



National Wetlands Research Center

Eco-hydromorphic Characterization of the Louisiana Coastal Region Using Multiple Remotely Sensed Data Sources and Analyses

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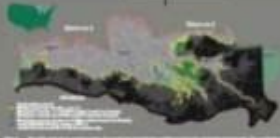
Land Area Change in Coastal Louisiana (1932 to 2010)



Land Area Change in Coastal Louisiana (1932 to 2010)

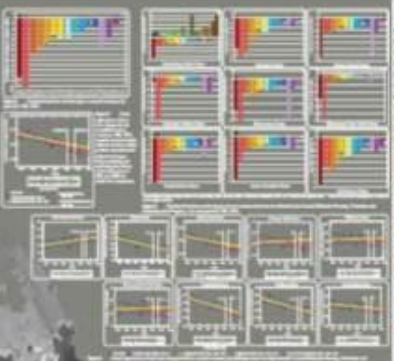
By Philip T. Dunbar, Jack E. Sauer, Tracey T. Hoop, William Brown, Michelle Turner, Holly Rich, Robert Taylor, David L. Williams, David Thomson

Introduction
Coastal Louisiana has experienced significant land area loss since 1932. This report provides a detailed analysis of the changes in land area across the state's coastal regions, including the Mississippi River Delta, the Atchafalaya River Delta, and the Lake Charles Delta. The data is presented in a series of maps, tables, and graphs, illustrating the extent and rate of land loss over time.



Year	Land Area (km²)
1932	125,000
1940	124,000
1950	122,000
1960	120,000
1970	118,000
1980	115,000
1990	112,000
2000	108,000
2010	105,000

Region	1932	1940	1950	1960	1970	1980	1990	2000	2010
Atchafalaya Delta	15,000	14,500	14,000	13,500	13,000	12,500	12,000	11,500	11,000
Mississippi Delta	85,000	84,000	83,000	82,000	81,000	80,000	79,000	78,000	77,000
Lake Charles Delta	25,000	24,500	24,000	23,500	23,000	22,500	22,000	21,500	21,000



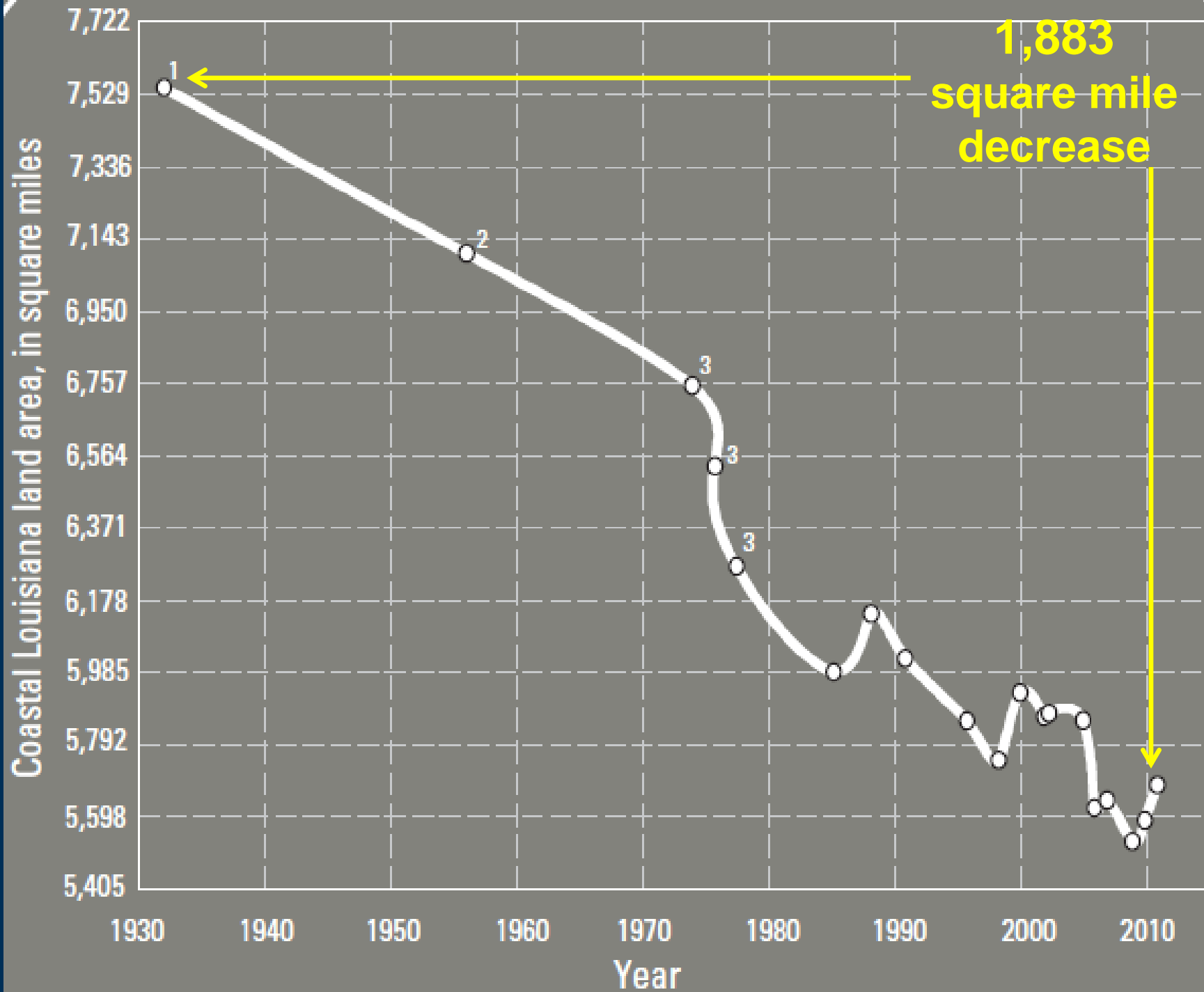
DEFINITION
Land area change is defined as the difference in land area between two consecutive years. Land area is measured in square kilometers (km²). Land area change is calculated as the difference between the land area in the current year and the land area in the previous year. Land area change is positive if the land area increased and negative if the land area decreased.

Legend
Land area change: Positive (green), Negative (red), Zero (black).
Water bodies: Blue.
Land area: Gray.
Coastline: Black line.
Scale: 1:100,000.

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1932	125,000
1940	124,000
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2010	105,000

Discussion
The data shows a clear and consistent trend of land area loss in coastal Louisiana over the 78-year period. The most significant loss occurred in the Mississippi River Delta, which lost approximately 8% of its land area. The Atchafalaya River Delta and the Lake Charles Delta also experienced substantial losses, with the Atchafalaya Delta losing about 10% and the Lake Charles Delta losing about 8% of its land area. The rate of land loss appears to have accelerated in the latter half of the 20th century, particularly in the 1980s and 1990s.



