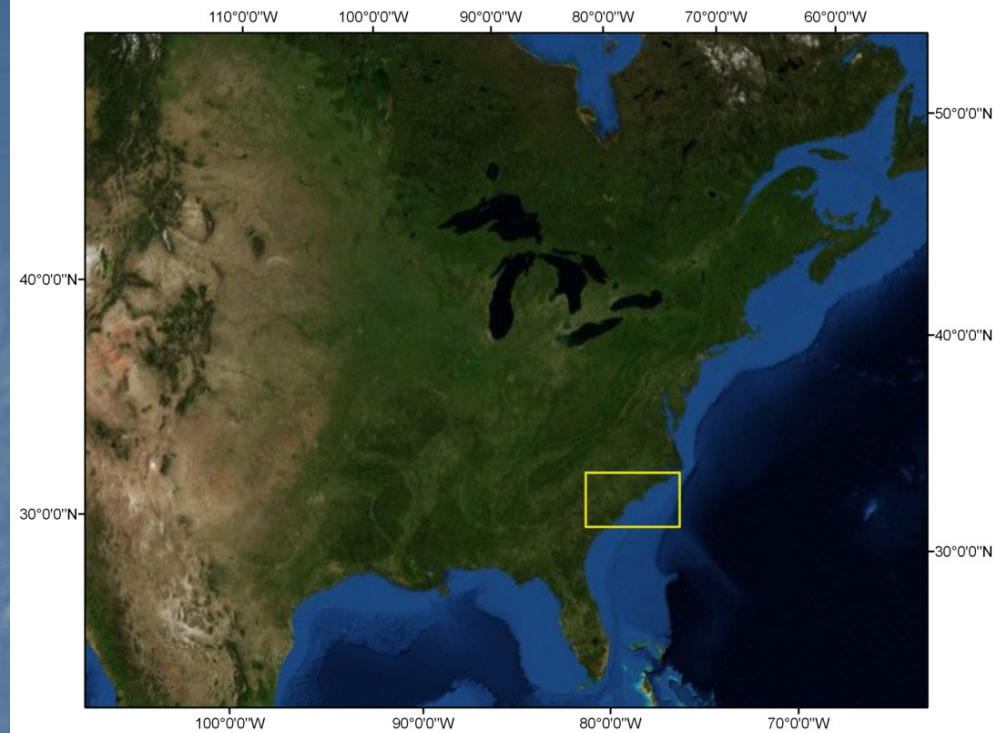
Goal: To assess shoreline change and coastal sediment dynamics associated with the Grand Strand beach nourishment project.

Outline

- Background information
- Beachfront management in South Carolina
- **Preliminary data** from 2007-2009 beach nourishment monitoring and research
 - Beach profiles
 - Mean High Water surveys
 - Borrow site bathymetry and side scan sonar
 - Aerial photography
 - Beach cameras

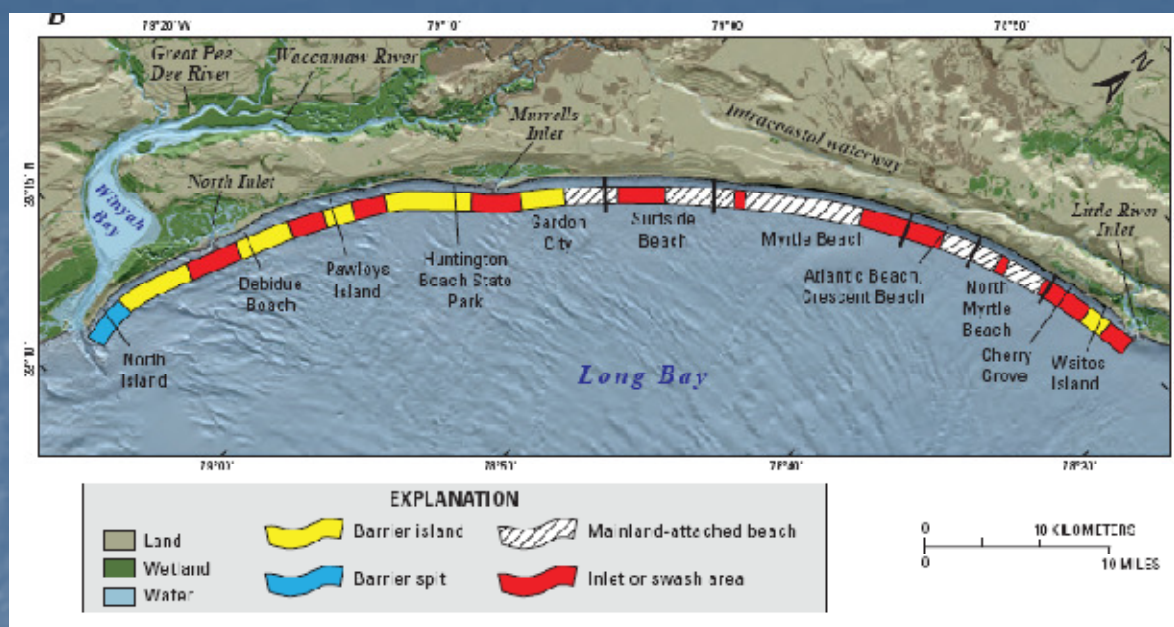
Study Site

- East coast of the United States
 - South Atlantic Bight
 - Long Bay
-
- Shallow coastal embayment
 - 100 km to shelf break
 - 1.5 m tidal range
 - Average wave height < 1 m



Grand Strand Region

- 5 mainland attached beaches along 60 km of shoreline
- Several barrier islands north and south of mainland attached beaches
- 13 million visitors annually
- \$5.8 billion economic impact



(Barnhardt et al., 2009)

Horry County Population (1970 – 2004)¹

| County | 1970 | 1990 | 2000 | 2004 | % change ('70 – '04) |
|--------|--------|---------|---------|---------|----------------------|
| Horry | 69,992 | 144,053 | 196,629 | 217,608 | 311 |

