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National Wetlands Research Center

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

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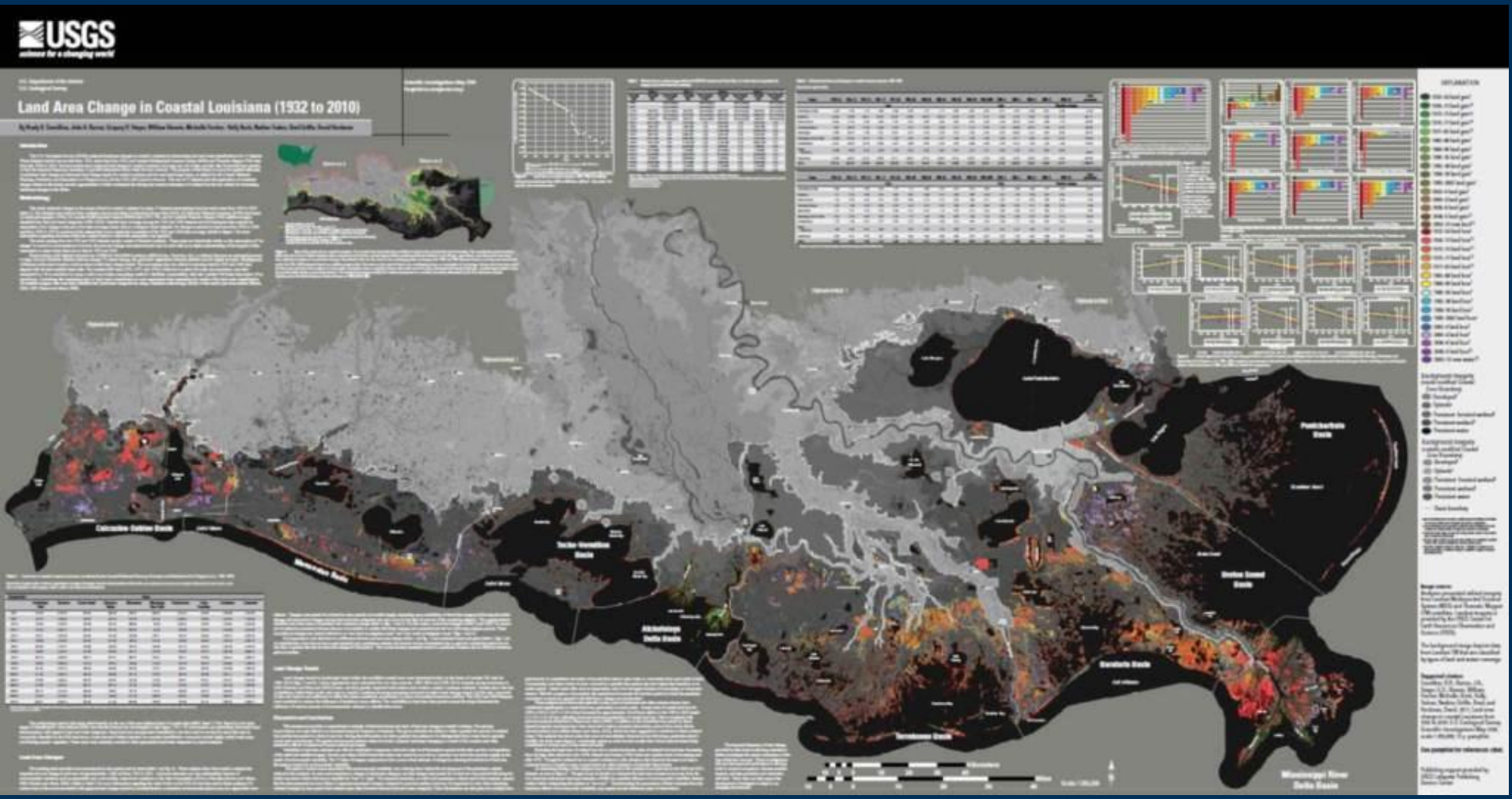
U.S. Department of the Interior
U.S. Geological Survey