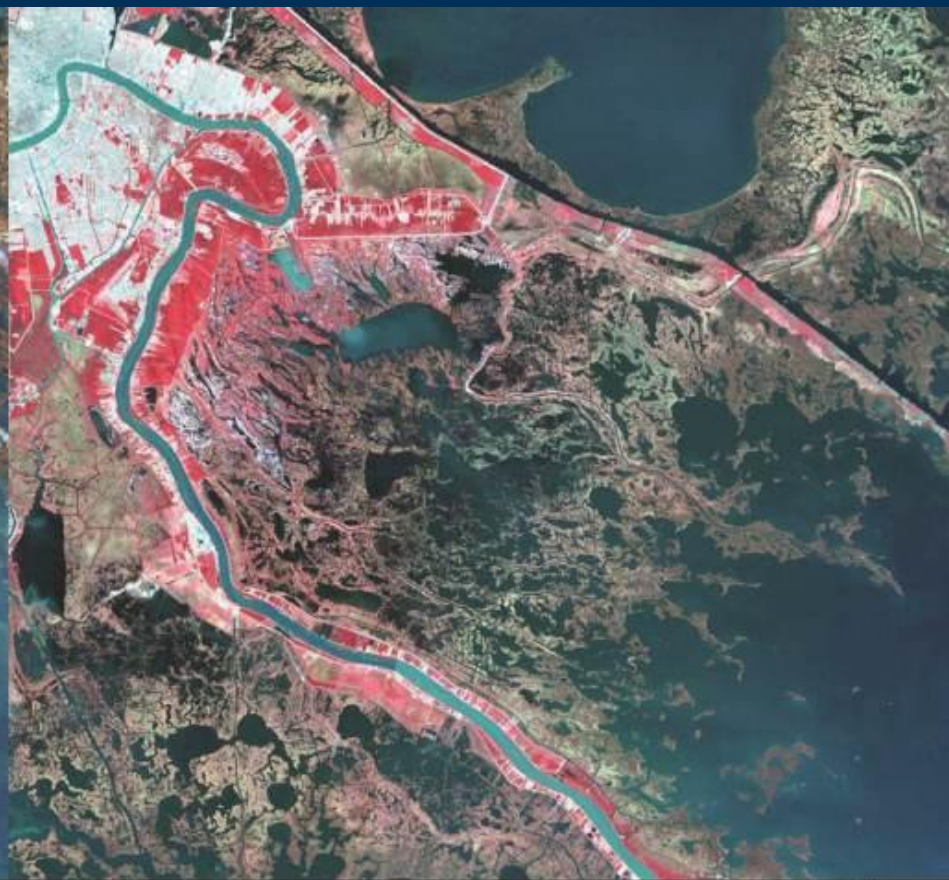






1973

0 3 6 12 18 24 Miles



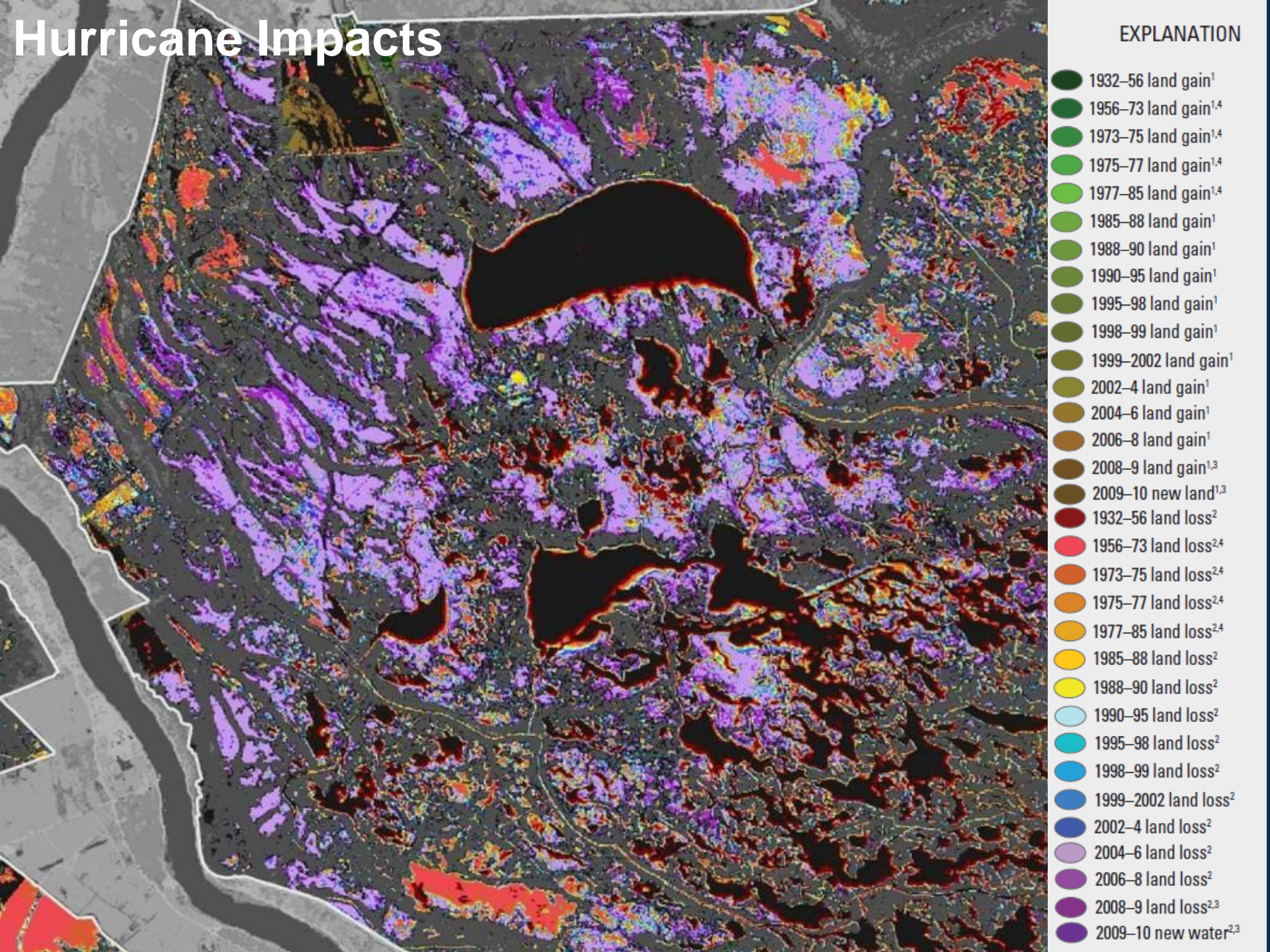
2010

0 3 6 12 18 24 Miles

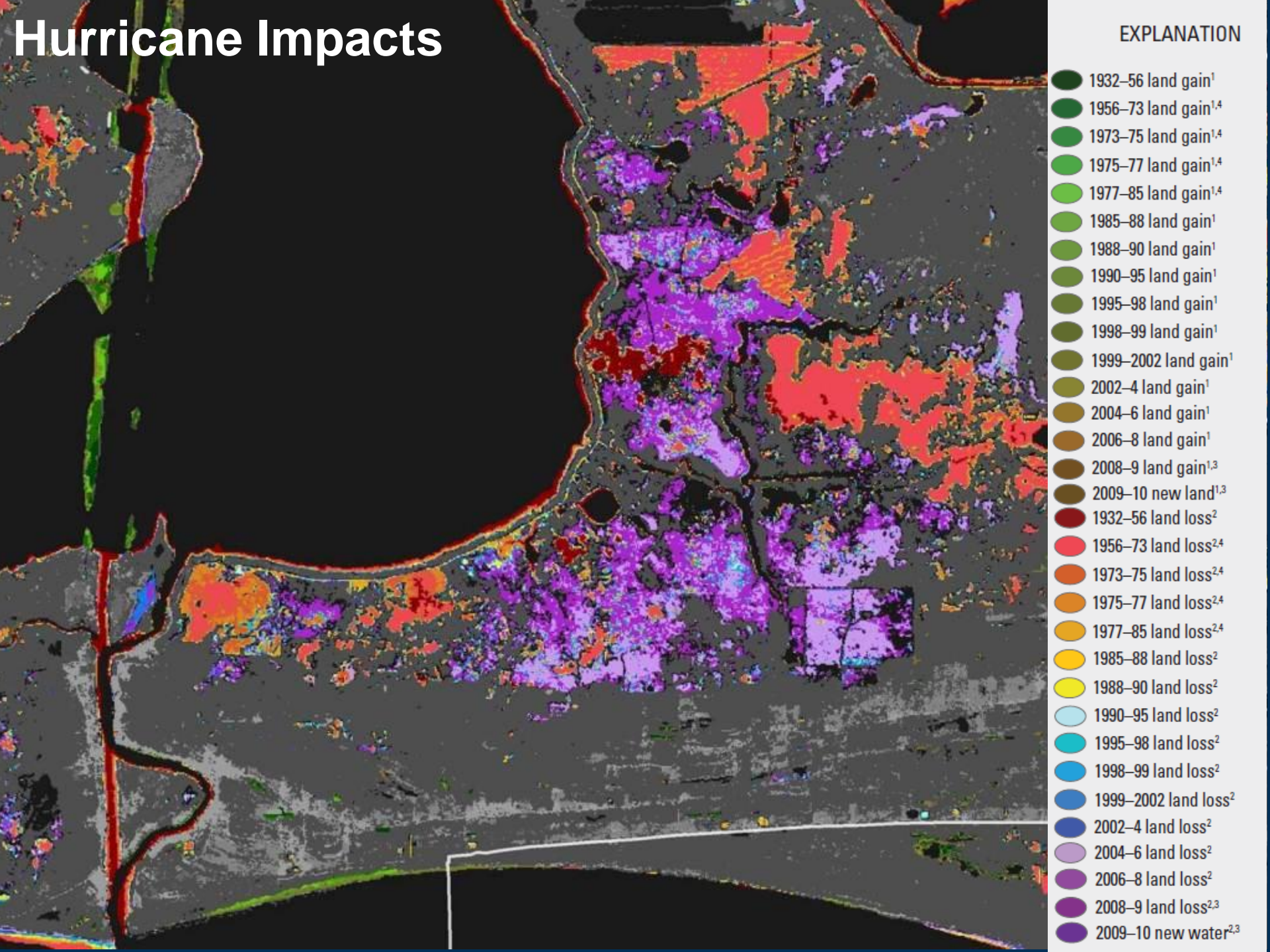


Hurricane Impacts

EXPLANATION



Hurricane Impacts

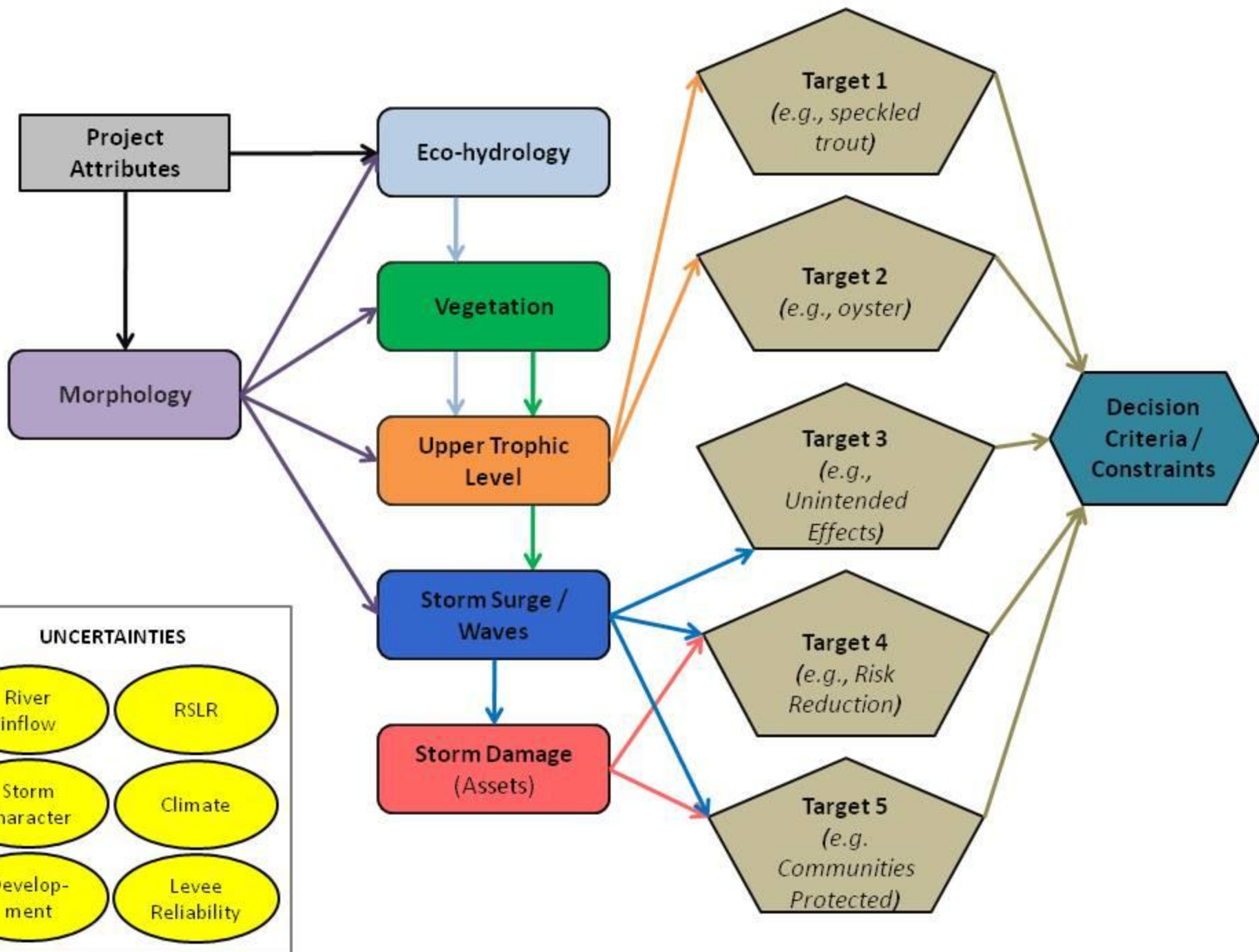


State of Louisiana
The Honorable Kathleen Babineaux Blanco, Governor

Integrated Ecosystem Restoration and Hurricane Protection:
**Louisiana's Comprehensive Master Plan
for a Sustainable Coast**