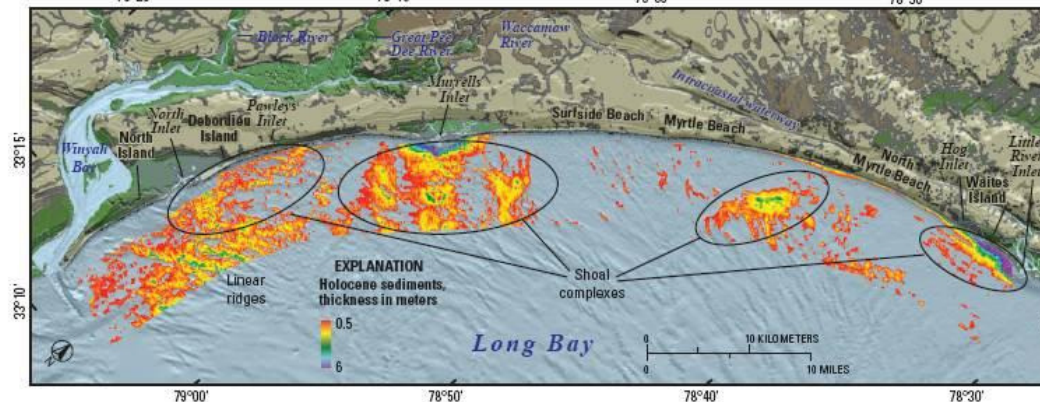
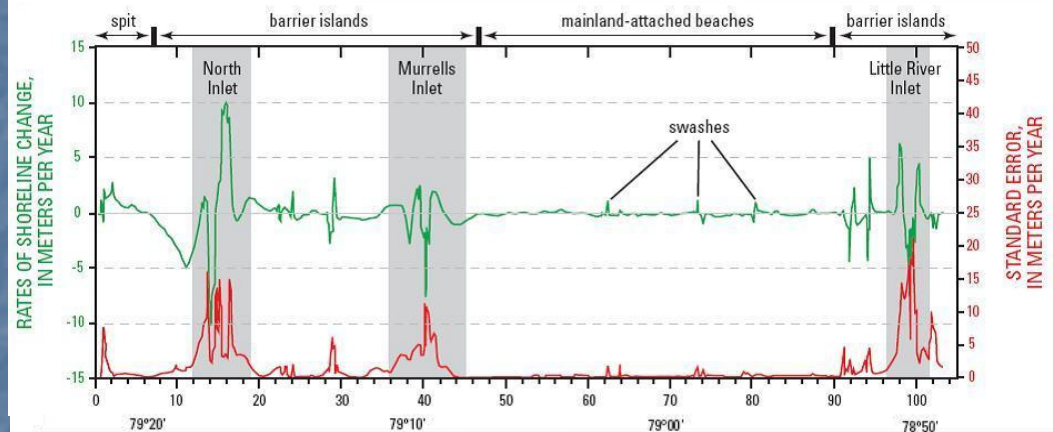
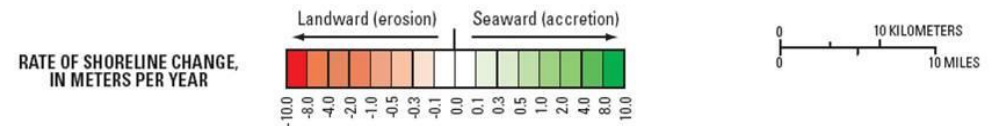
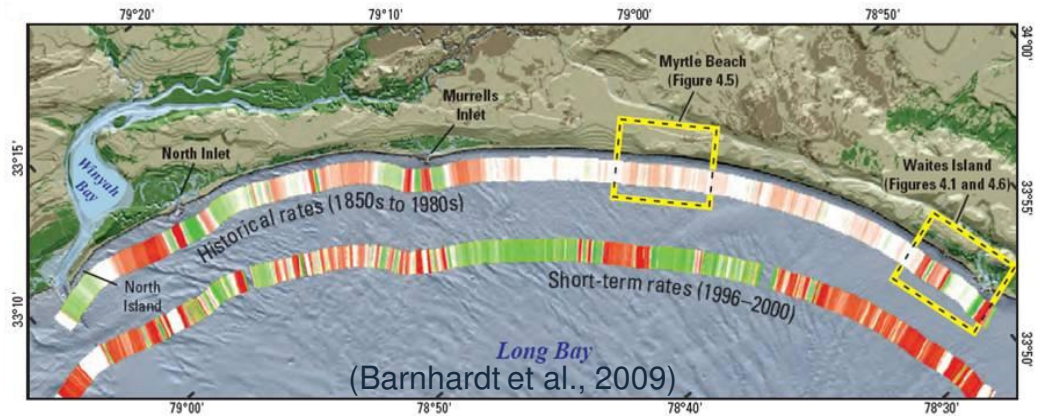
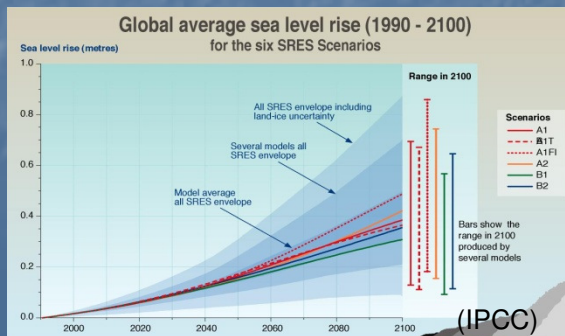


¹Marineconomics.noaa.gov/socioeconomics/CZCounties/cz_pop_housing/state_pages/CZ_SC.html

Management Questions:

1. Where are sand resources?
2. What are the implications of coastal processes and sea level rise?

- Sea level rise = 0.52 m/100 years
- Long-term minor erosion rates on mainland attached beaches (0-0.2 m yr⁻¹)
- Mainland-attached beaches slightly accretional over last 20 years (beach nourishment)
- Sediment starved continental shelf
- Net sediment transport to southwest



Regional Beach Management

- Hard stabilization structures outlawed in late 1980s
- Beach nourishment primary erosion control method
- 3 projects: 1986, 1996, 2008
- 2008:
 - 3 “borrow” sites
 - 2.3 million m³ of sand placed over 50 km of shoreline
 - 30 – 125 m³ m⁻¹
 - \$30 million total cost