Photo by: Brady Couvillion

Land Area Change in Coastal Louisiana



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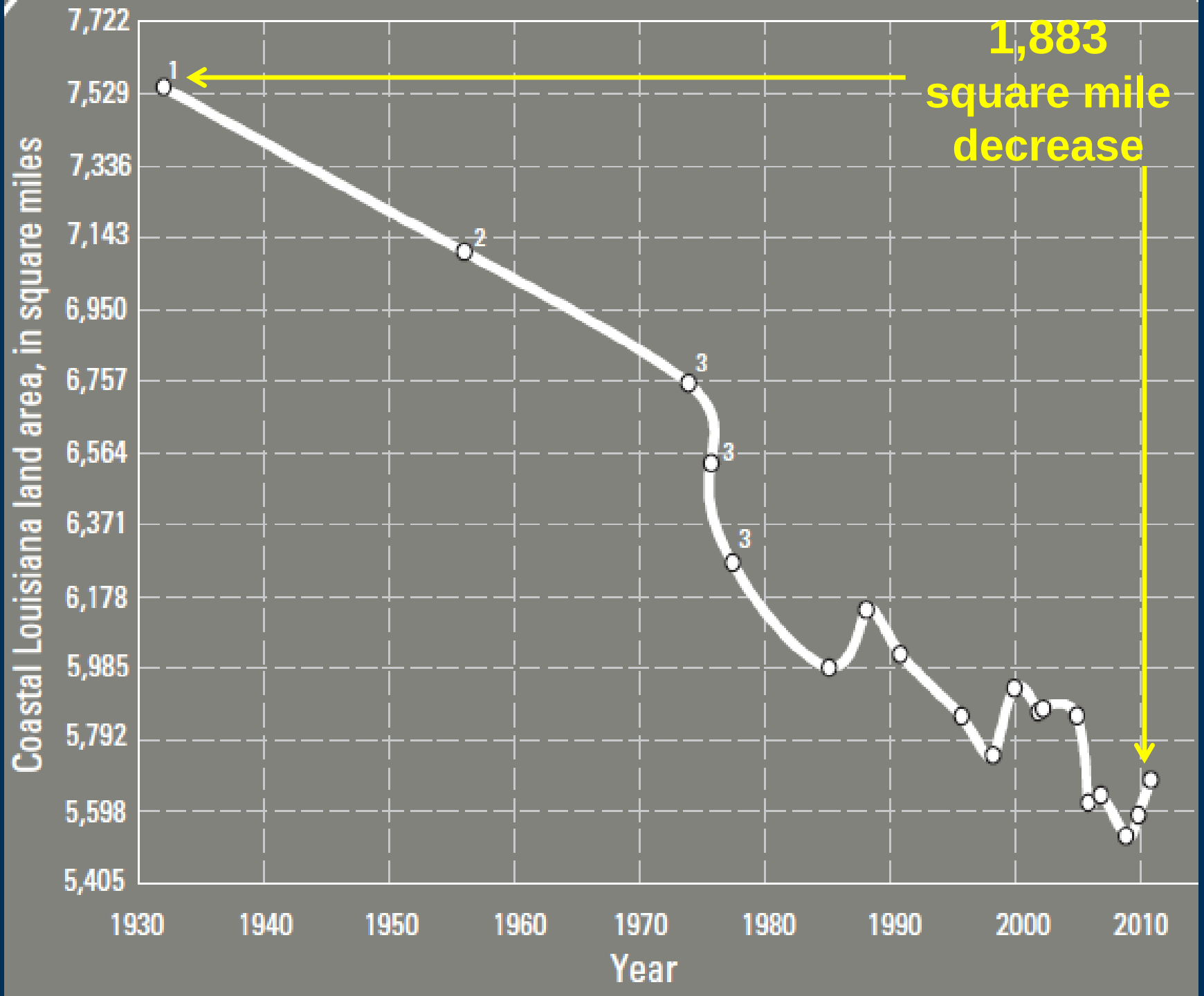
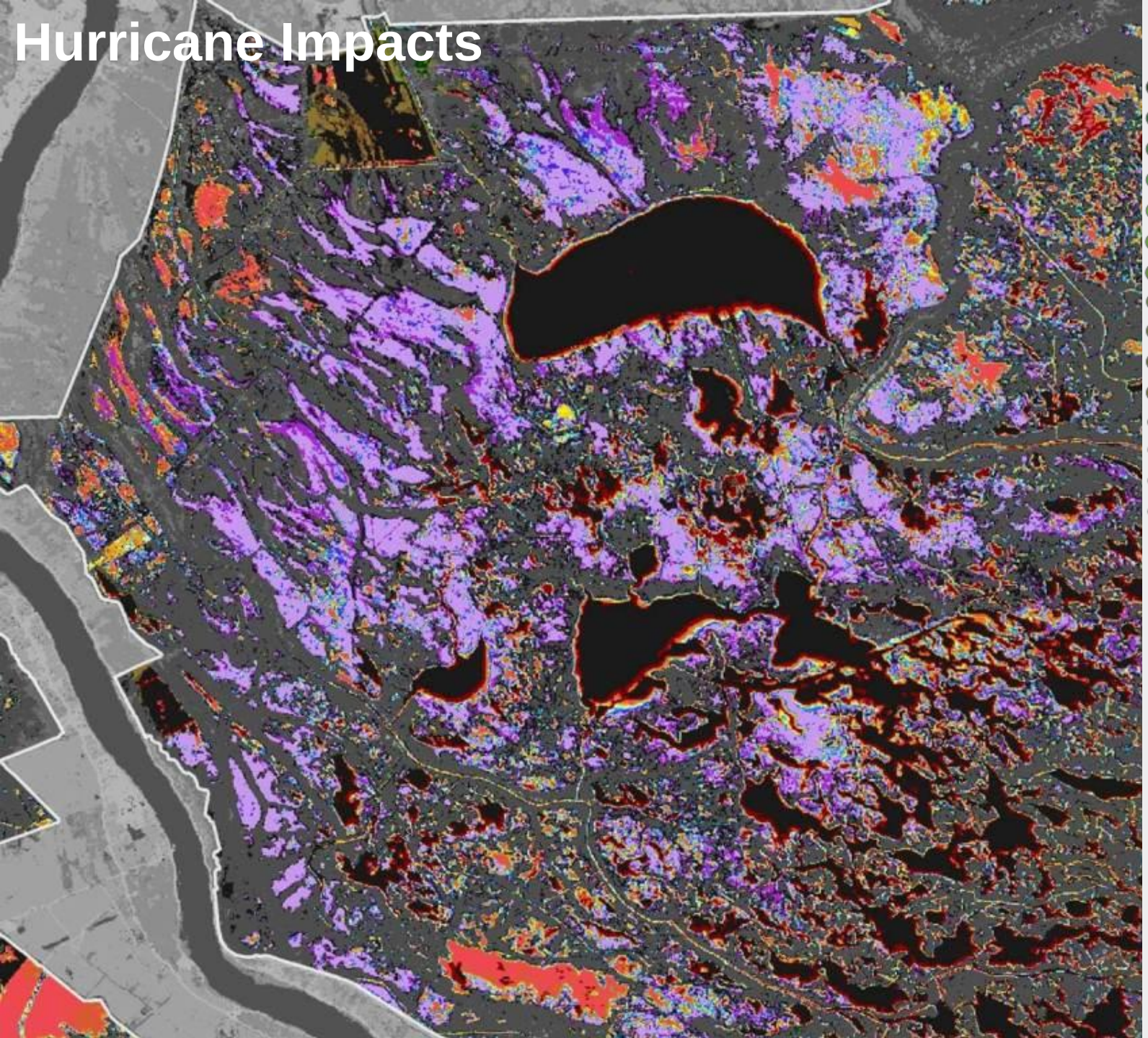