Coastal Protection and
Restoration Authority of Louisiana



Wetland Morphology Team - Land Change/Relative Elevation Module

Model elements

Model/Function: Diamond shape

Input: Circle shape

Output: Rectangle shape

Importance:

- High – thick line
- Medium – med. line
- Low – thin line

Understanding:

- High – green line
- Medium – blue line
- Low – Red line

Predictability:

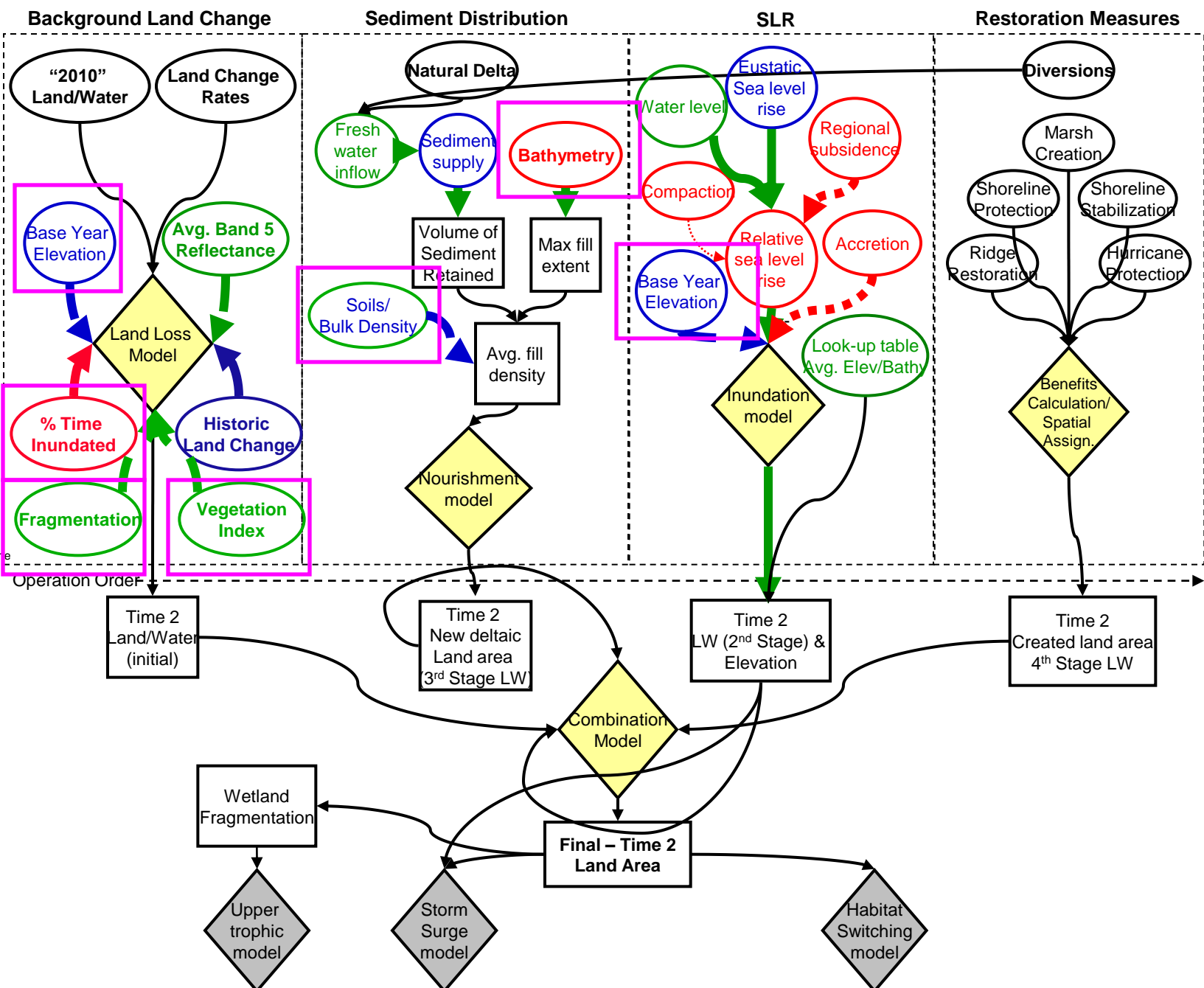
- High – solid line
- Medium – dashed line
- Low – dotted line

Relationship:

- + Positive
- Negative
- ↷ Non-linear

Quality of the data currently available:

- Good** – currently available data / information is acceptable
- Fair** – need some additional data
- Poor** – need substantial investments to acquire additional data



Landscape Characterization

- The work I will describe today aims to describe the biophysical structure and dominant processes of the Louisiana coastal landscape as derived from various sources and analyses of remotely sensed data.
- This multi-parameter approach enables observation and projection of interrelated and cross-scalar processes.

Remote Sensing

- Remotely sensed data, in combination with ground observations, can provide valuable information with regard to many of these form/process associations.
- The value of remotely sensed datasets is the spatially variable representation of these parameters.

Training Data

- Training data is the most important part of any remotely sensed assessment.
- It is of vital importance that the training data is accurate (garbage in/ garbage out)
- In coastal Louisiana, we are fortunate to have an expansive network of monitoring sites.

Coastwide Reference Monitoring System

- CRMS funded by CWPPRA
- 390 CRMS sites established
- several thousand environmental monitoring stations
- monitoring sites established both inside & outside of CWPPRA project boundaries
- many sites serve as “control” reference areas for projects
- system allows for assessments at project, basin, & ecosystem level
- system allows for assessments of projects both individually & cumulatively





CRMS Website

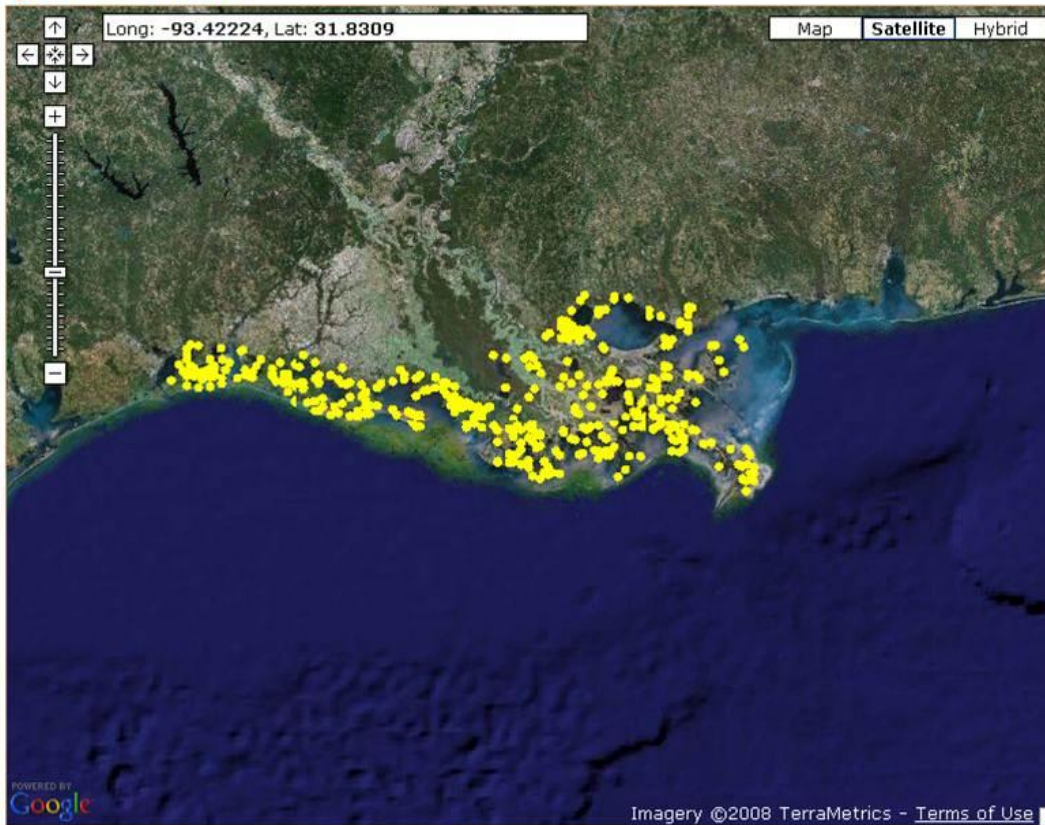
Coastwide Reference Monitoring System

a CWPRA funded project



Home Data Mapping Library Visualization Program

Spatial Viewer *DRAFT



Layers

- CRMS Sites
- 1 Km Buffer
- CWPRA Projects
- Hydro Basins

Site Info

Click the yellow symbology on the map to view CRMS Site information.

Disclaimer

PROVISIONAL DATA SUBJECT TO REVISION.