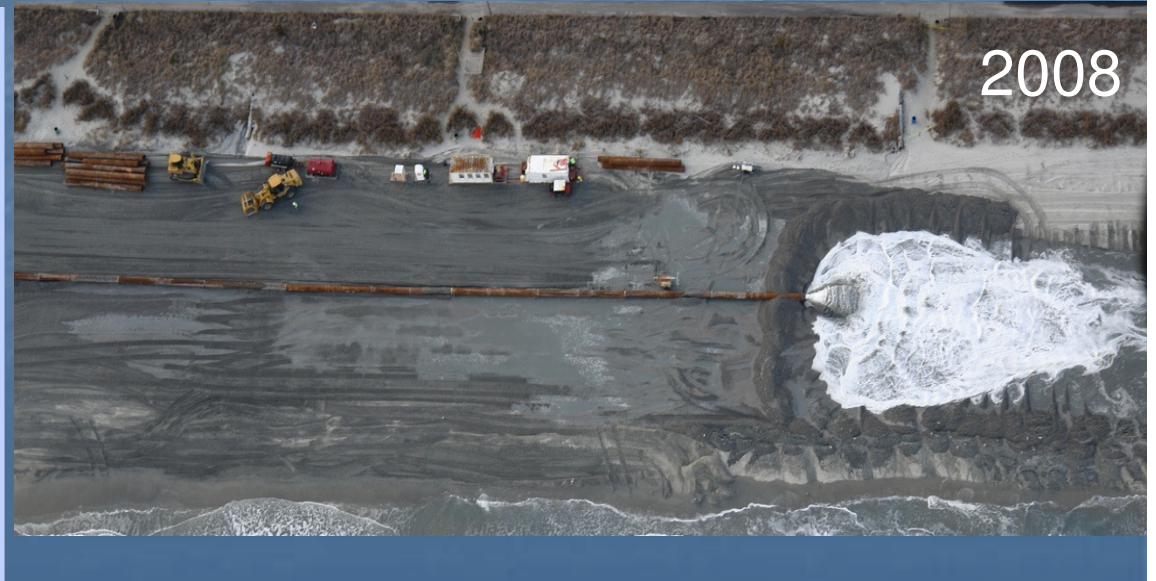


1986

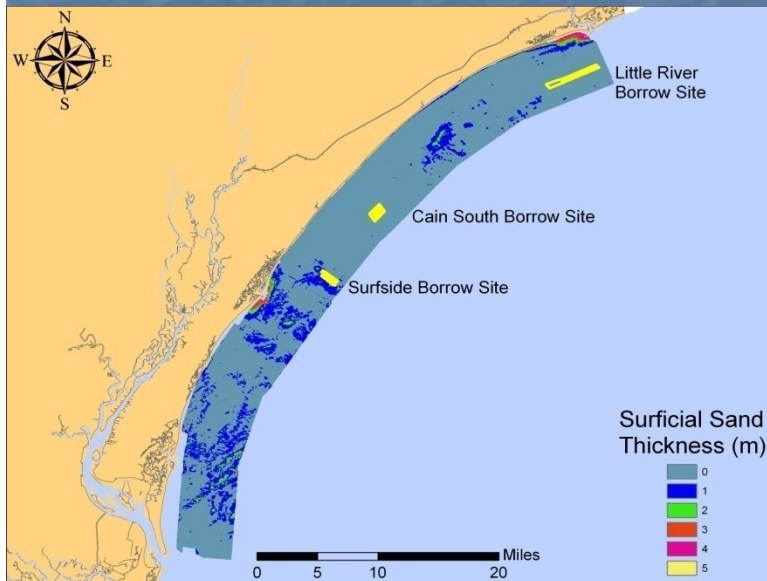


1996

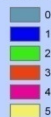
(photo: B. Eiser) 10:22'96



2008



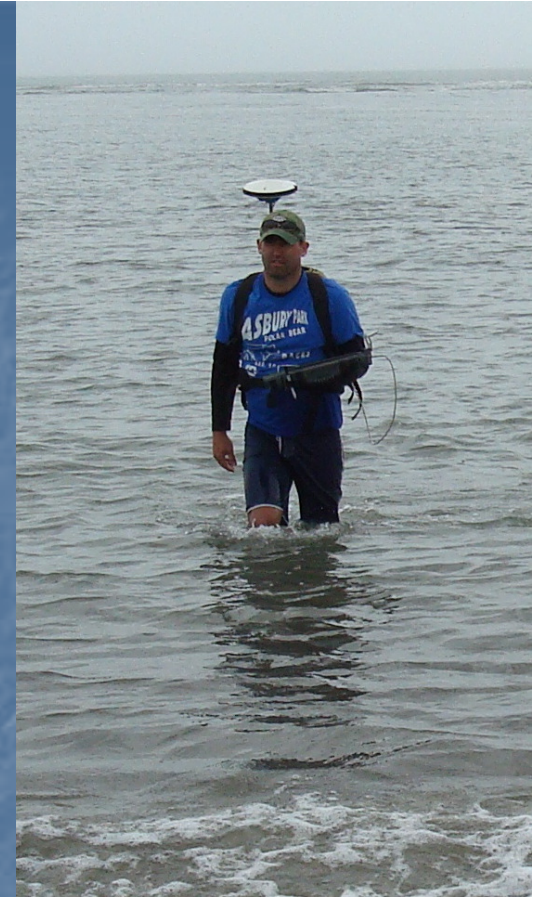
Surficial Sand Thickness (m)



0 5 10 20 Miles

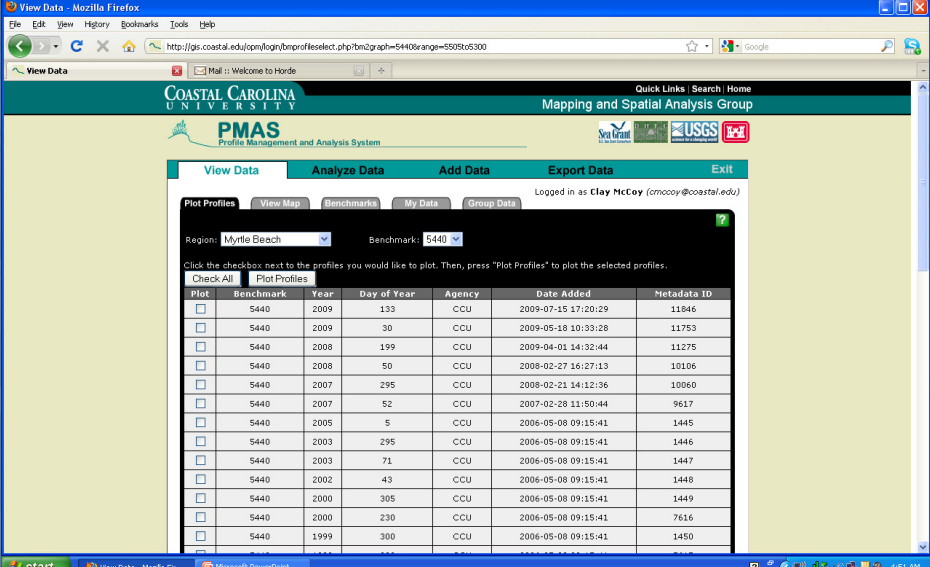
Methods

- Project began Oct. '07, data collection will be completed Feb. '10
- Beach profiles, shoreline surveys – RTK GPS (<5 cm accuracy), Hypack software
- Nearshore bathymetry - R/V Arial - Rigid Hull Inflatable with RTK-GPS, MRU, survey-grade fathometer
- Side Scan Sonar – R/V Privateer – Klein 3000 Dual Frequency (100, 500 kHz) towfish
- Aerial photography – Cessna, 10 MP camera, Panarama software, ArcMap
- Beach cameras – Erdman Video Systems



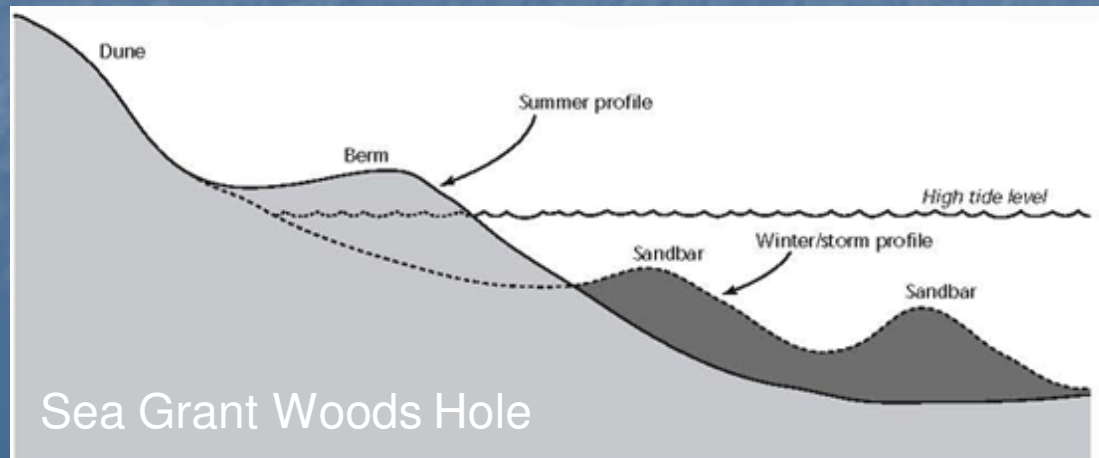
Beach Profiles

- Beach Profile - Shore perpendicular transect across the beachface from landward toe of primary dune to 1000 m offshore
- Online database of profiles collected annually throughout state of SC since 1988 available at gis.coastal.edu
 - used to assess volume change, movement of elevation contours, sediment transport, effectiveness of nourishment projects
- Winter vs. summer beaches
 - calmer summer conditions generally build the berm and upper beach face
 - winter conditions generally erode berm and deposit sediments in nearshore bar