1,883
square mile
decrease
Coastal Louisiana land area, in square miles
7,722
7,529
7,336
7,143
6,950
6,757
6,564
6,371
6,178
5,985
5,792
5,598
5,405
1930
1940
1950
1960
1970
1980
1990
2000
2010
Year
1
2
3
3
3


1973
Miles
0 2.5 5 10 15 20


2010
Miles
0 2.5 5 10 15 20


1973
Miles
0 3 6 12 18 24
2010
Miles
0 3 6 12 18 24

Hurricane Impacts



EXPLANATION

- 1932–56 land gain[1]
- 1956–73 land gain[1,4]
- 1973–75 land gain[1,4]
- 1975–77 land gain[1,4]
- 1977–85 land gain[1,4]
- 1985–88 land gain[1]
- 1988–90 land gain[1]
- 1990–95 land gain[1]
- 1995–98 land gain[1]
- 1998–99 land gain[1]
- 1999–2002 land gain[1]
- 2002–4 land gain[1]
- 2004–6 land gain[1]
- 2006–8 land gain[1]
- 2008–9 land gain[1,3]
- 2009–10 new land[1,3]
- 1932–56 land loss[2]
- 1956–73 land loss[2,4]
- 1973–75 land loss[2,4]
- 1975–77 land loss[2,4]
- 1977–85 land loss[2,4]
- 1985–88 land loss[2]
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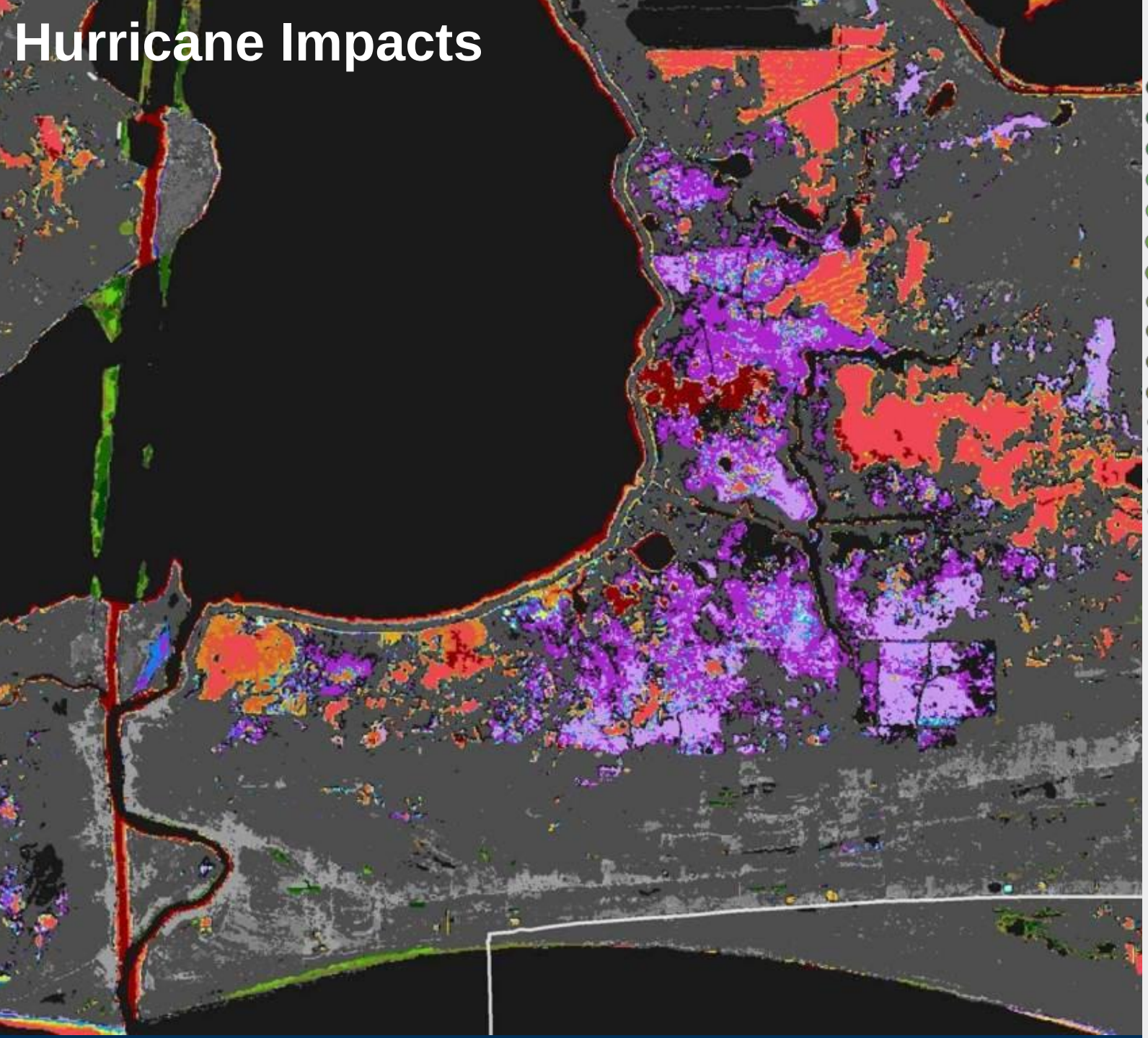
- 2004–6 land loss[2]
- 2006–8 land loss[2]
- 2008–9 land loss[2,3]
- 2009–10 new water[2,3]