Spatial Viewer *DRAFT

Long: -90.5055, Lat: 29.51641 Map **Satellite** Hybrid

Site Info [Water](#) [Vegetation](#) [Soil](#) [Spatial](#) [Report Card](#)

Site ID: CRMS0416
Lat, Long: 29.476, -90.4792
Marsh Elevation: 1.36ft NAVD1988
NGS Benchmark: Not currently available.
Pre/Post Construction Pictures:

Post Construction Pre Construction Preliminary Site Visit North

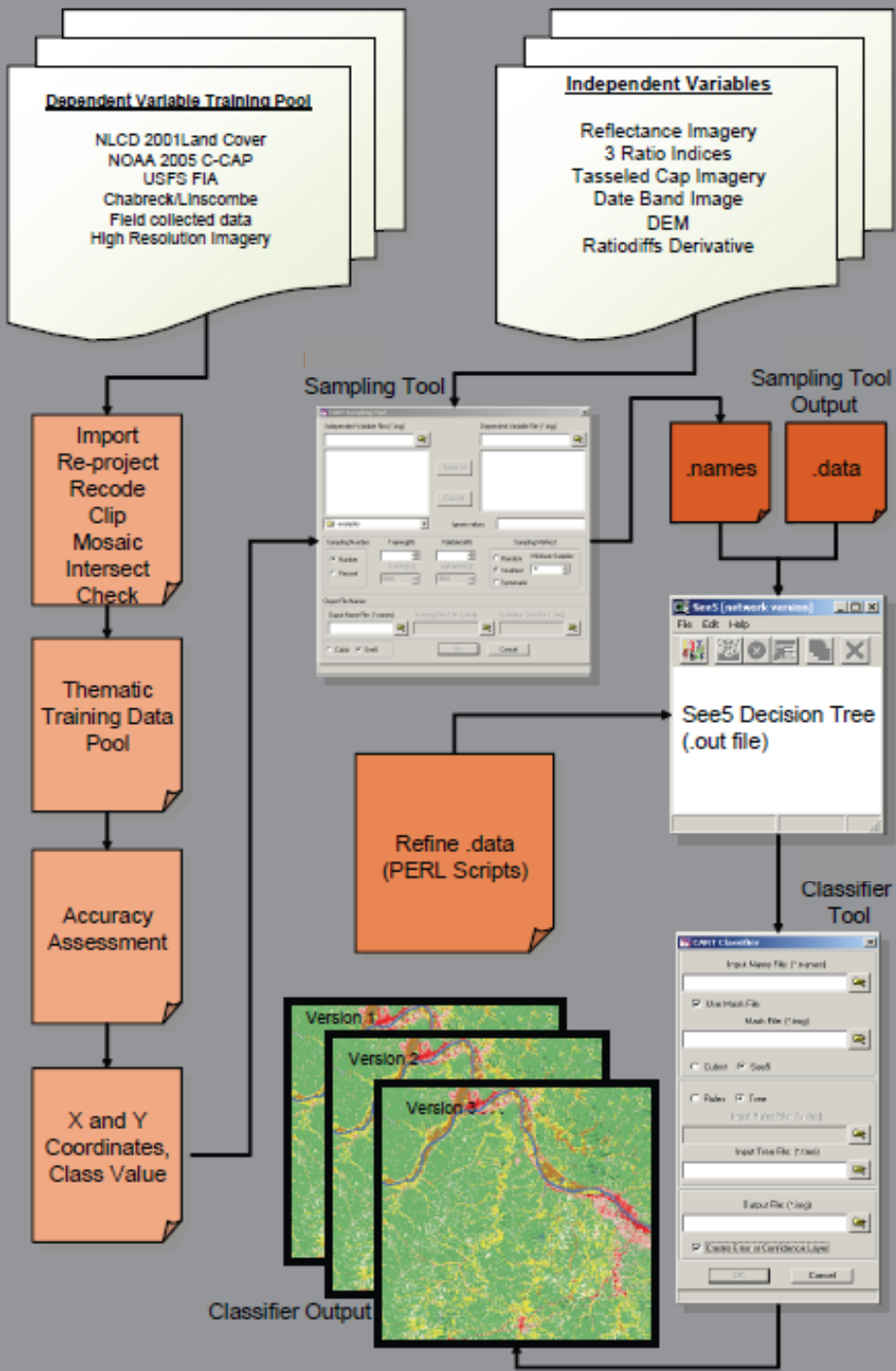
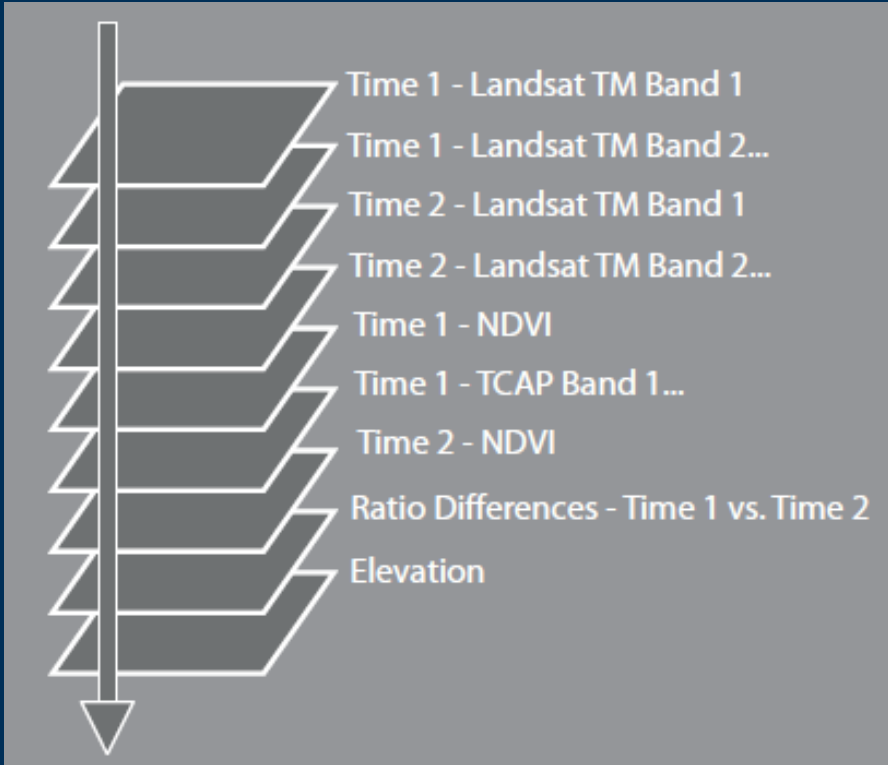
Layers

- CRMS Sites **AA**
- Zoom To: CRMS0002
- 1 Km Buffer
- CWPPRA Projects

Imagery ©2008 D1



Methodology



Generalized diagram of classification methodologies utilized. Illustration courtesy of: Joyce Fry - SAIC/USGS EROS Archive and Data Resources Department

Ancillary and Remotely Sensed Datasets commonly used as Independent Variables

- Remotely sensed imagery (e.g. Landsat TM, MODIS)
 - Particular “bands” (data representative of a specific range of wavelengths light) are often informative about particular parameters as there are distinctive reflection and absorption patterns associated with specific features.
- Derivations from spectral imagery such as ratios, indices and transformations
- Elevation data
- Land Use/Land Cover data
- Distance to features

Landscape Characterization

- Can include thematic variables such as Land Use/Land Cover, or continuous variable such as bulk density.

Landscape Characterization

EXAMPLES

Landscape Characterization

Land Use Land Cover



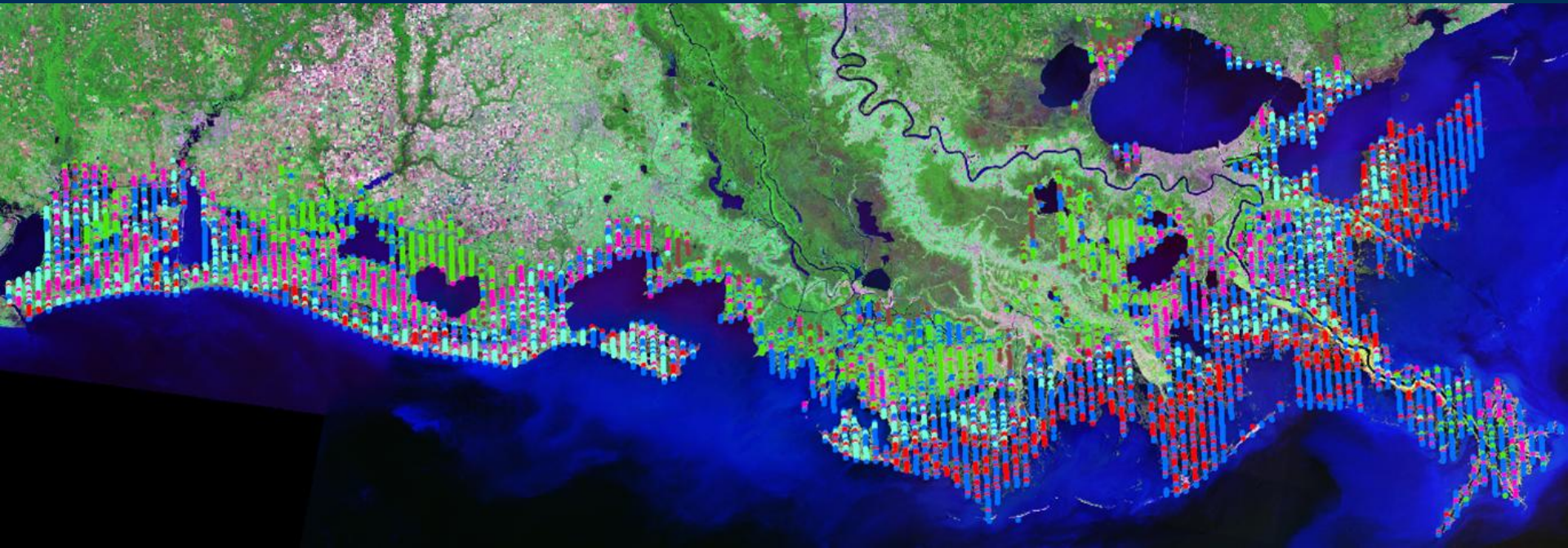
Landscape Characterization

Land Use Land Cover

Training Data

Chabreck/Linscombe Helicopter Surveys (2007)

- 7289 points (not including “other”)
- 4289 points excluding water
- 3914 plots excluding forested wetlands



Land Use/Land Cover Data

DRAFT



Taxodium distichum
Figure 1. Representative forested wetlands occupying freshwater.



Salix nigra
Figure 2. Representative herbaceous marsh species occupying freshwater.



Figure 3. Representative herbaceous marsh species occupying fresh marsh sites.



Figure 4. Representative herbaceous marsh species occupying intermediate marsh sites.

