

Monitoring Coastal Marshes for Persistent Saltwater Intrusion

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Primary Goal

- Provide resource managers with remote sensing products that support ecosystem forecasting models requiring salinity and inundation data.
- Work supports the habitat-switching modules in the Coastal Louisiana Ecosystem Assessment and Restoration (CLEAR) model, which provides scientific evaluation for restoration management (Visser et al., 2008).

Visser, J.M., C. Kaiser, and A.B. Owens. 2008. Forecasting 50-years of Habitat Switching in Coastal Louisiana: No Increased Action & Preliminary Draft Master Plan. Chapter 4 in: R.R. Twilley (ed.), Coastal Louisiana Ecosystem Assessment & Restoration (CLEAR) Program: A tool to support coastal restoration. Volume IV. Final Report to Department of Natural Resources, Coastal Restoration Division, Baton Rouge, LA. Contract No. 2512-06-02.



Project Description

- Daily MODIS time series are used to generate vegetation, water, and soil indices.
- Daily indices are used to compute percent flooding over any period of time and will be validated with a lidar Digital Elevation Model.
- Higher resolution data (e.g., Landsat) are used to compute salinity indirectly using CRMS ground truth and modeling.
- Percent inundation and salinity are merged to produce data for models like CLEAR Habitat Switching Model for coastal marshes.

Potential Partners/Collaborators

- USGS National Wetlands Research Center-CRMS (Coastwide Reference Monitoring System)
- Barataria Terrebonne National Estuary Program
- Louisiana Dept. of Natural Resources (LDNR)
- NOAA Fisheries Service

GOMA Relationship

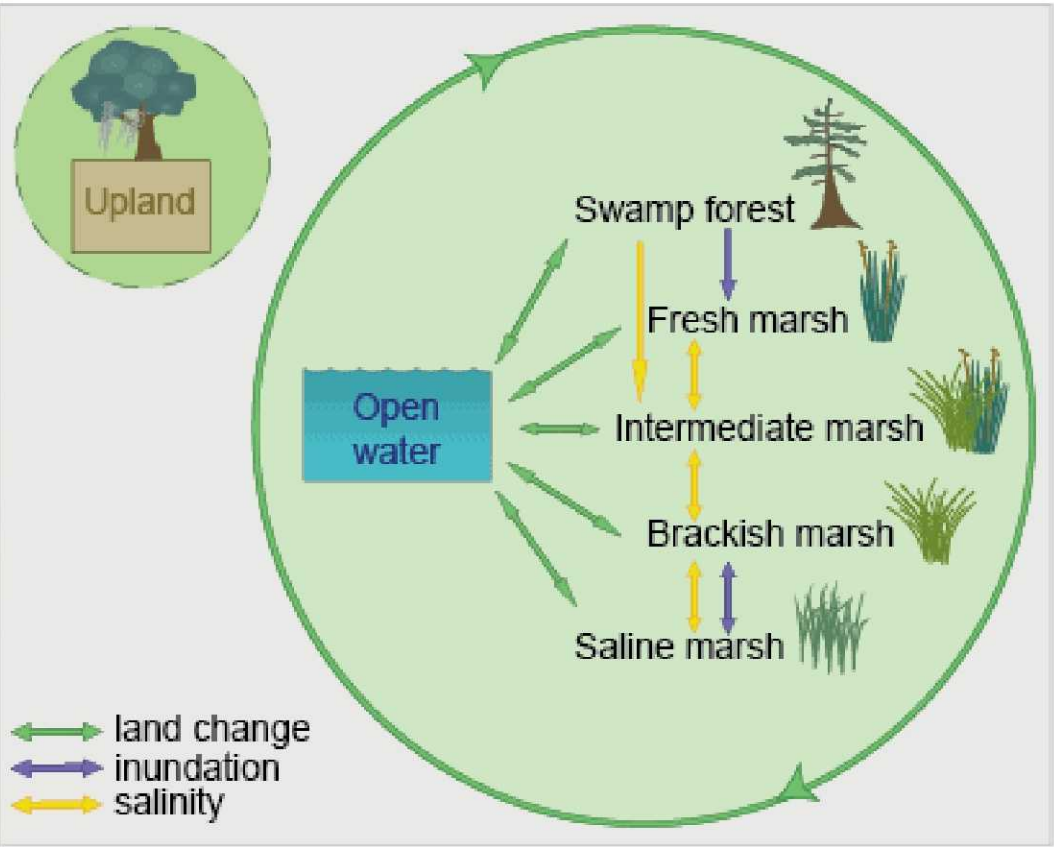
- Ecosystem Integration and Assessment
 - EIA-2: Data gap analysis and acquisition in support of resource management
 - EIA-3: Develop a Gulf of Mexico Ocean and Coastal Mapping and Monitoring Master Plan
 - EIA-4: Implementation of the Coastal and Marine Ecological Classification Standard (CMECS) in the Gulf of Mexico
- Coastal Community Resilience
 - Assess risks to natural environment

Related Proposals

- Monitoring Coastal Marshes for Persistent Flooding and Salinity Stress (Radar emphasis) submitted 10/2008 under ROSES A:28 Gulf of Mexico by: Kalcic (SSAI); Hall (NASA); Steyer (USGS)



Habitat Switching Algorithm



Coastwide Reference Monitoring System (CRMS)



- 390 Stations across Coastal Louisiana

Measurements include:

- ***Hydrology***

water level, temperature, specific conductance, and salinity

- ***Accretion data***

- ***Forested Swamp Vegetation Data***

- ***Herbaceous Marsh Vegetation Data***

- ***Soil Properties***

wet & dry soil pH, soil-specific conductance, soil salinity, soil moisture content, bulk density, percent organic matter, and wet & dry volume