Hurricane Impacts



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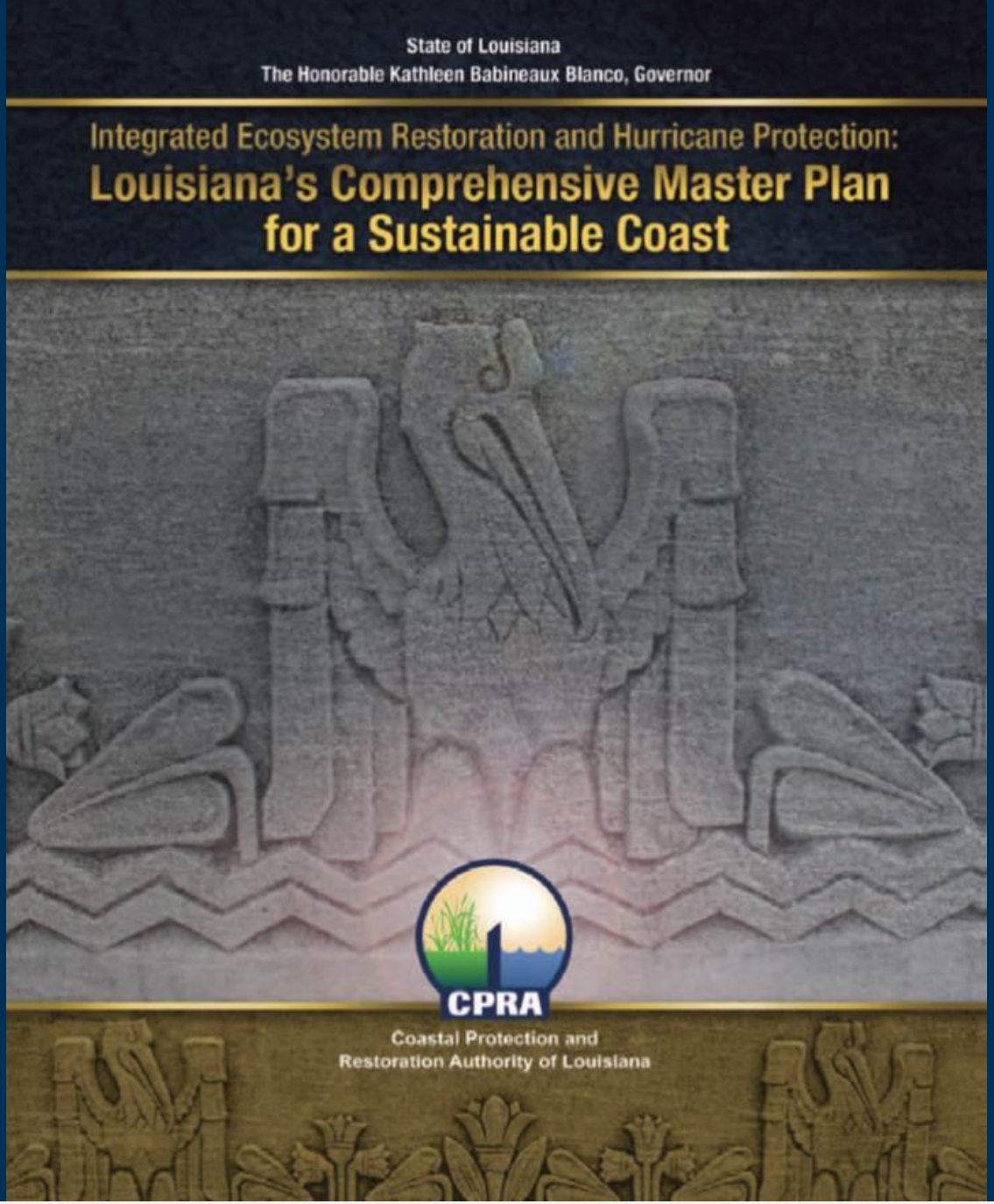