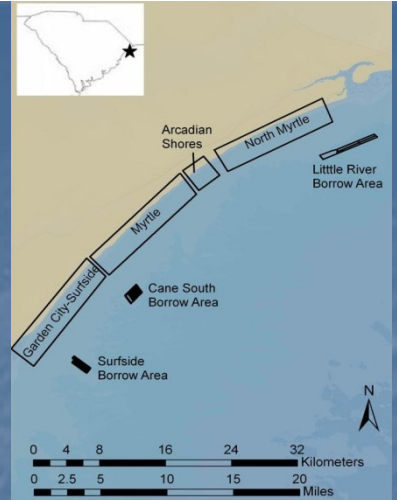
The screenshot shows the PMAS (Profile Management and Analysis System) web interface. The user is logged in as Clay McCoy. The interface includes a navigation menu with options like 'View Data', 'Analyze Data', 'Add Data', 'Export Data', and 'Exit'. A table of profile data is displayed for the 'Myrtle Beach' region and benchmark '5440'. The table columns are Plot, Benchmark, Year, Day of Year, Agency, Date Added, and Metadata ID.

| Plot | Benchmark | Year | Day of Year | Agency | Date Added | Metadata ID |
|--------------------------|-----------|------|-------------|--------|---------------------|-------------|
| <input type="checkbox"/> | 5440 | 2009 | 133 | CCU | 2009-07-15 17:20:29 | 11846 |
| <input type="checkbox"/> | 5440 | 2009 | 30 | CCU | 2009-05-18 10:33:28 | 11753 |
| <input type="checkbox"/> | 5440 | 2008 | 199 | CCU | 2009-04-01 14:32:44 | 11275 |
| <input type="checkbox"/> | 5440 | 2008 | 50 | CCU | 2008-02-27 16:27:13 | 10106 |
| <input type="checkbox"/> | 5440 | 2007 | 295 | CCU | 2008-02-21 14:12:36 | 10060 |
| <input type="checkbox"/> | 5440 | 2007 | 52 | CCU | 2007-02-28 11:50:44 | 9617 |
| <input type="checkbox"/> | 5440 | 2005 | 5 | CCU | 2006-05-08 09:15:41 | 1445 |
| <input type="checkbox"/> | 5440 | 2003 | 295 | CCU | 2006-05-08 09:15:41 | 1446 |
| <input type="checkbox"/> | 5440 | 2003 | 71 | CCU | 2006-05-08 09:15:41 | 1447 |
| <input type="checkbox"/> | 5440 | 2002 | 43 | CCU | 2006-05-08 09:15:41 | 1448 |
| <input type="checkbox"/> | 5440 | 2000 | 305 | CCU | 2006-05-08 09:15:41 | 1449 |
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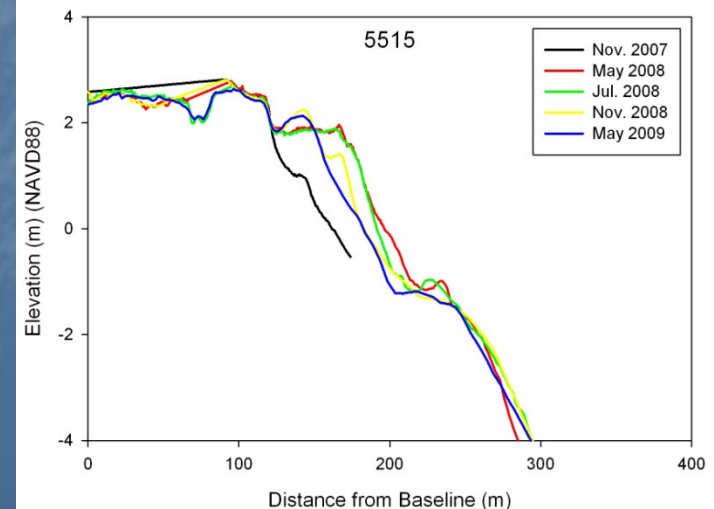
Arcadian Shores

- 150,000 m³ of sand placed above MLW over 1.2 km (120 m³ m⁻¹) in Feb. '08
- 56 - 60 % of sand remaining above MHW, MSL, MLW contours after 15 months
- Additional data suggests some recovery over summer 2009 in northern half of nourished beach



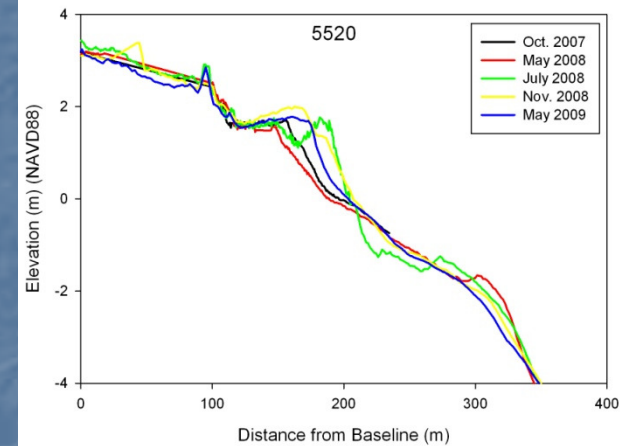
Volume Change Relative to Pre-Nourishment

| 5515 | MHW | MSL | MLW |
|-----------|-----------------------------------|-----------------------------------|-----------------------------------|
| | (m ³ m ⁻¹) | (m ³ m ⁻¹) | (m ³ m ⁻¹) |
| May 2008 | 57.4 | 85.0 | 110.5 |
| Jul. 2008 | 53.4 | 78.8 | 97.7 |
| Nov. 2008 | 44.1 | 62.0 | 78.1 |
| May 2009 | 33.2 | 49.6 | 63.5 |



Arcadian Shores

- Sediment transport to north and south (tidal creek)
- $20 \text{ m}^3 \text{ m}^{-1}$ more sand above MSL after 15 months at profile 300 m to north
- Slight accretion at MHW contour from May '09 through summer '09



Volume Change Relative to Pre-Nourishment

| 5520 | MHW | MSL | MLW |
|-----------|---------------------------------|---------------------------------|---------------------------------|
| | ($\text{m}^3 \text{ m}^{-1}$) | ($\text{m}^3 \text{ m}^{-1}$) | ($\text{m}^3 \text{ m}^{-1}$) |
| May 2008 | -10.4 | -14.9 | -18.3 |
| Jul. 2008 | 20.6 | 31.4 | 21.7 |
| Nov. 2008 | 32.7 | 45.0 | 43.1 |
| May 2009 | 14.5 | 20.9 | 20.2 |

Arcadian Shores - MHW Surveys

- Bracket MHW (0.65 m, NAVD88) contour with RTK GPS attached to ATV
- Tidal inlet processes impacting adjacent shoreline dynamics is
- Calculate shoreline change rates with Digital Shoreline Analysis Software