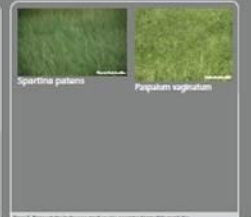
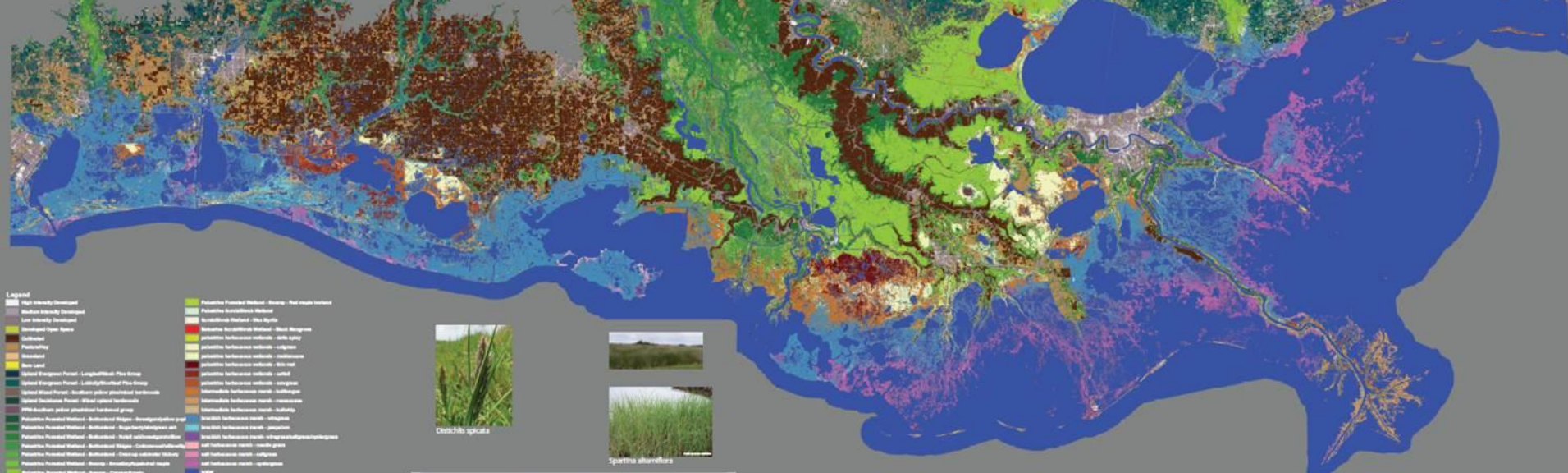


Figure 5. Representative herbaceous marsh species occupying intermediate marsh sites.



Figure 6. Study areas in the northern Gulf of Mexico.



- Legend**
- High Intensity Development
 - Medium Intensity Development
 - Low Intensity Development
 - Deciduous Forest
 - Coniferous Forest
 - Forest
 - Barren Land
 - Water
 - Open Water
 - Shrub Wetland
 - Palustrine Wetland
 - Terrestrial Wetland
 - Submerged Wetland
 - Saline Wetland
 - Non-saline Wetland
 - Other



Orizaba spicata



Spartina alterniflora

Figure 7. Representative herbaceous marsh species occupying salt marsh sites.

Landscape Characterization

Elevation

Lidar

THE LOUISIANA STATEWIDE LIDAR PROJECT

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ABSTRACT

Louisiana's statewide LIDAR project began in 2000 largely in response to the high per capita and repetitive flood loss rates experienced by the FEMA, National Flood Insurance Program and the private insurance industry in the state. The LIDAR systems being used in the Louisiana project are accurate to 15-30 cm RMSE, depending upon land cover, and will support contours of 1'-2' vertical map accuracy standards. These accuracies meet FEMA standards for floodplain reevaluation studies and map modernization programs designed to update the Flood Insurance Rate Maps (FIRM).

The project is being funded by FEMA with matching funds and deliverables distribution provided by the state of Louisiana. The area of the state is approximately 50,000 sq. mi. encompassing about 3500 quarter quadrangles (3.75-minute DEM tile size). Areas in procurement include all of SE Louisiana and the majority of the coastal zone. The project will proceed in six phases over six years with the first phase (554 quarter quads) and second phase (473 quarter quads) completed in 2003. Over 900, 5-meter DEM data files, 2-foot contours and associated metadata files have been delivered and can be found on the LSU Atlas web site (<http://atlas.lsu.edu>). Approximately 550 additional LIDAR QQs are scheduled to be completed in 2004.

INTRODUCTION

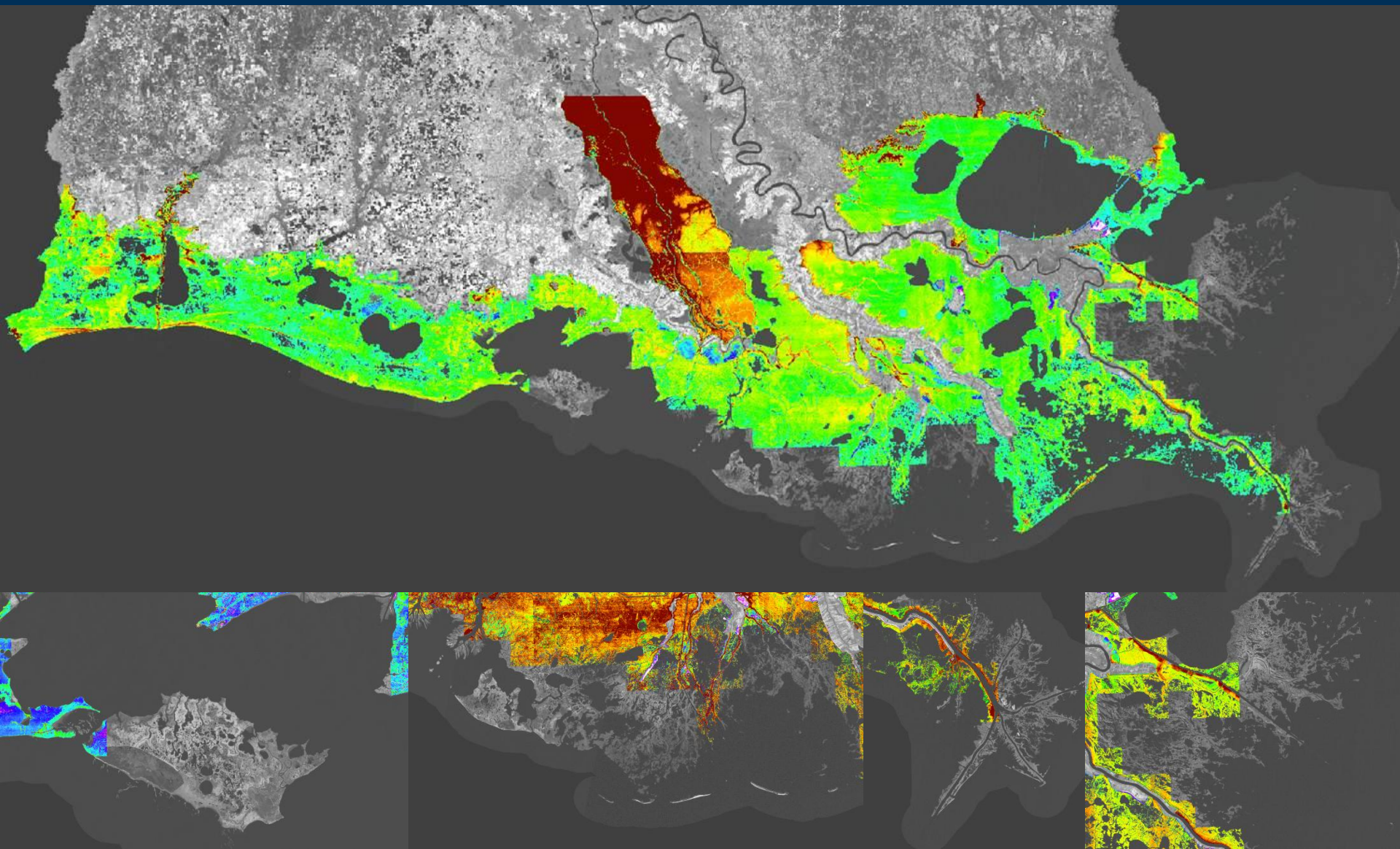
Begun in 2000, Louisiana's statewide LIDAR project was initiated in response to the high per capita and repetitive flood loss rates experienced by the FEMA, National Flood Insurance Program and the private insurance industry in the state. LIDAR derived, high-resolution topographic information has been accepted by FEMA as a low cost means to update inaccurate and out of date flood maps. The state sponsor for the project, thus far, has been the Louisiana Oil Spill Coordinators Office (LOSCO), which has managed the project and arranged for state match through legislative action. Oil spill contingency planning and response issues plague all Louisiana parishes requiring critical high resolution topographic information. The Louisiana Office of Emergency Preparedness (OEP) has recently assumed administrative control of the project, largely because of OEP's direct, official connection with FEMA. Sean Fontenot of OEP manages the fiscal aspect of the project and David Gisclair of LOSCO will continue to ably manage the project technical aspects. It is anticipated that the project will require an additional 3 years to complete.

LIDAR is an acronym for LIght Detection And Ranging. LIDAR is a complex system of airborne instruments which employ an (airborne/ground-based GPS, an inertial measurement units (IMU)), and an active laser sensor as the source to measure distances (ranging) and angles to specific and densely spaced points (2-6m) on the ground. The LIDAR systems being used in the Louisiana project are accurate to 15-30 cm RMSE, depending upon land cover, and will support contours of 1'-2' vertical map accuracy standards. These accuracies meet FEMA standards for floodplain reevaluation studies and map modernization programs designed to update the Flood Insurance Rate Maps (FIRM). Previous flood