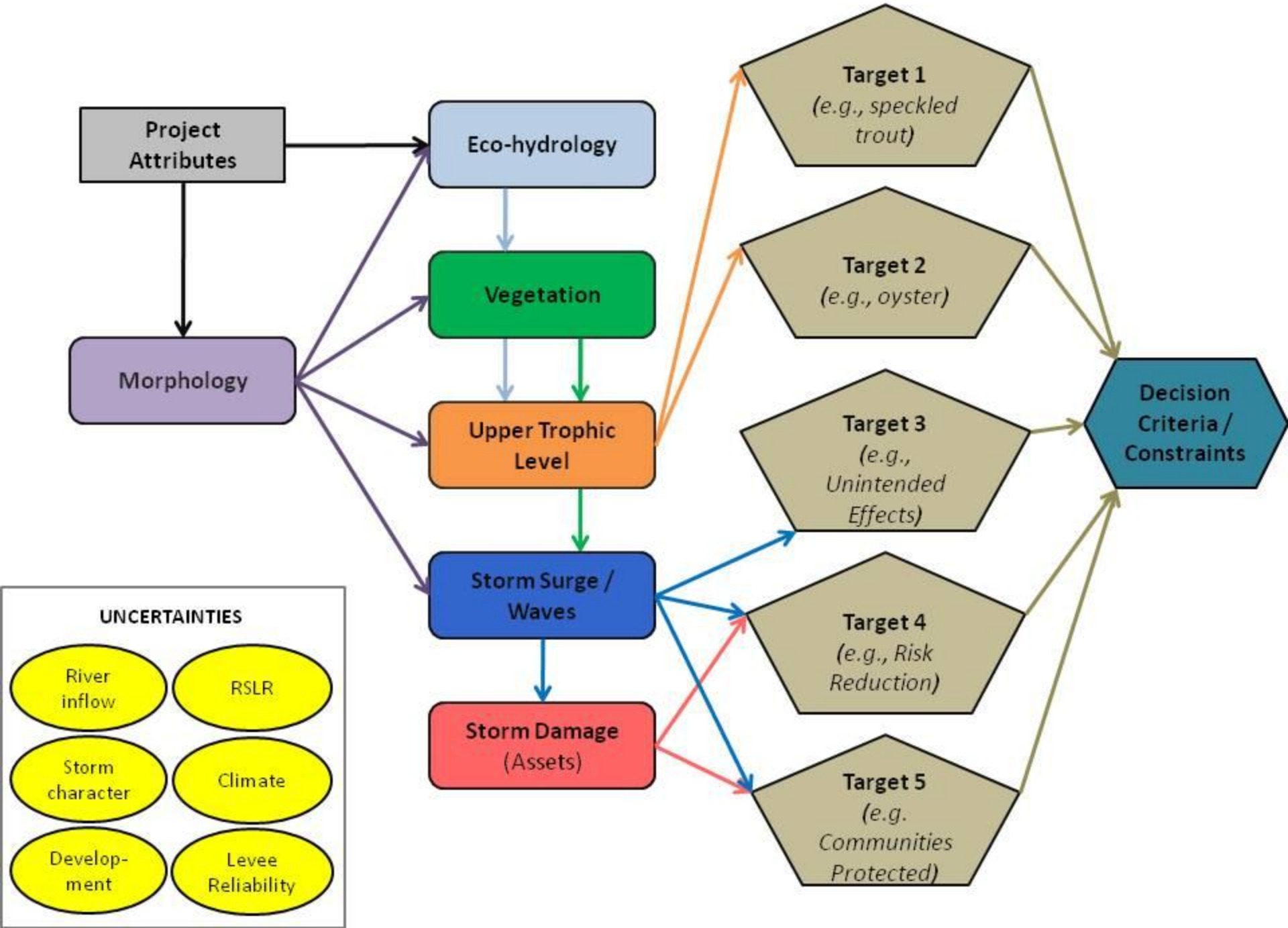
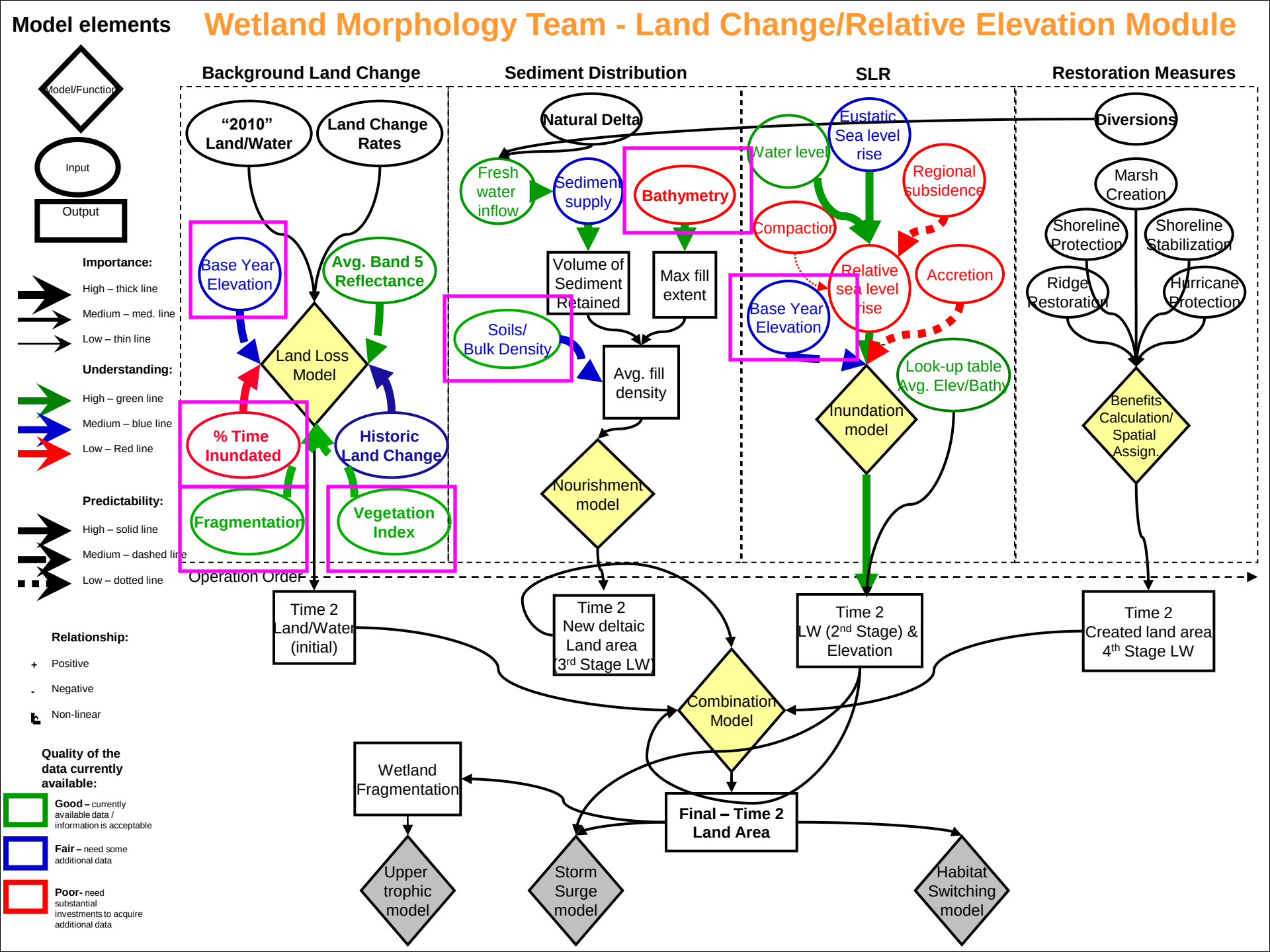