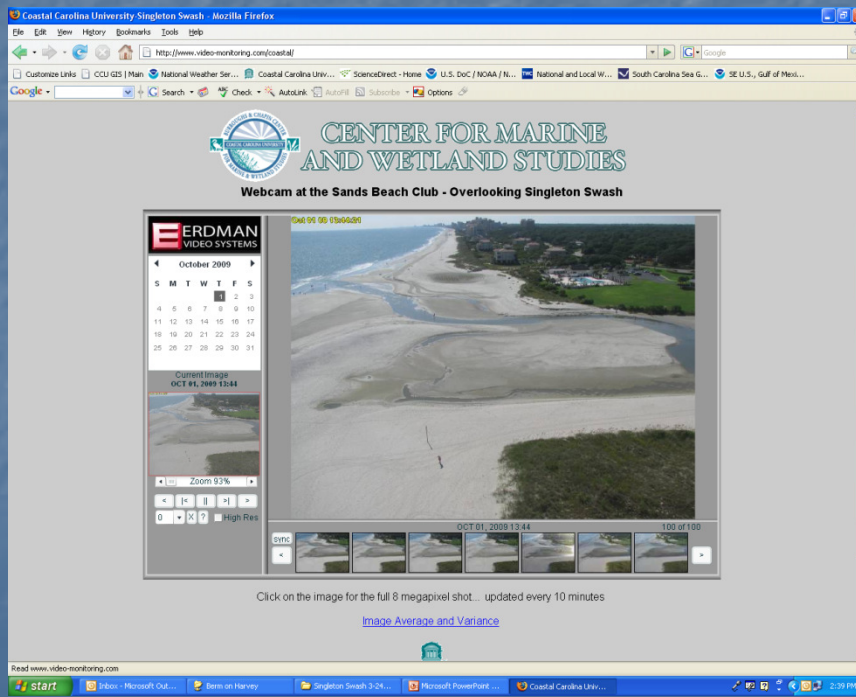
Movement of MHW Contour Relative to Nov. 2006 Location

| Transect | 1-5 | 6-10 | 11-15 | 16-20 | 21-25 |
|----------|------|-------|-------|-------|-------|
| | (m) | (m) | (m) | (m) | (m) |
| Feb 2008 | -6.0 | -13.9 | -6.1 | -0.8 | -6.2 |
| Apr 2008 | 37.3 | 33.3 | 9.6 | | |
| Apr 2009 | 19.3 | 14.7 | 10.9 | 0.4 | -4.7 |
| Aug 2009 | 14.9 | 20.0 | 22.9 | 6.8 | 0.5 |



Beach Camera – Singleton Swash

- Solar powered
- Programmed to take picture every 30 minutes
- Upload to CCU server via broadband card
- Available online
- Working to digitize wet-dry lines for analysis of swash evolution



<http://www.video-monitoring.com/coastal/>

<https://bcmw.coastal.edu/beach-erosion-research-and-monitoring-berm/beach-cameras>