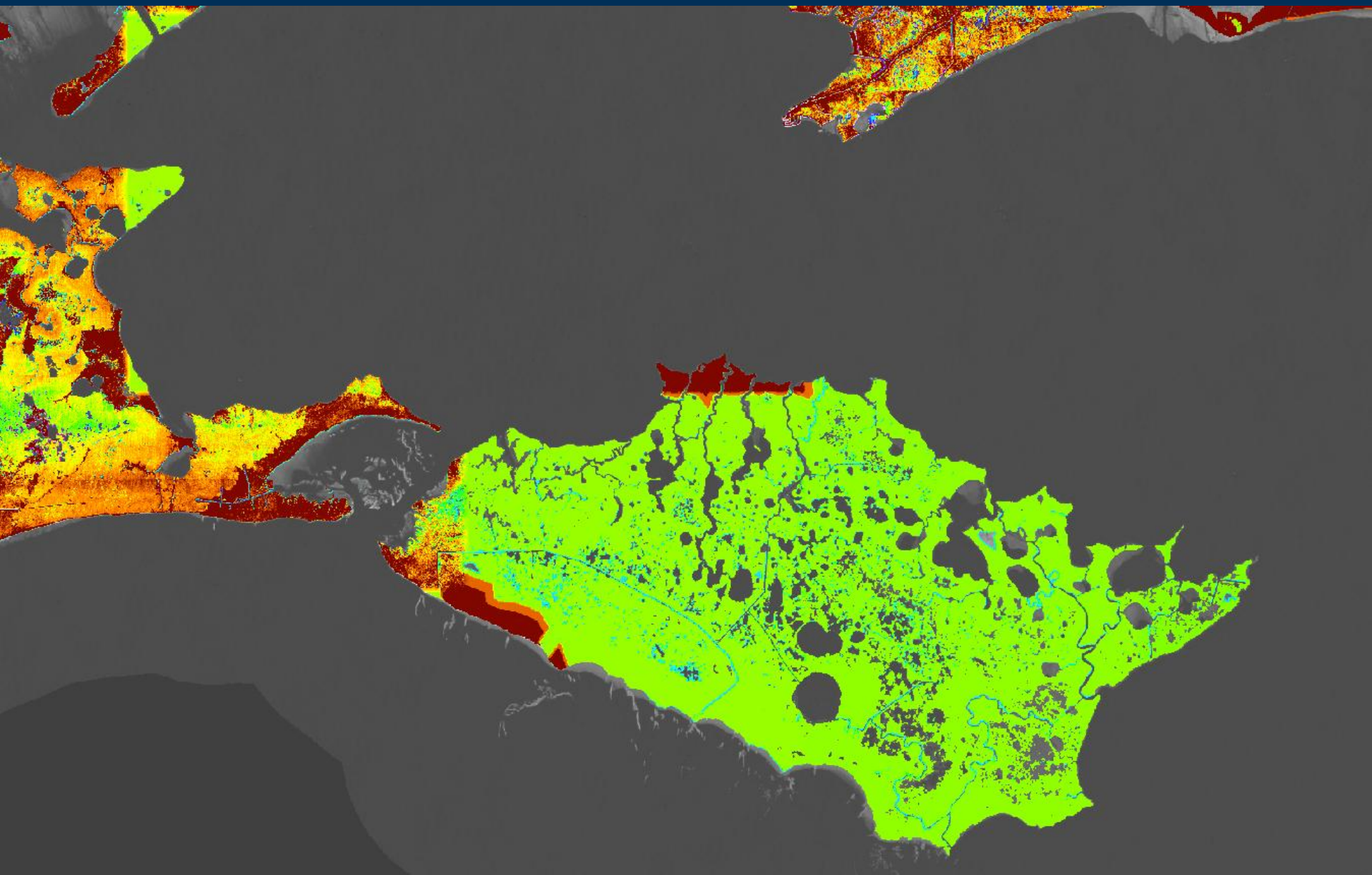
LIDAR

Funding for state-wide project: Funded areas include all of SE Louisiana, the majority of the coastal zone, Rapides and Calcasieu Parishes. Additional partners may be needed to complete the project. State Lands (LaDOA), LaDEQ, LaDOTD and the two Army Corps Districts appear to be likely candidates. USGS should provide some NED production funds to produce their products.

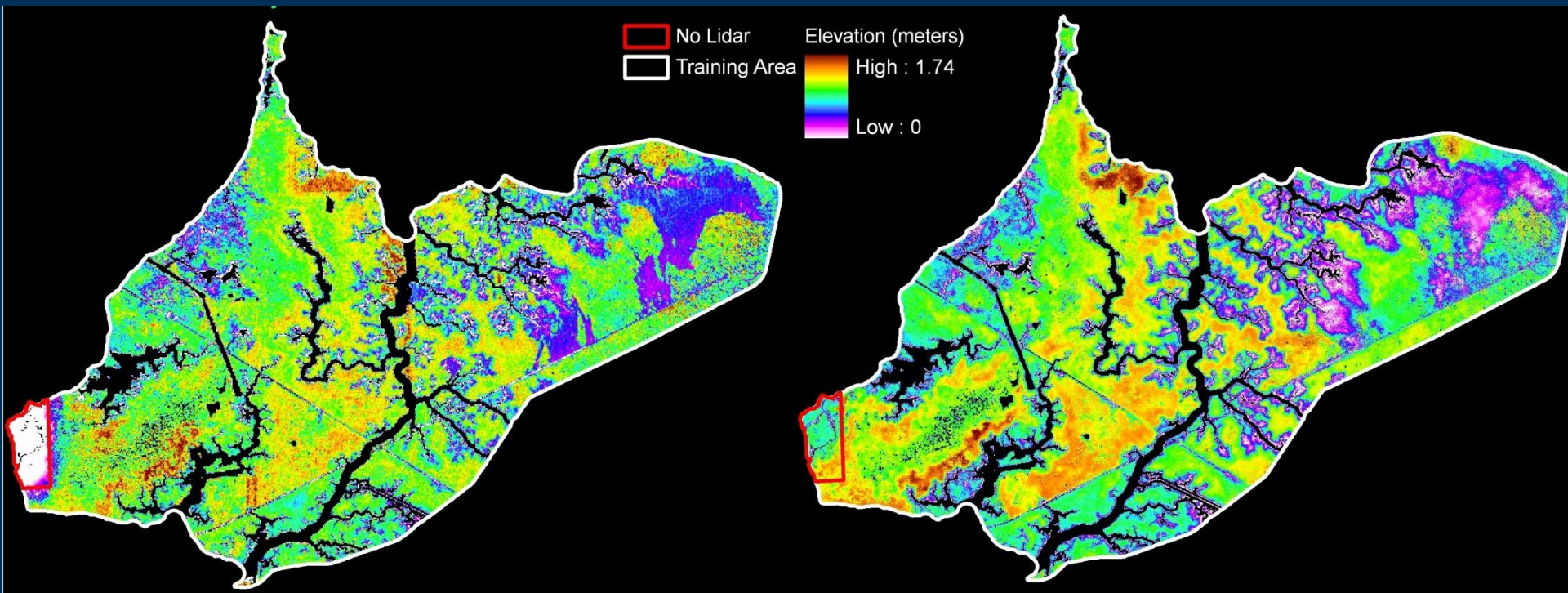
Elevation



NED (National Elevation Dataset)

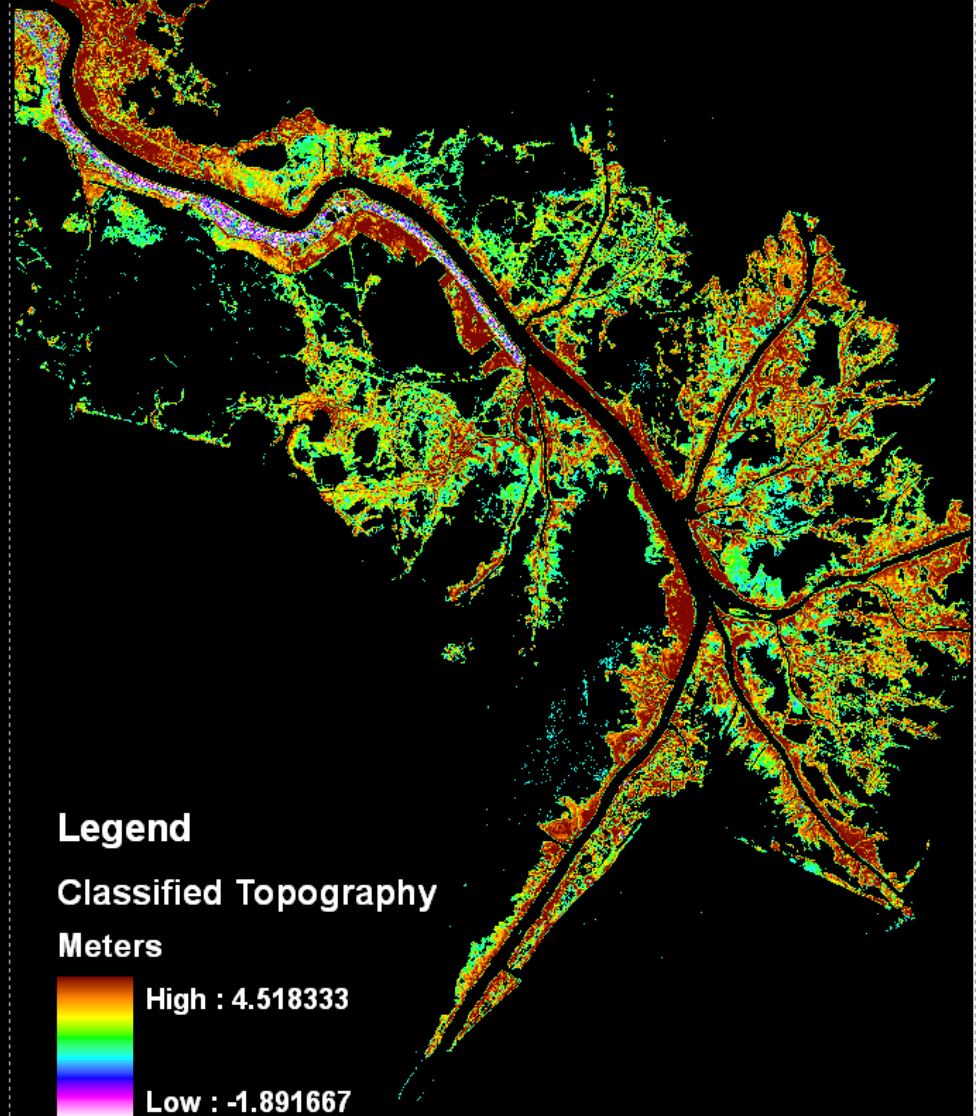
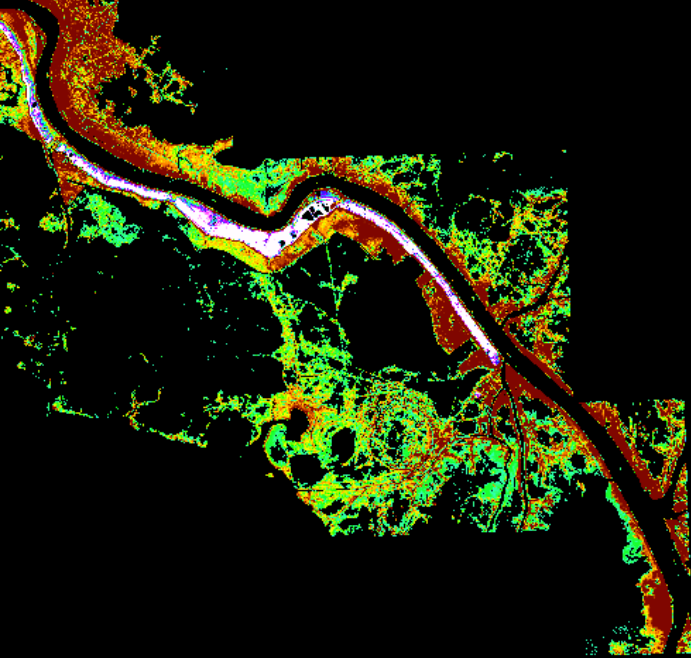