http://www.lacpra.org/assets/docs/cprafinalreport5-2-07.pdf


Project Attributes
Eco-hydrology
Vegetation
Morphology
Upper Trophic Level
Storm Surge / Waves
Storm Damage (Assets)
Target 1 (e.g., speckled trout)
Target 2 (e.g., oyster)
Target 3 (e.g., Unintended Effects)
Target 4 (e.g., Risk Reduction)
Target 5 (e.g. Communities Protected)
Decision Criteria / Constraints
UNCERTAINTIES
River inflow
RSLR
Storm character
Climate
Develop-ment
Levee Reliability

Wetland Morphology Team - Land Change/Relative Elevation Module



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.

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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.

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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.

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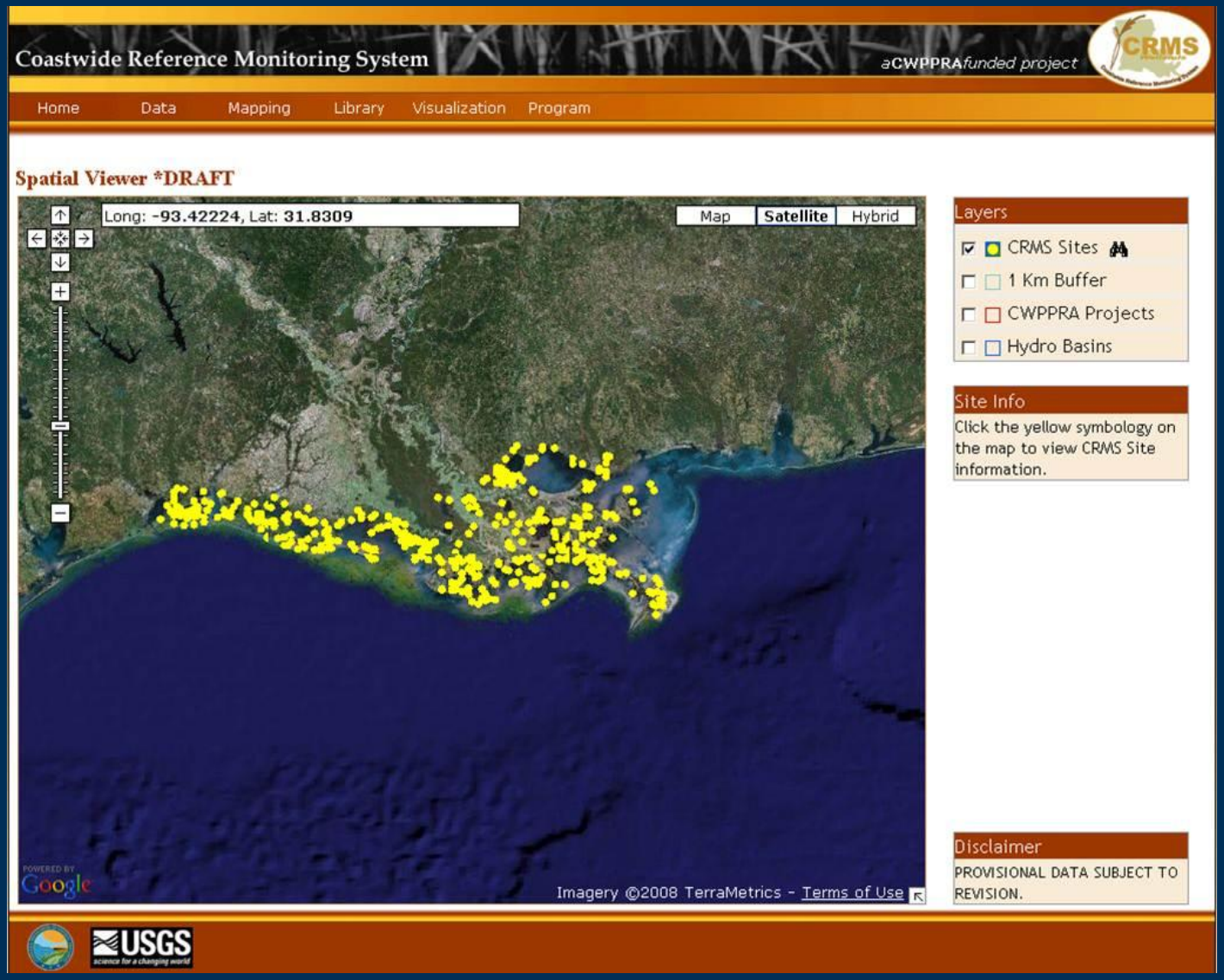
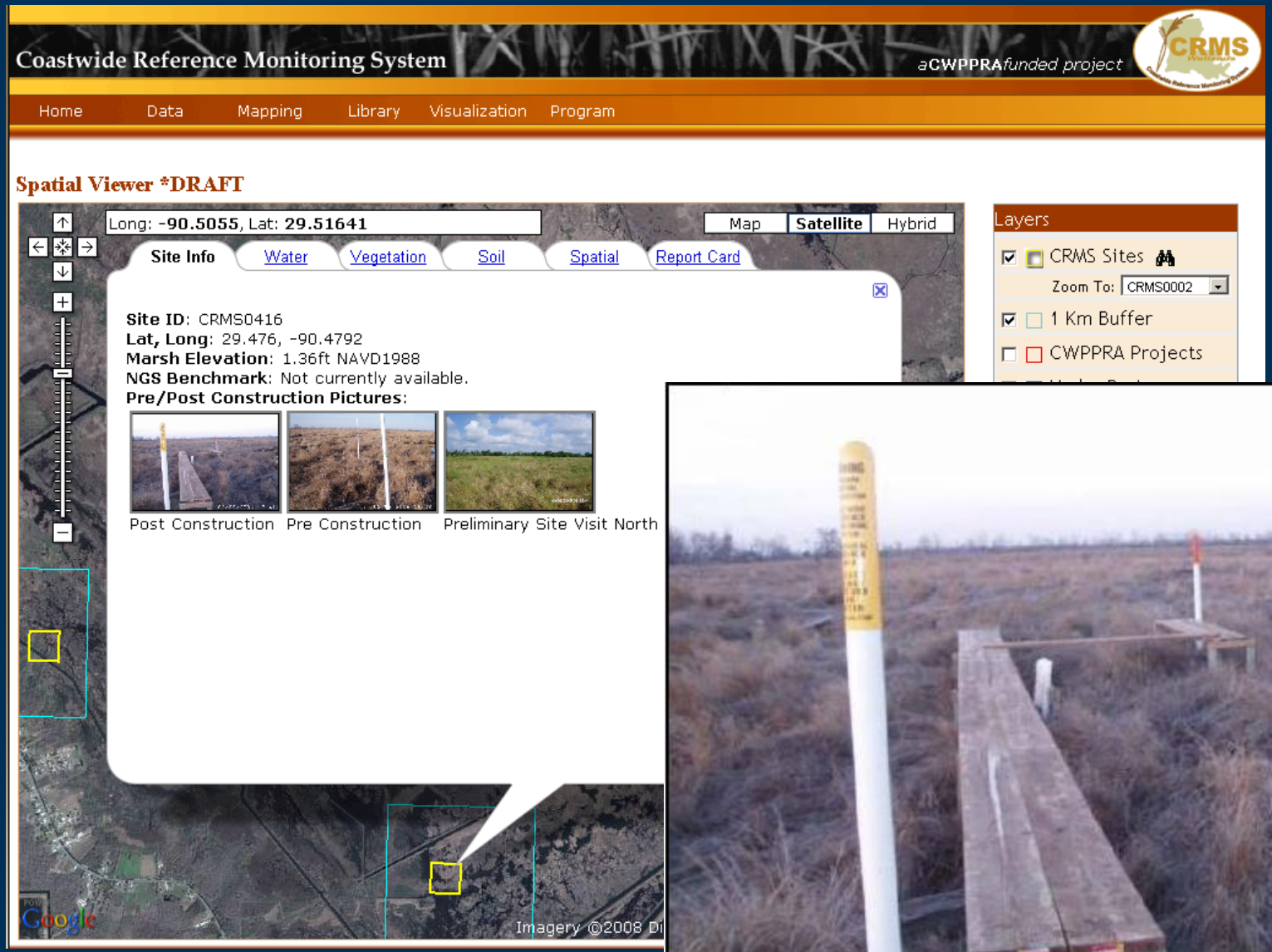
Coastwide Reference Monitoring System