- ***Surface Elevation***

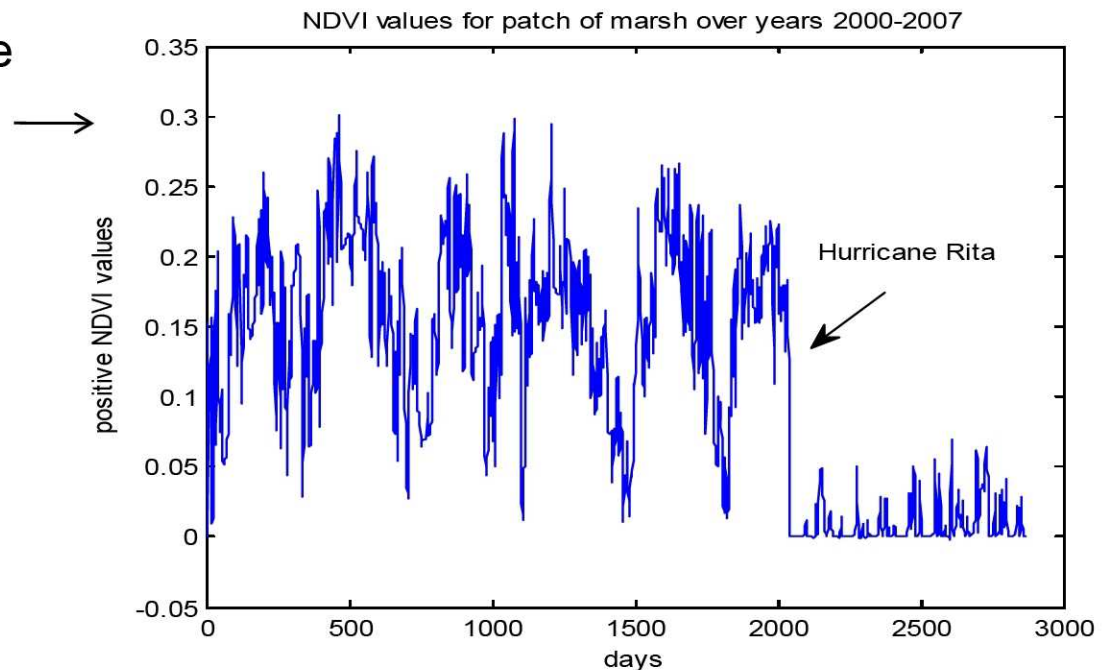
Data available at <http://www.lacoast.gov/crms2/Home.aspx>

NASA Time Series Product Tool

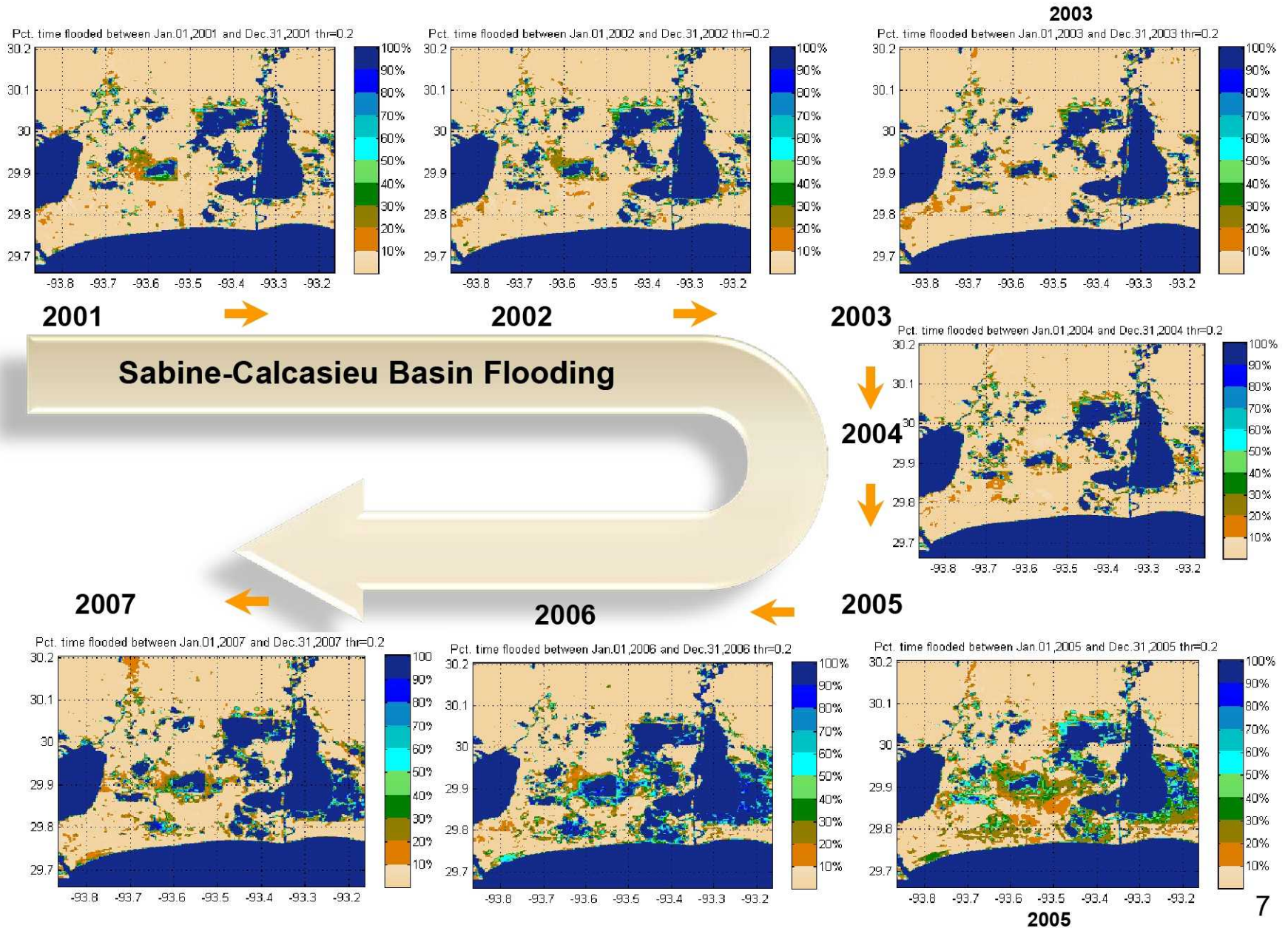
- NASA SSC developed the Time Series Product Tool (TSPT) to derive daily normalized difference vegetation index (NDVI) values from the Moderate Resolution Imaging Spectroradiometer (MODIS) Aqua/Terra satellite data.