Mar 18 09 17:28:16



March '09

Jun 19 09 13:04:53



June '09

Oct 01 09 09:27:38



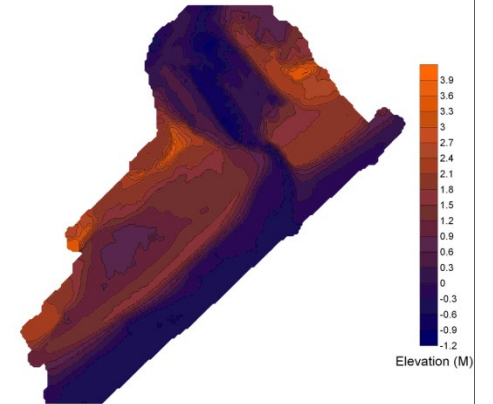
Sept. '09

Nov 08 09 09:29:20

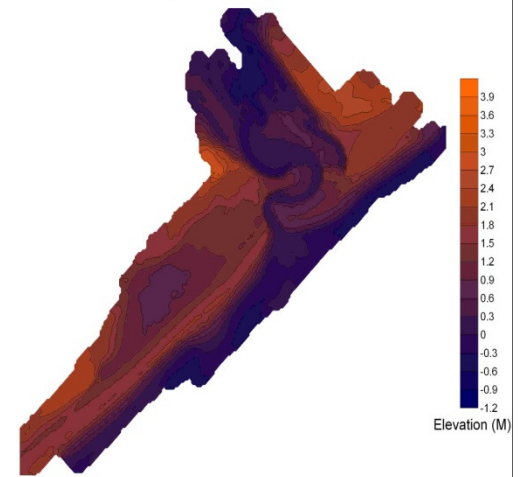


Nov. '09

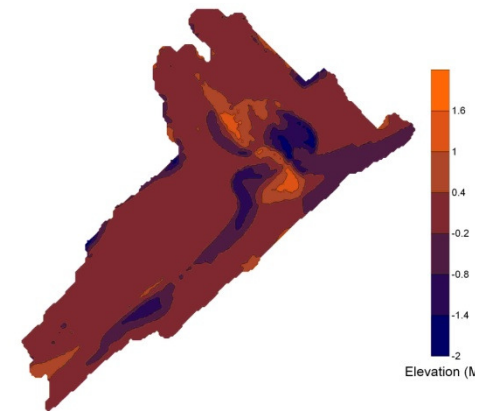
Singleton Swash April 2009



Singleton Swash June 2009



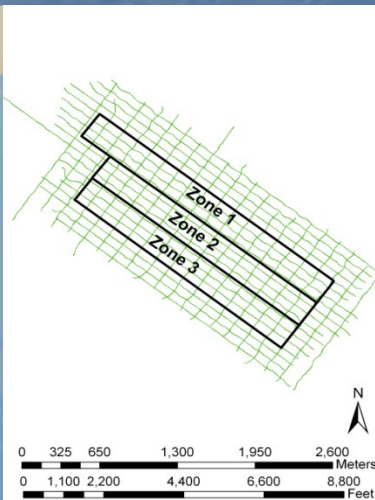
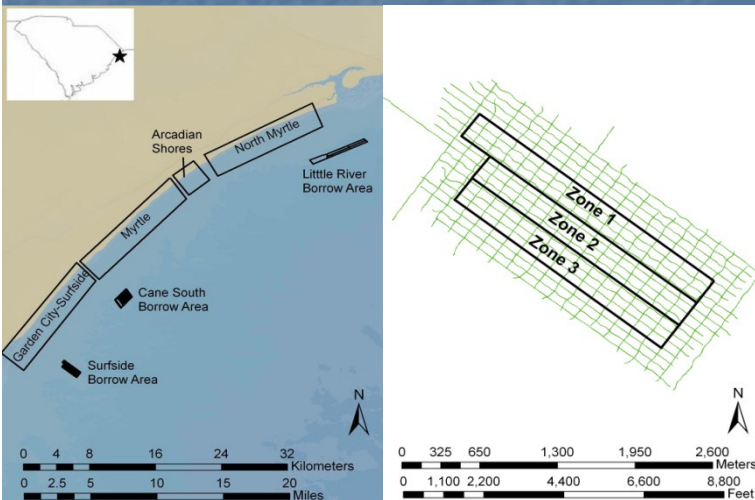
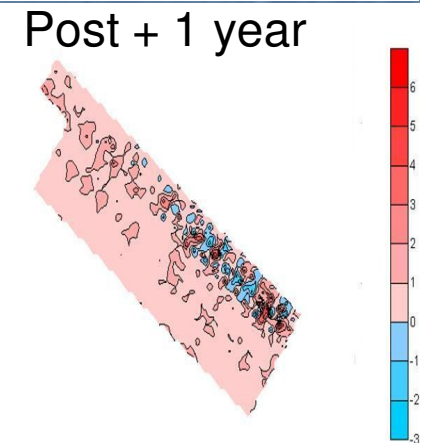
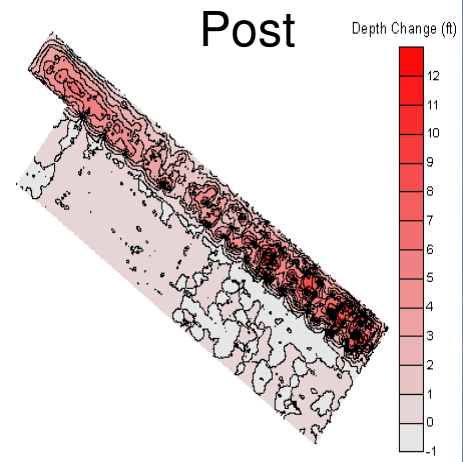
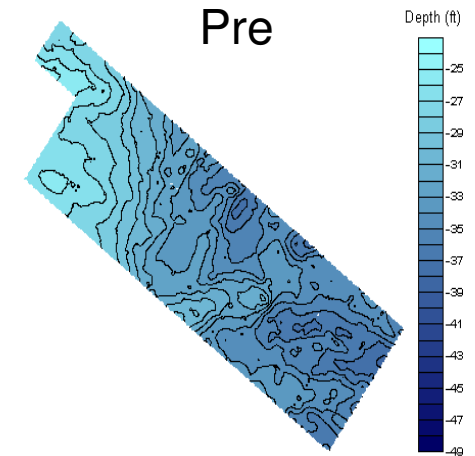