Classified Topography Results Vermilion Example

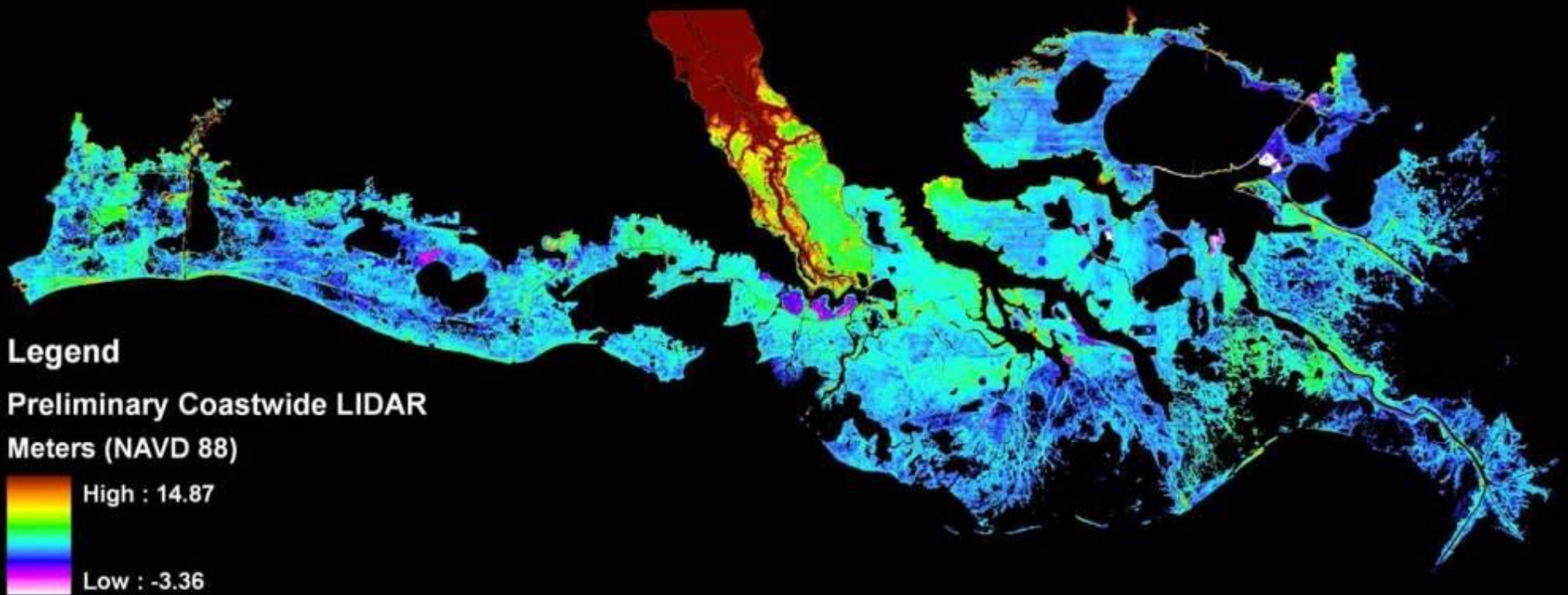


Classified Topography Results

Mississippi River Delta Example



Final Coastwide Data Composite

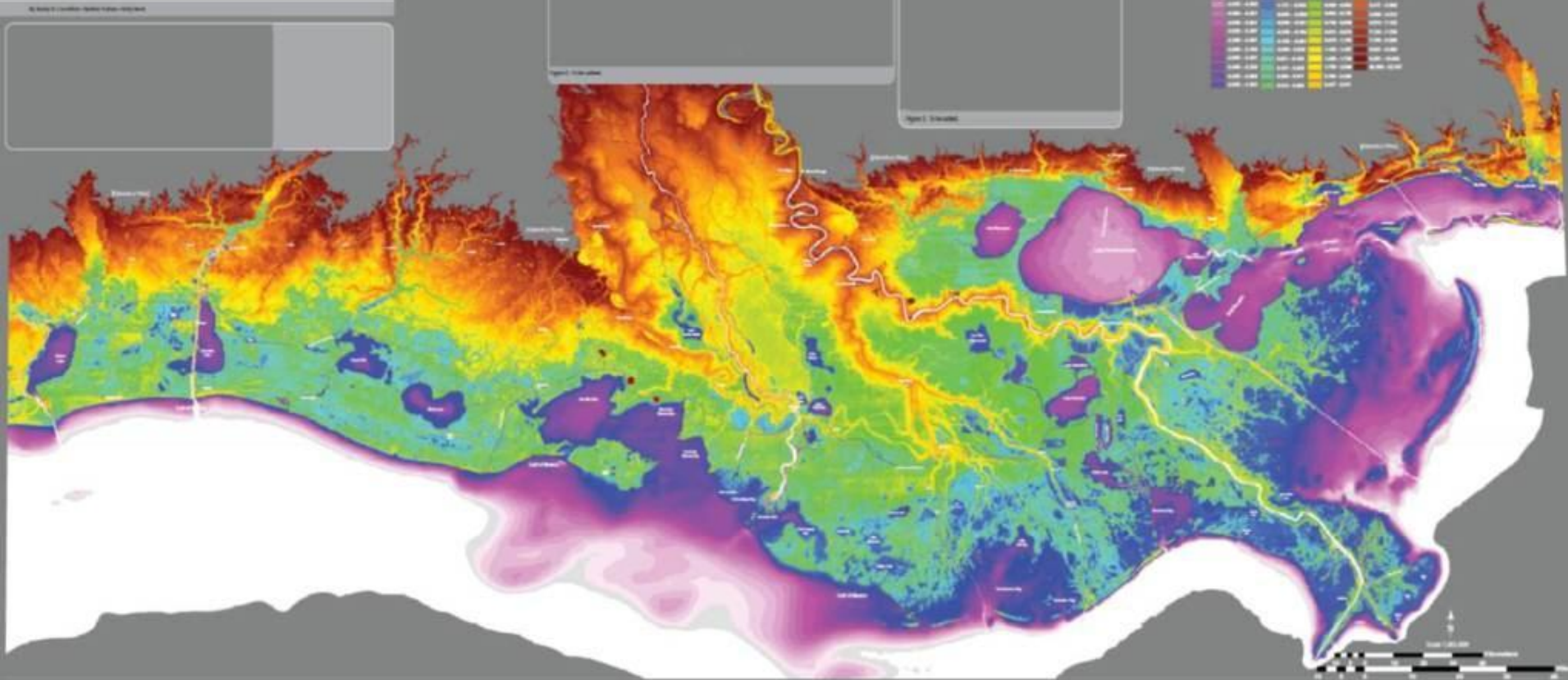
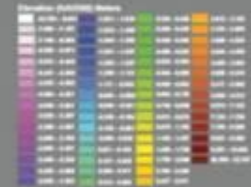


Topography/Bathymetry

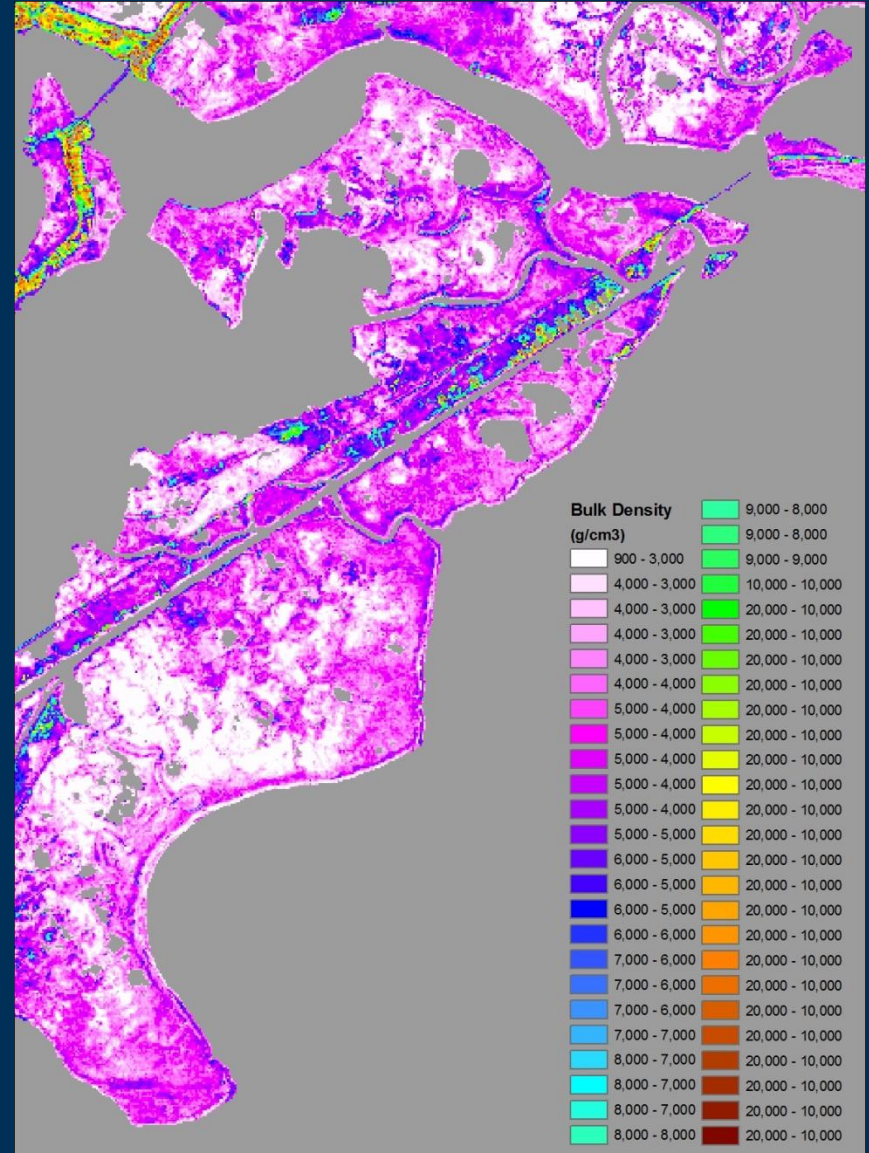
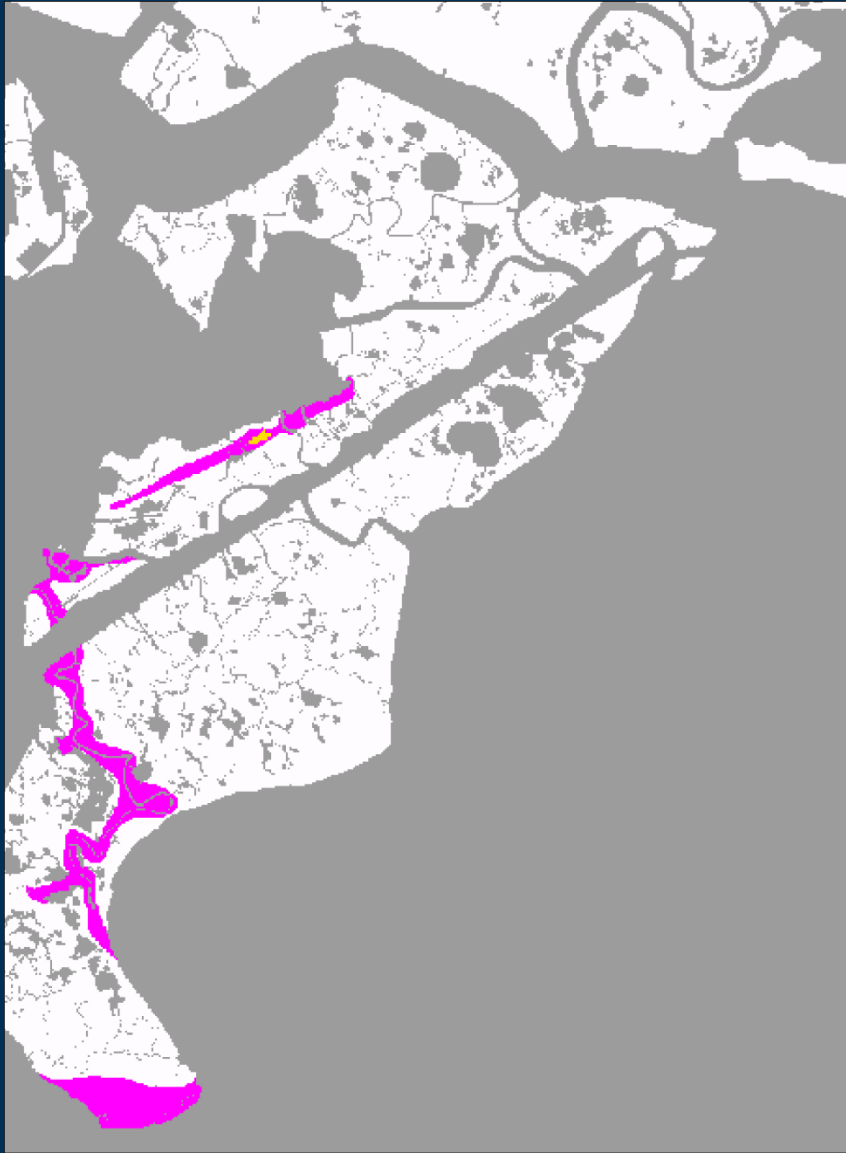