NDVI time series were developed daily for years 2000-2007.

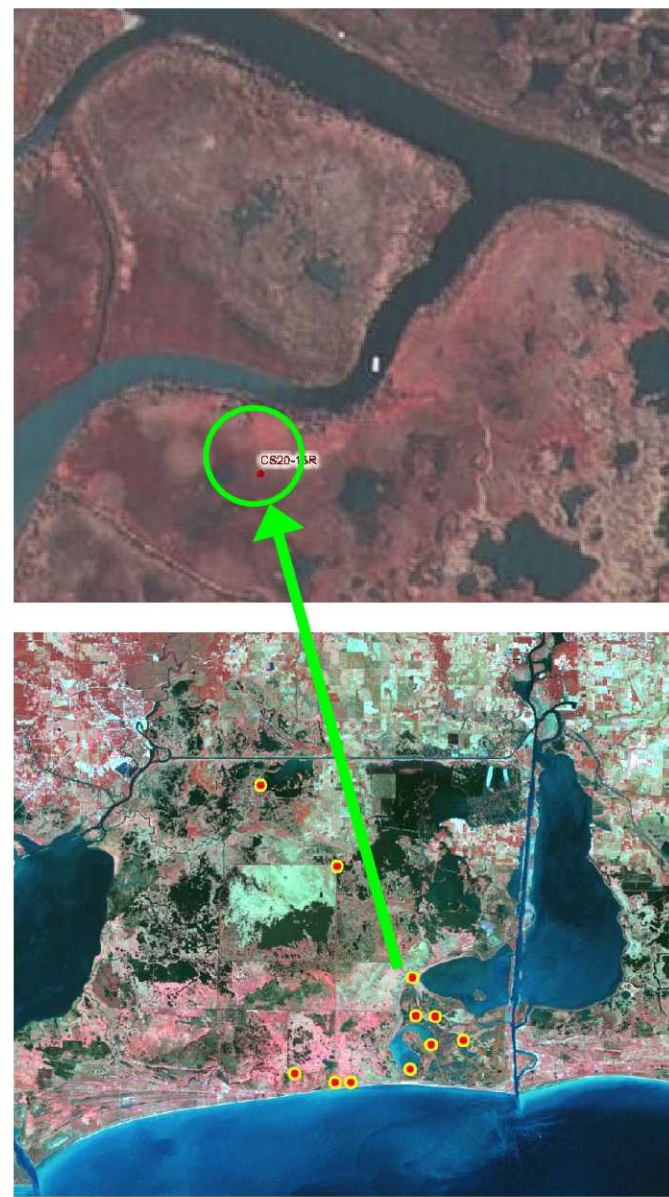
In addition to NDVI, TSPT computes the normalized difference water and soil indices (NDWI and NDSI, respectively).



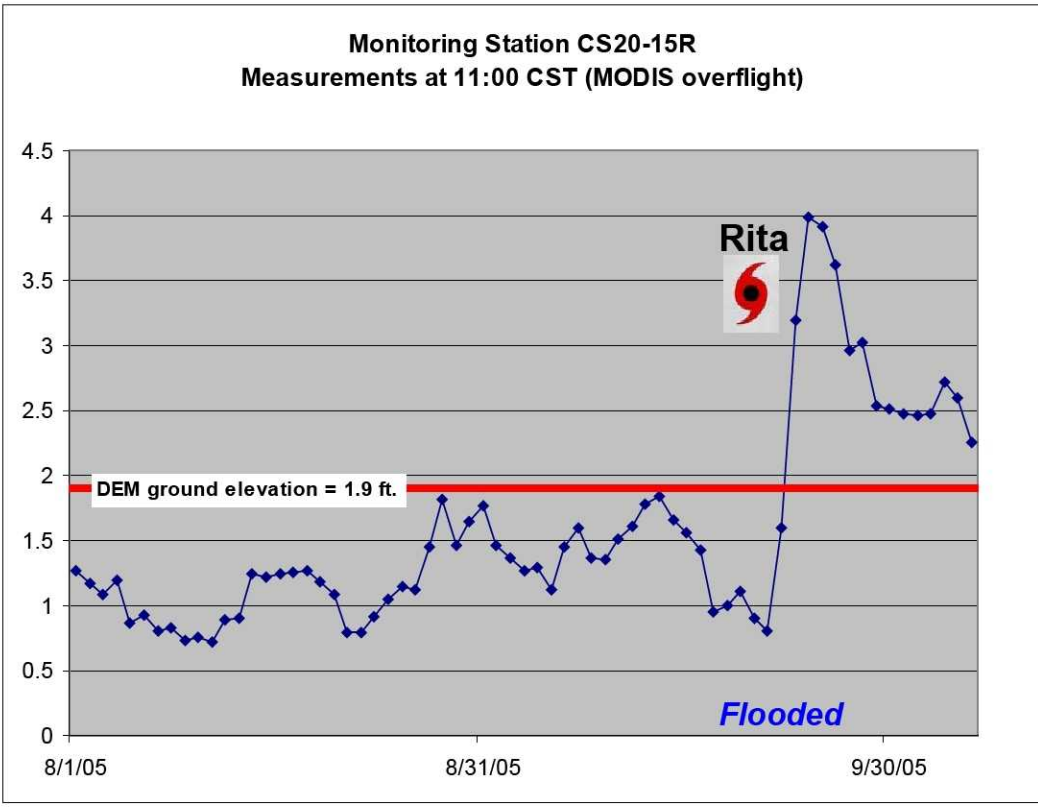
Preliminary Estimates of Annual Percent Inundation from MODIS NDVI