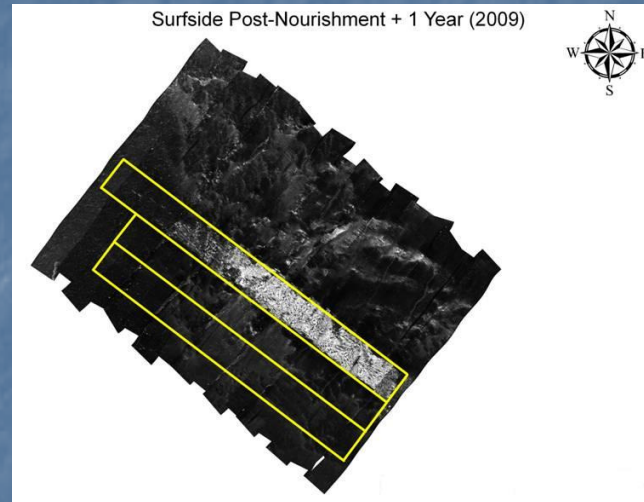
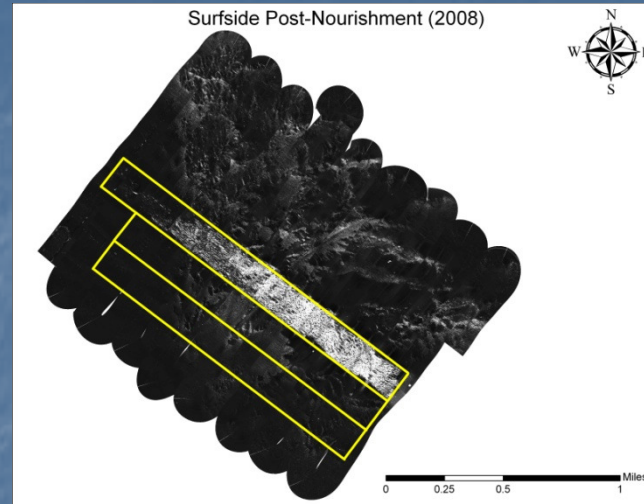
Singleton Swash Difference Map



- Migration of inlet to the south
- Infilling of inlet

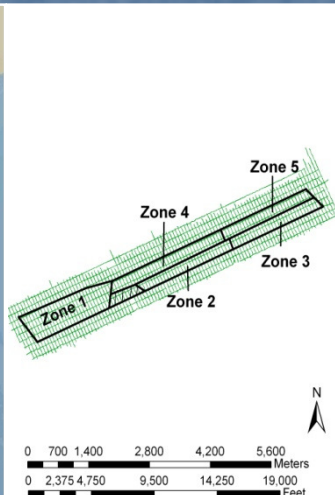
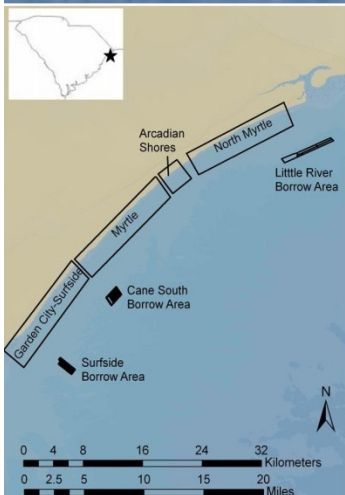
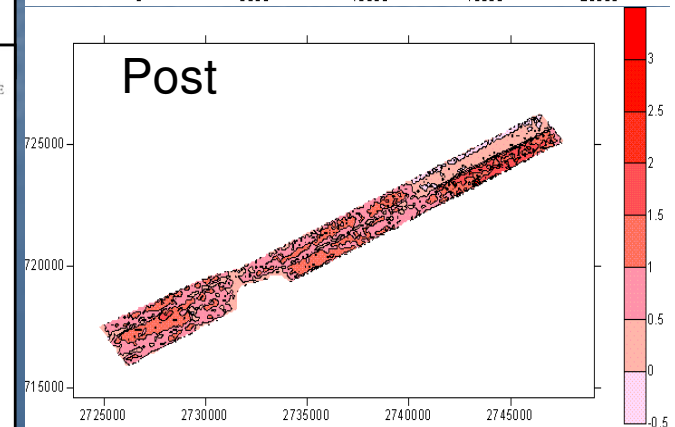
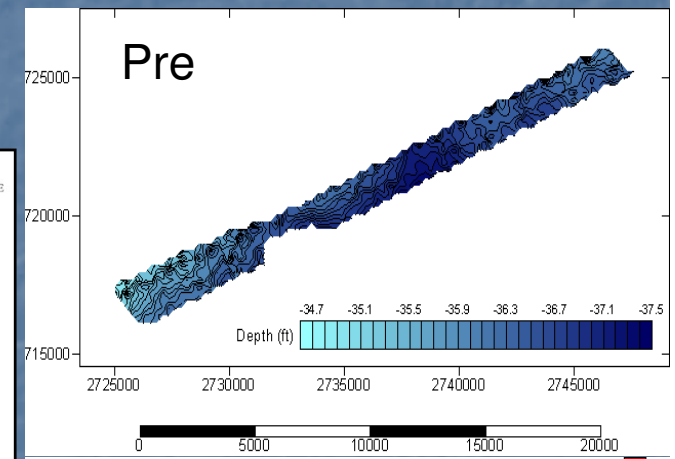
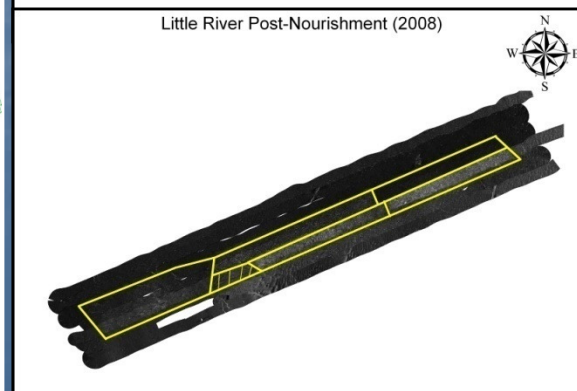
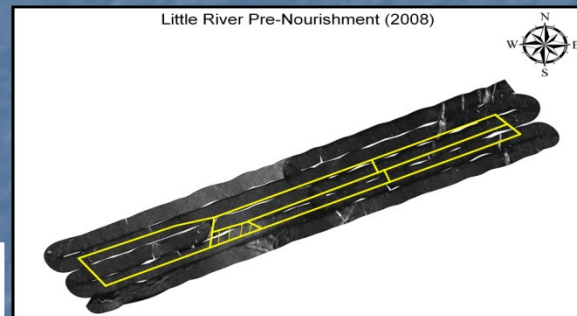
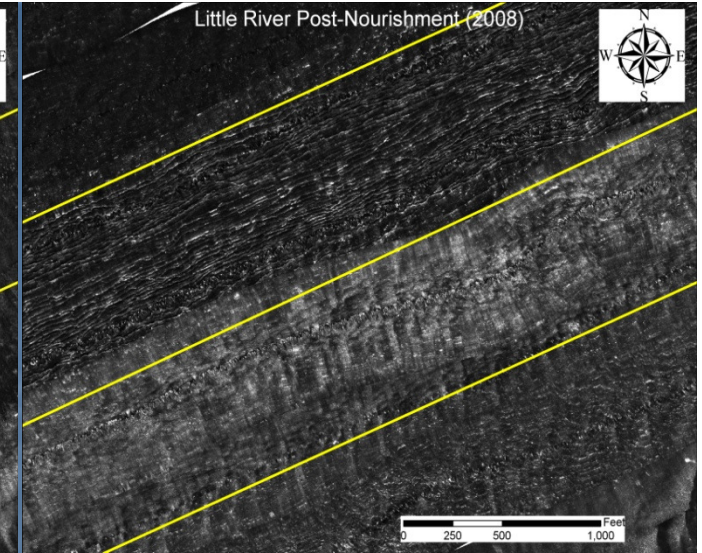
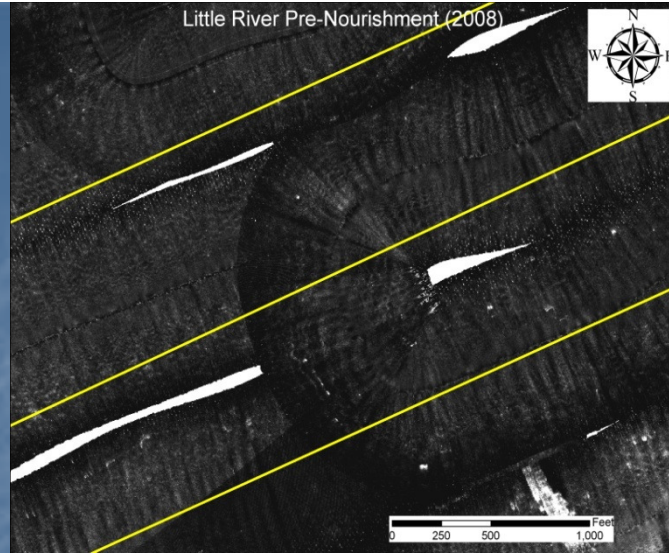
Borrow Sites - Surfside