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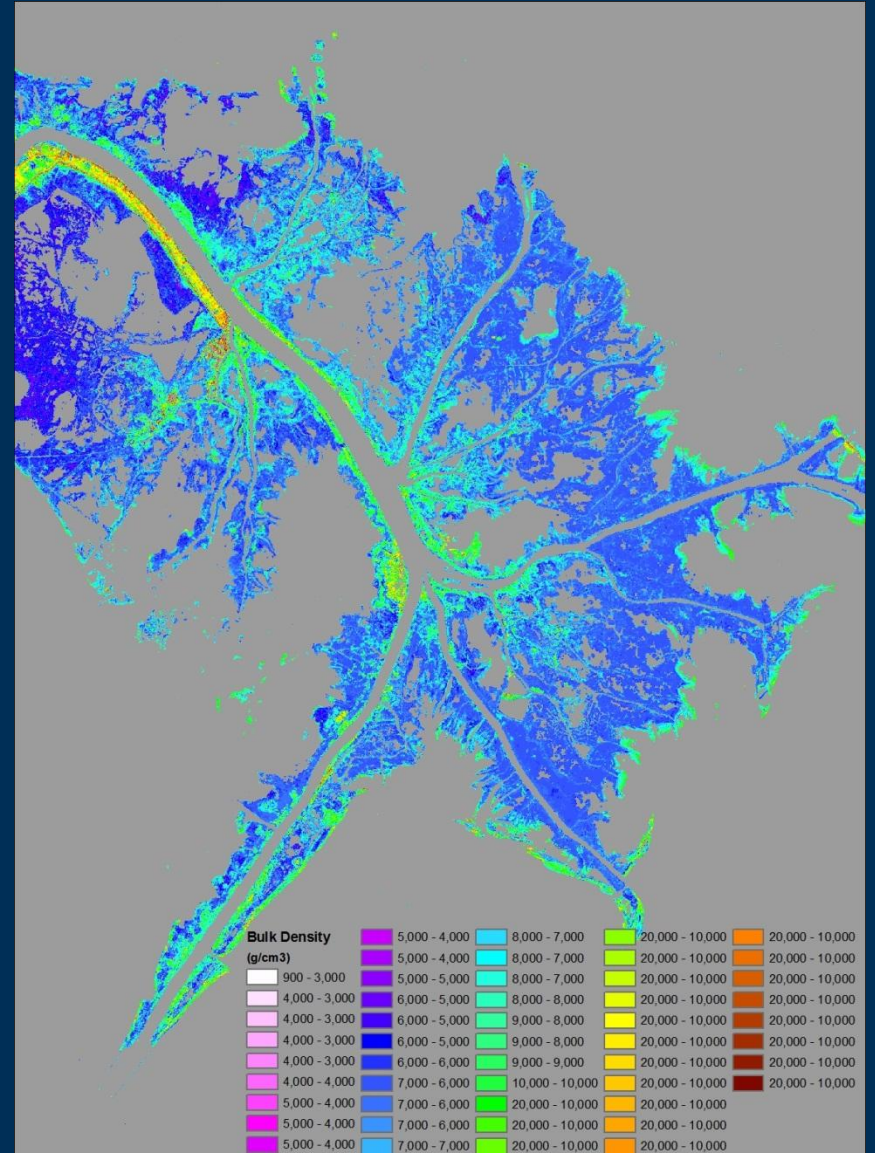
Integrated Bathymetry and Topography in the northern Gulf of Mexico



Bulk Density



Bulk Density



Summary

- Importance of multi-parameter characterization of the landscape
- Importance of spatial variability
- Importance of using training data to the best of your advantage



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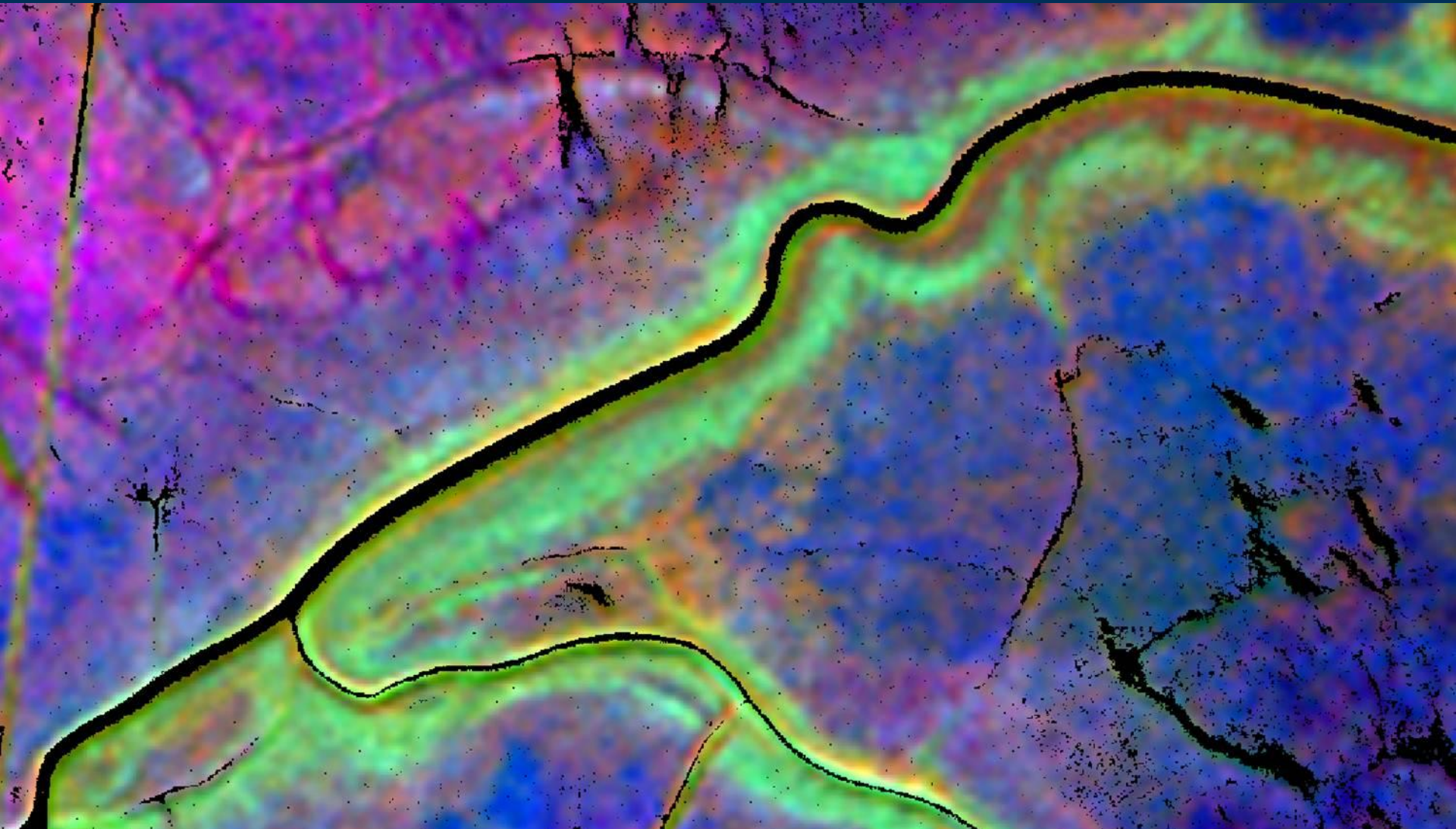
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Questions

Wetting/Drying Cycles evident in multi-temporal imagery



Wetting/Drying Cycles evident in multi-temporal imagery