Validation of Sabine Basin Flooding Hurricane Rita



Coastal Restoration Monitoring Station CS20-15R



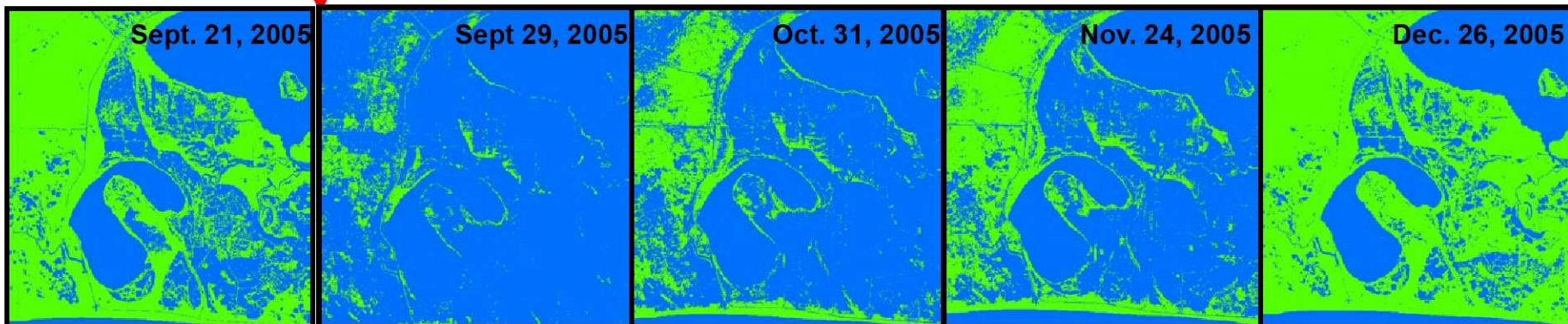
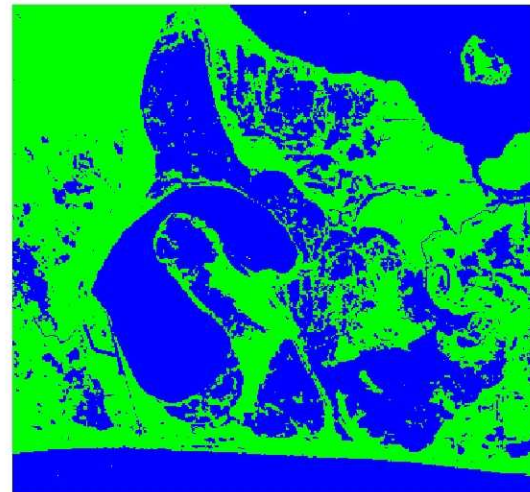
Mud Lake, Sabine-Calcasieu Study Area

- Flooding determined from comparison of DEM from lidar (NAVD88) and gridded water levels from Coastal Restoration Monitoring Station Field Data (NAVD88) for dates shown below.
- Comparison to Landsat NDWI values for October 31, 2005, shows less flooding in the image. Further work to calibrate water levels to marsh elevation is planned as well as more comparison sites.