- Pre, post, post + 1 year assessments
- 60m x 60m grid spacing
- Removed 700,000 m³ of sediment to depth of -4m
- Initial infill typically silt and mud along SC coast
- Coordinate with Dept. of Natural Resources for sediment samples

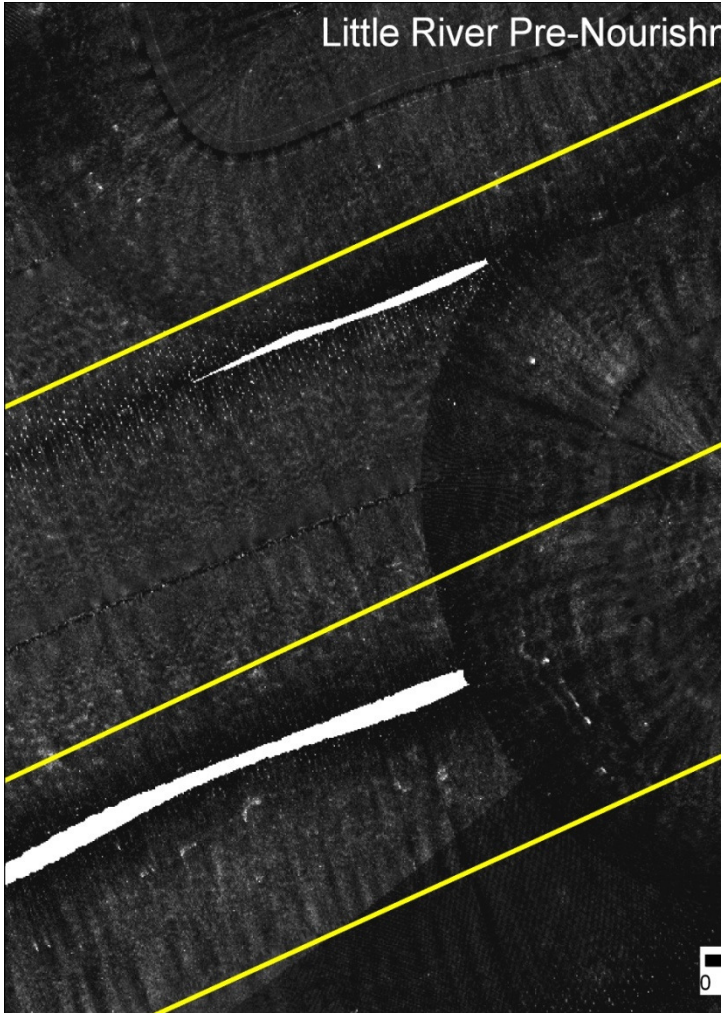


Little River

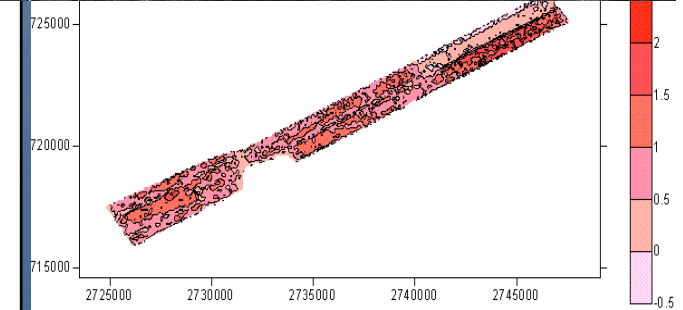
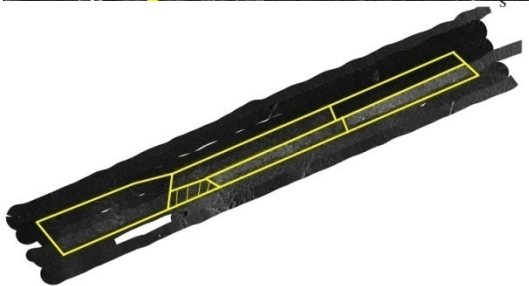
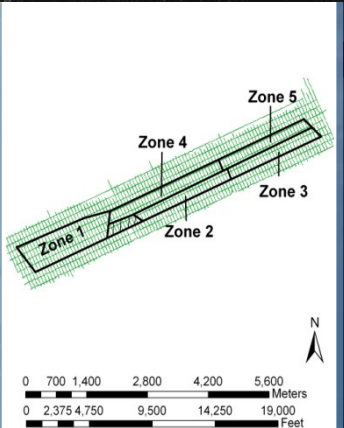
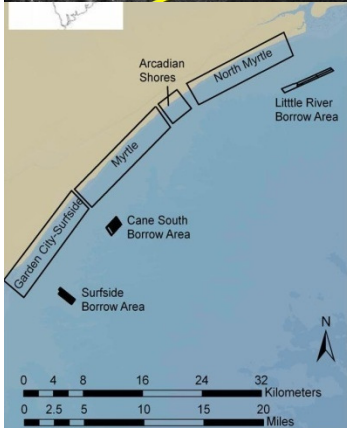
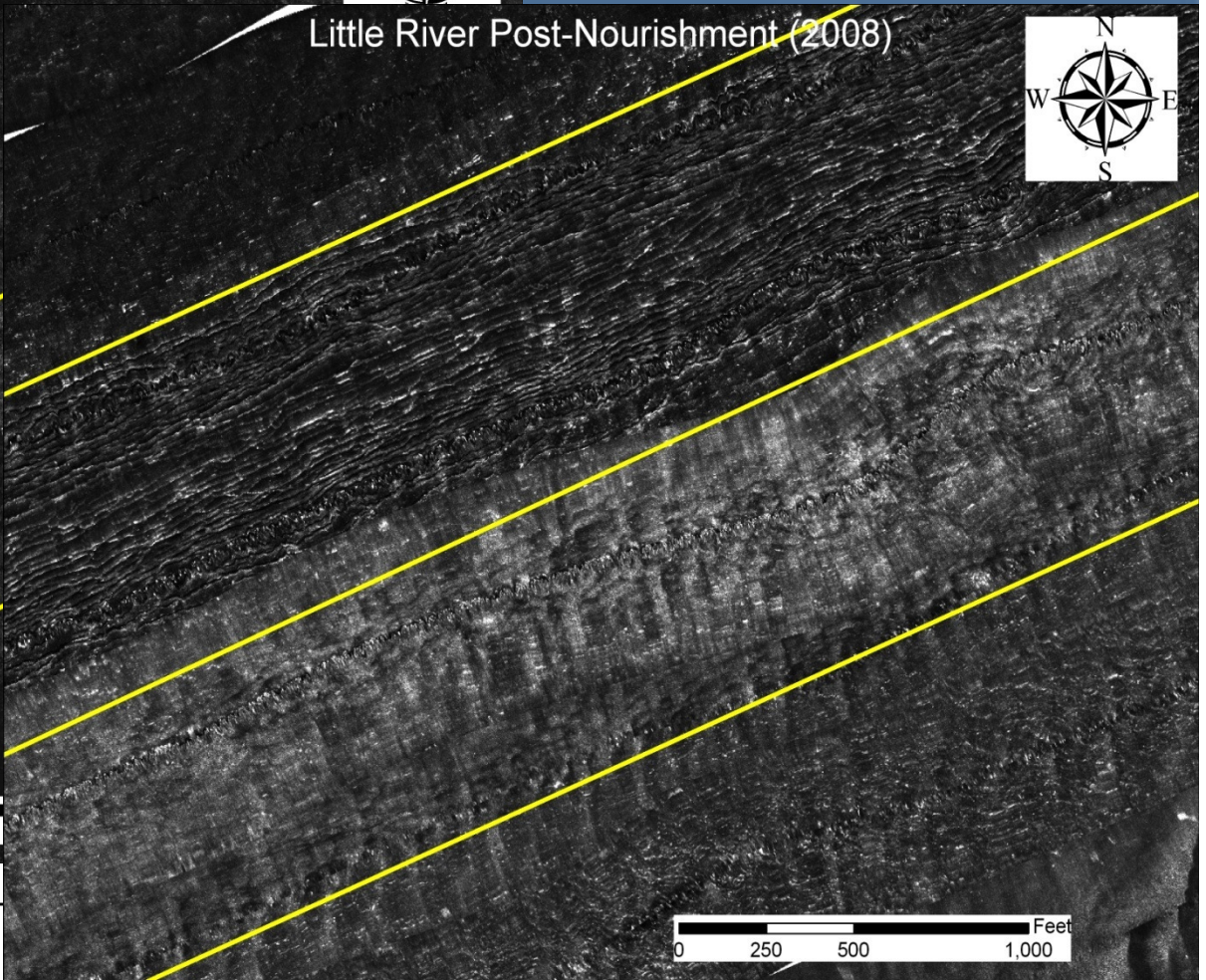
- Removed upper 0.5 - 1m of sediment across all zones
- Very limited sediment in northern Long Bay
- Post + 1 year due this month



Little River Pre-Nourishment (2008)

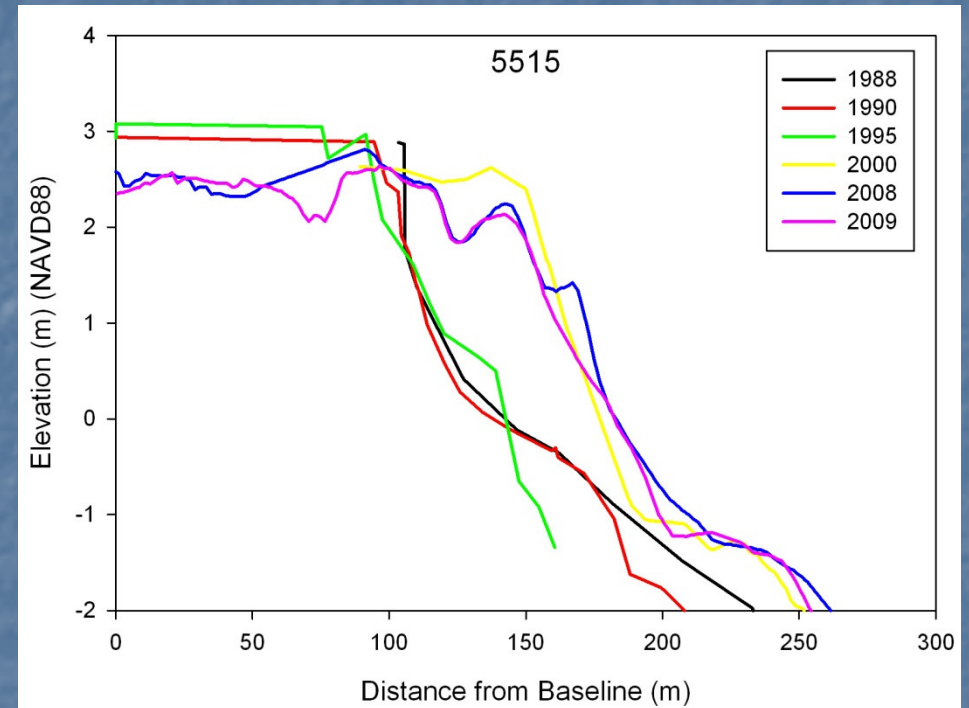


Little River Post-Nourishment (2008)



Summary

- 40% of beach fill is removed from above MLW 15 months after nourishment
- Likely to stabilize over next year
- Initial data indicates minor infilling of borrow sites
- Mainland attached beaches are accretional over past 20 years through beach nourishment
- Effective monitoring and research necessary to maintain resources and minimize impacts
- Maintaining current shoreline will become more challenging and expensive



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