*Hurricane
Rita
Sept. 24, 2005*

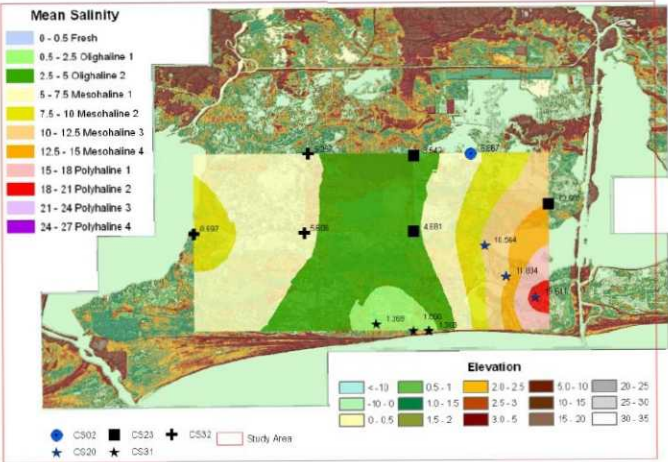


Landsat NDWI October 31, 2005

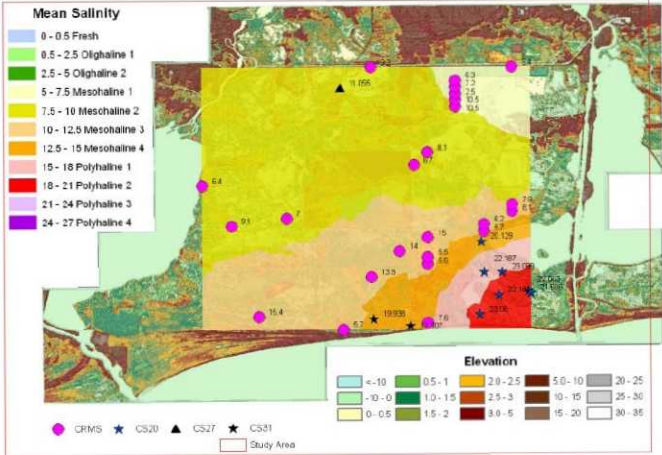




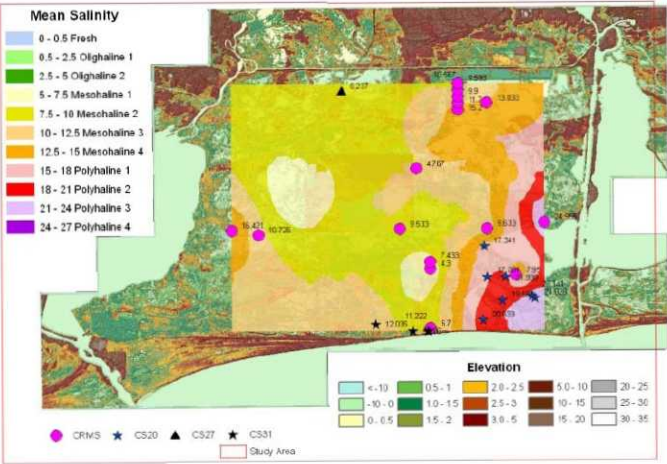
Fourth Quarter 2004 (October – December)



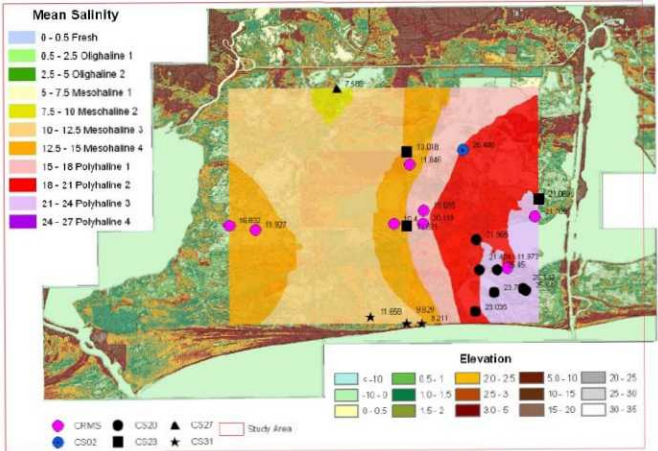
Fourth Quarter 2005 (October – December)

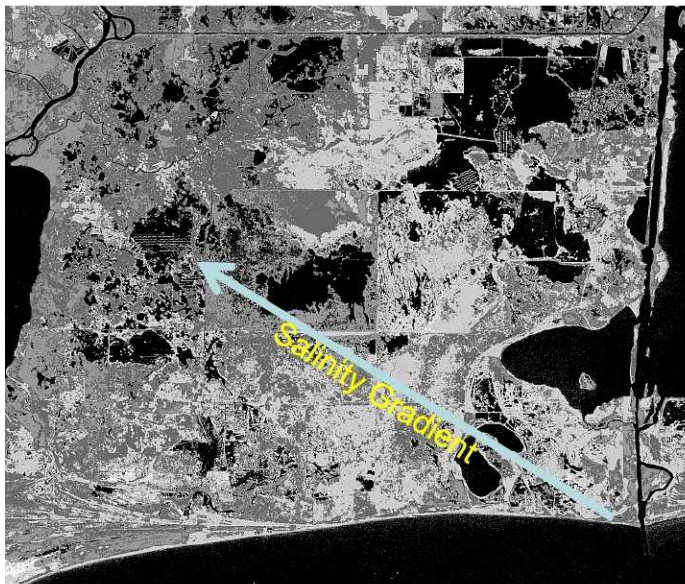


First Quarter 2006 (January – March)



Second Quarter 2006 (April – June)





- Porewater salinity maps for Sabine Basin 2005, estimates made from Landsat 7 (10/31/2005) using Neural net, rms=0.09
- Salinities range from 0-18 ppt where brighter areas indicate higher salinity



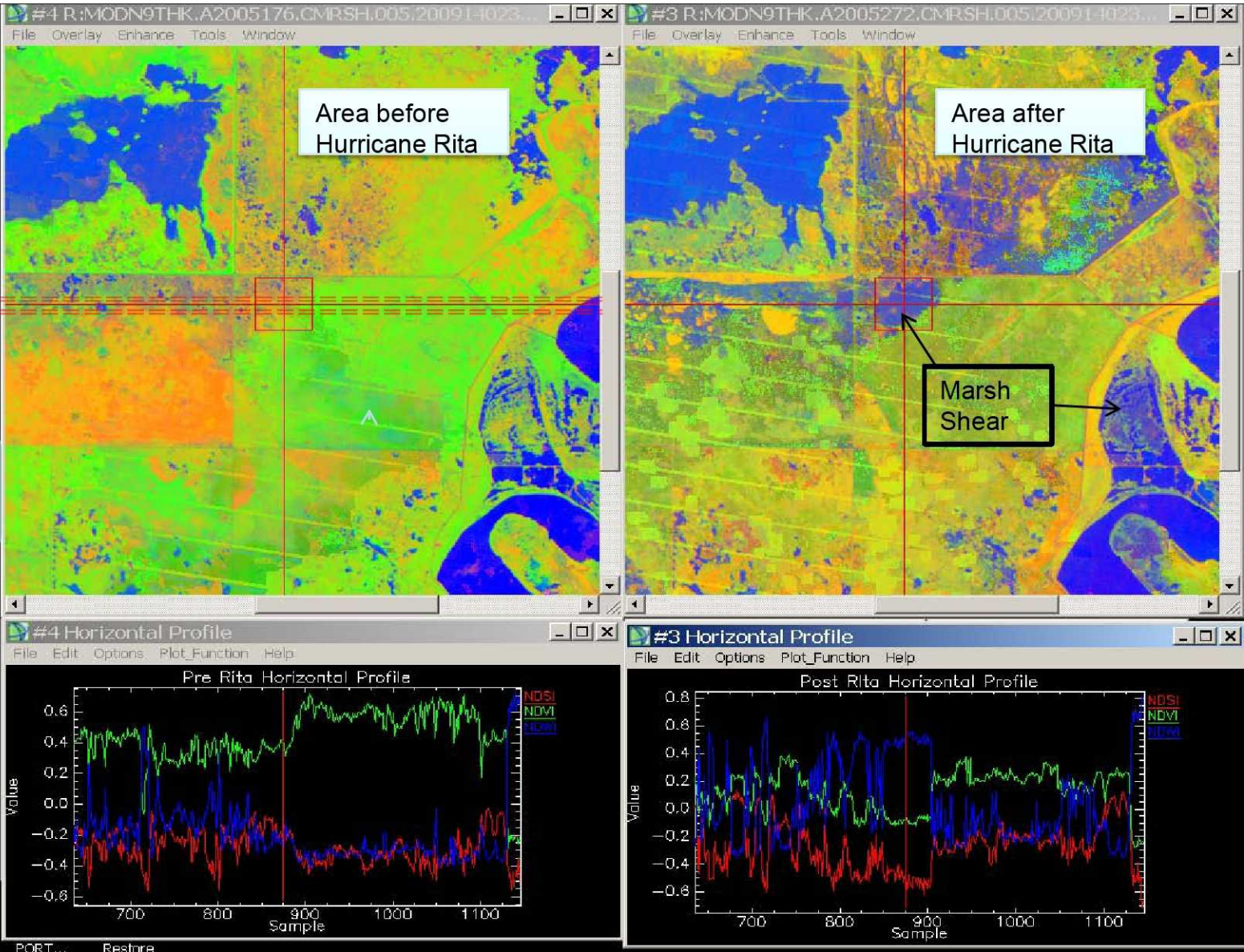
Superimposed
Landsat Images
of Normalized
Difference
Indices

NDVI – Green
NDWI – Blue
NDSI - Red

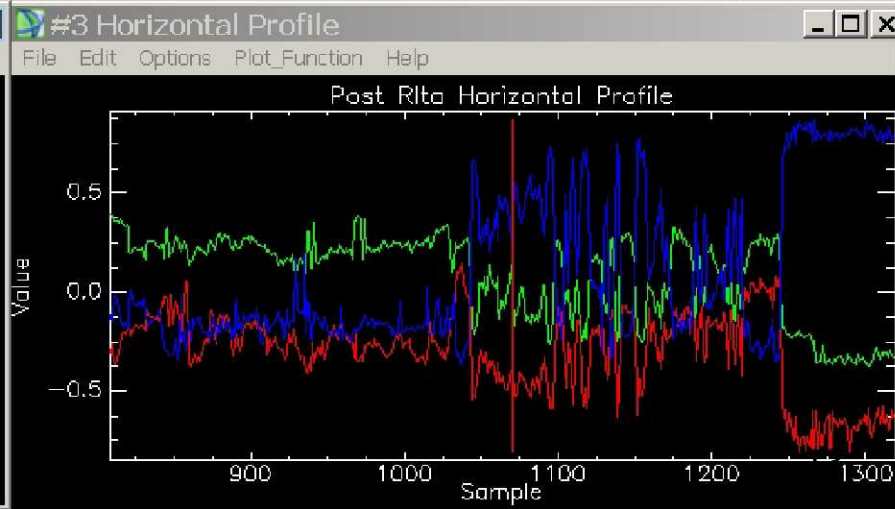
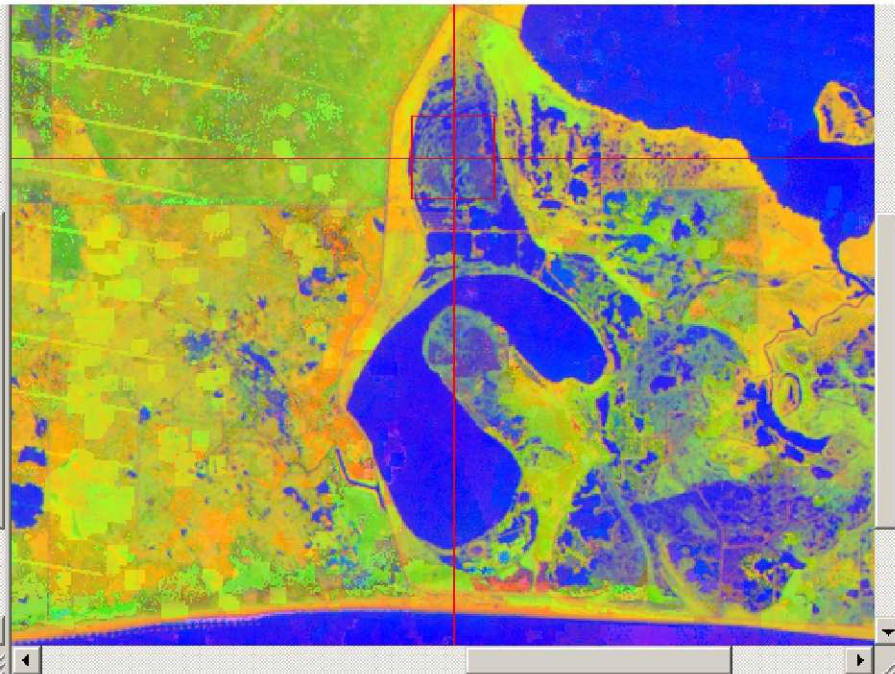
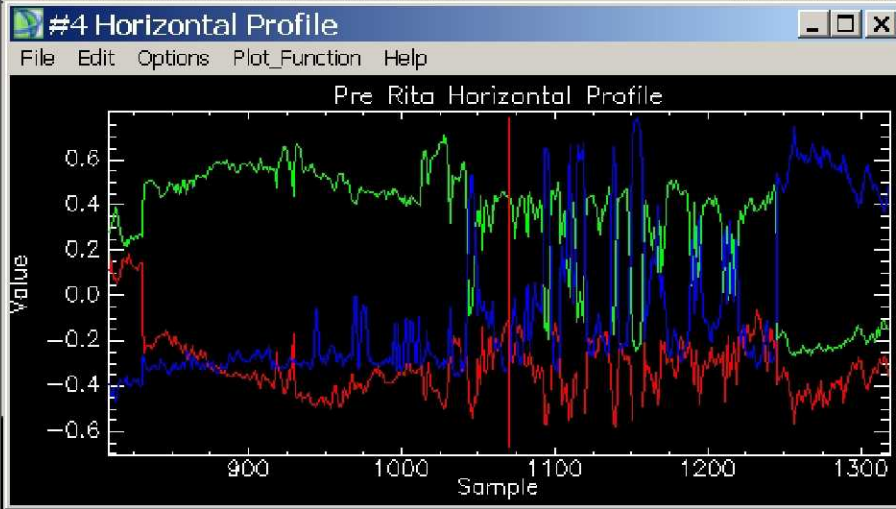
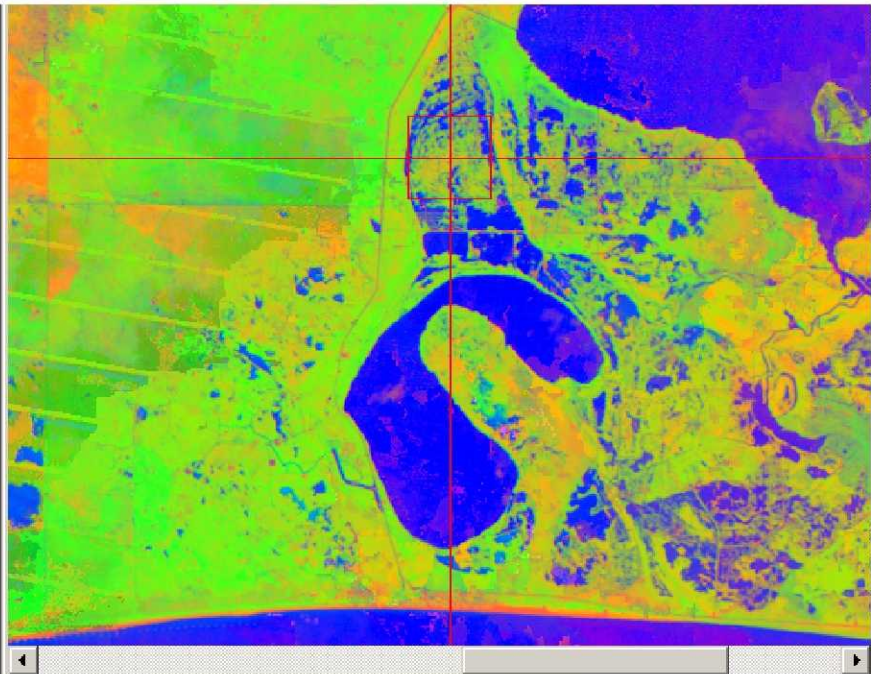
Horizontal
profile line

Plots show each index
along horizontal profile
line (above), before
(left), and after (right)
Hurricane Rita.

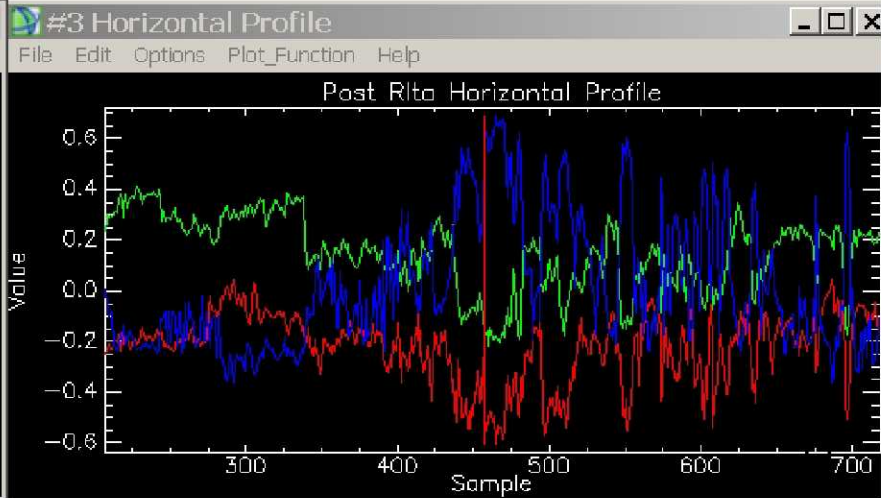
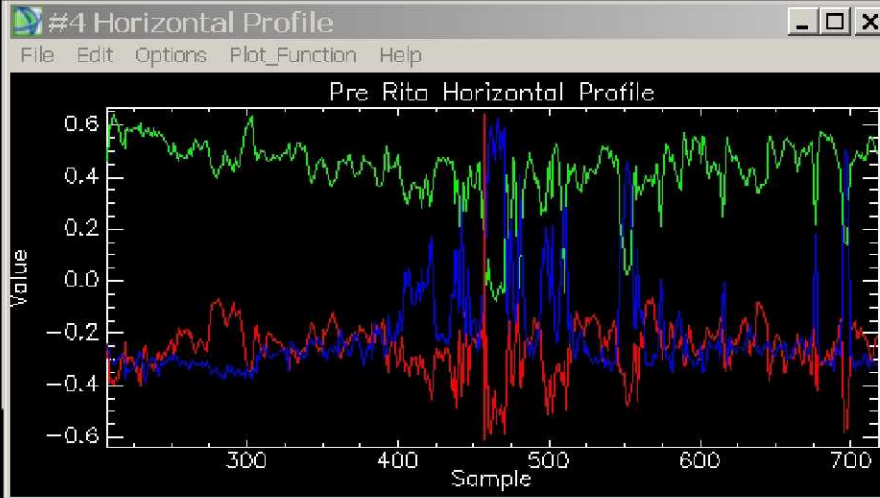
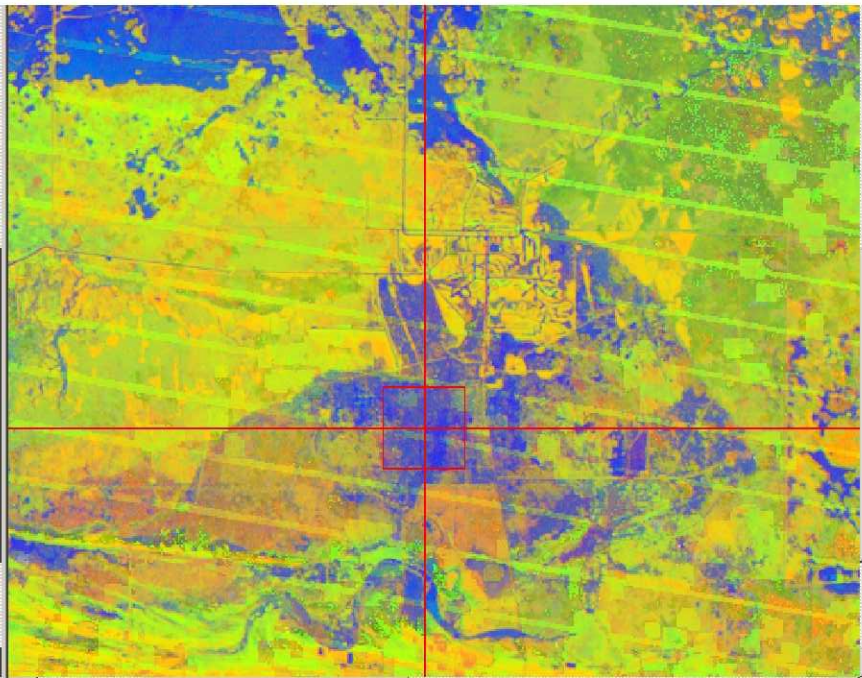
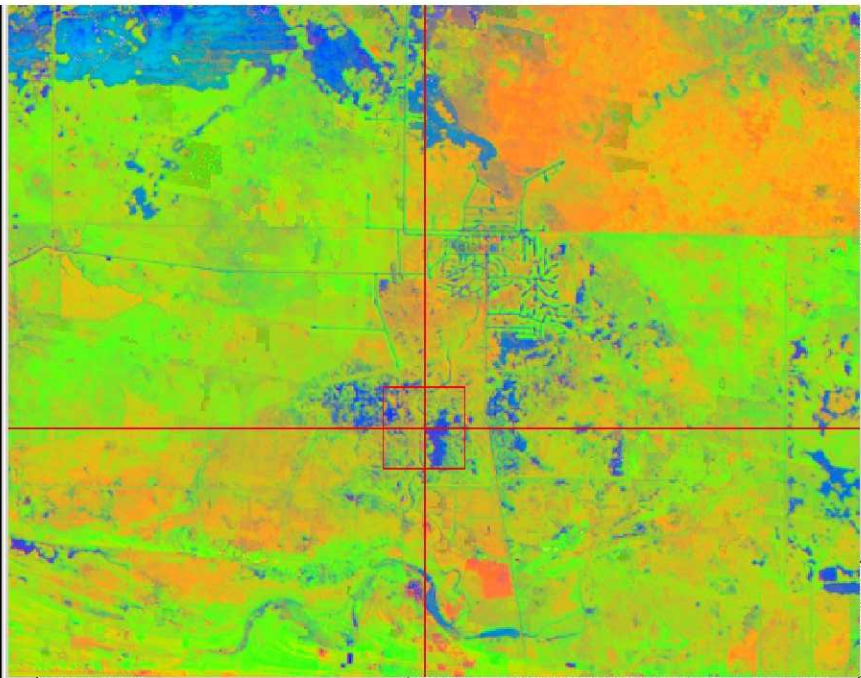
Pre-Rita profile shows
vegetation dominant
cover type as
indicated by
dominance of NDVI
(green); post-Rita
shows diminished
NDVI and increased
water index, NDWI
(blue).



Marsh shear and inundation (at crosshairs) shown in horizontal profiles of vegetation, water, and soil indices. Post-Rita profile shows dominances of water (blue) profile.



Pre-Rita horizontal profiles show marsh vegetation dominance on horizontal profile (green), while post-Rita shows water (blue) dominating much of the profile.





- Ongoing work to validate flooding with radar (NWRC/USGS) and enhance persistence estimates through “fusion” of MODIS and Landsat time series (ROSES A.28 Gulf of Mexico).
- Additional work will also investigate relationship between saltwater dielectric constant and radar returns (Radarsat) (ROSES A.28 Gulf of Mexico).