- 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

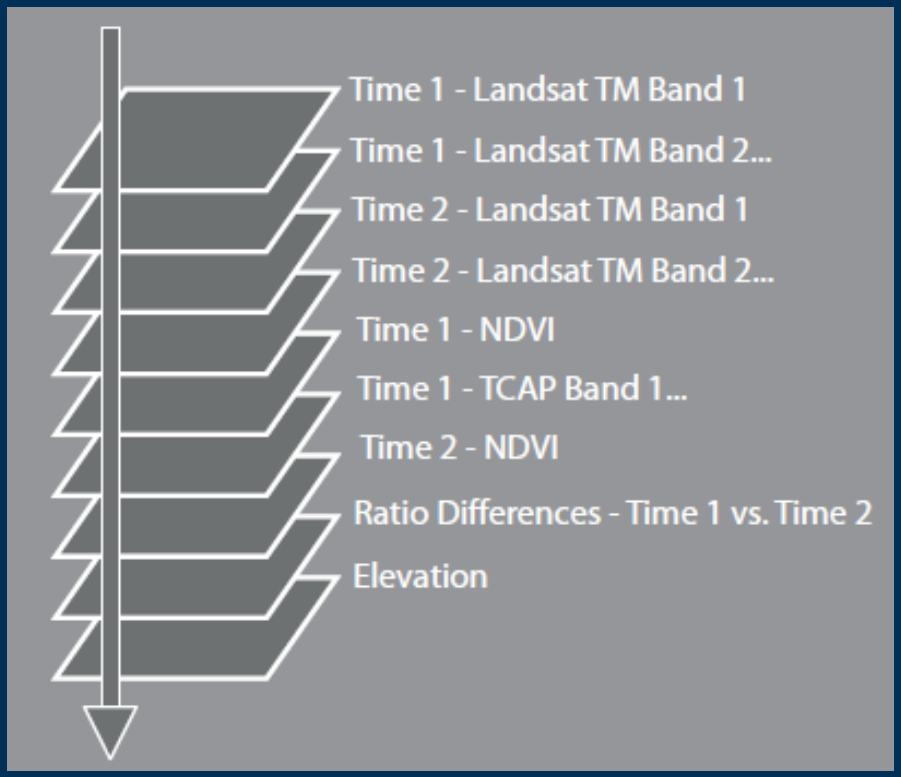
CRMS Website

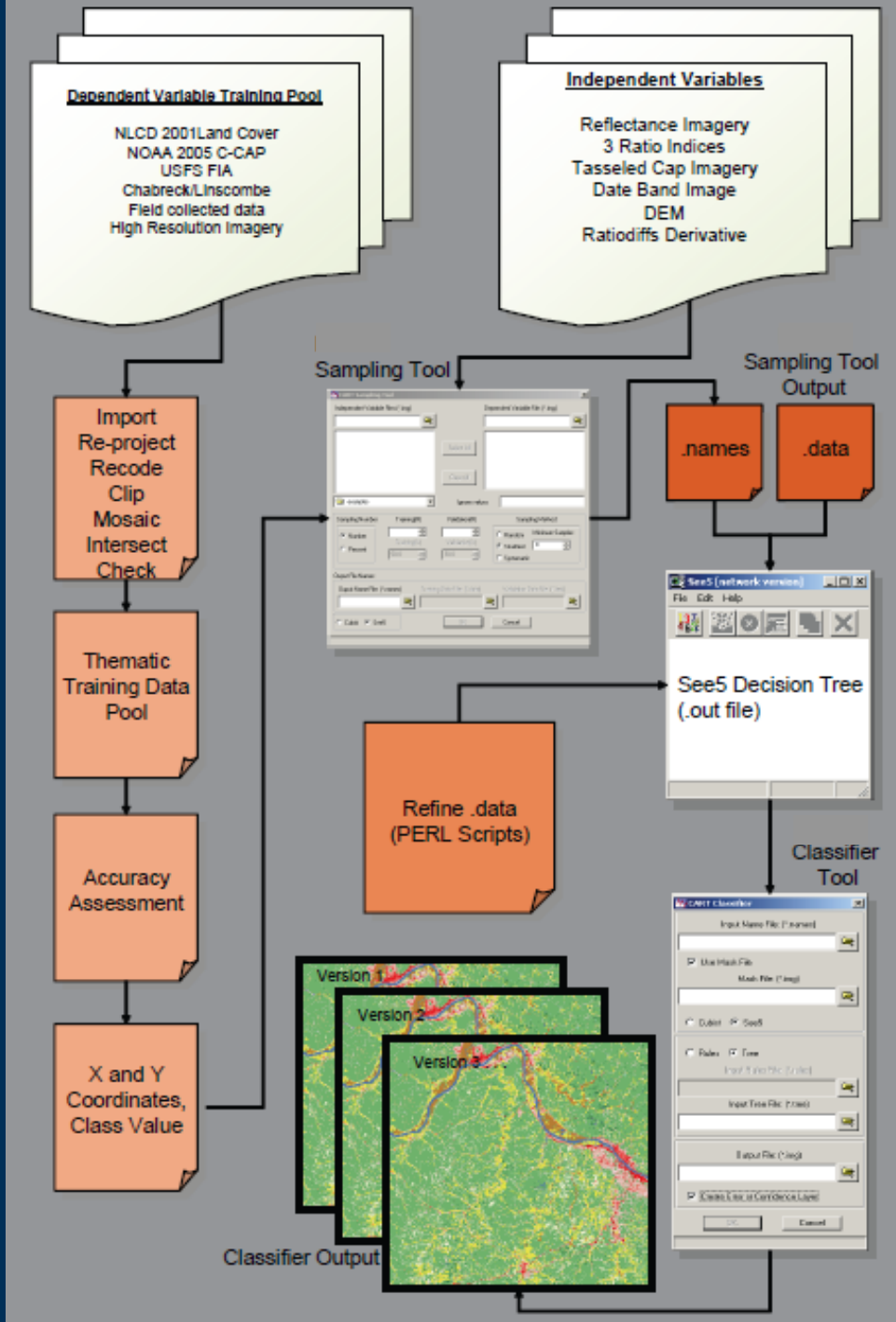


CRMS Website



Methodology





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Generalized diargam of classifcation 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

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Landscape Characterization

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

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Landscape Characterization

EXAMPLES

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Landscape Characterization

Land Use Land Cover

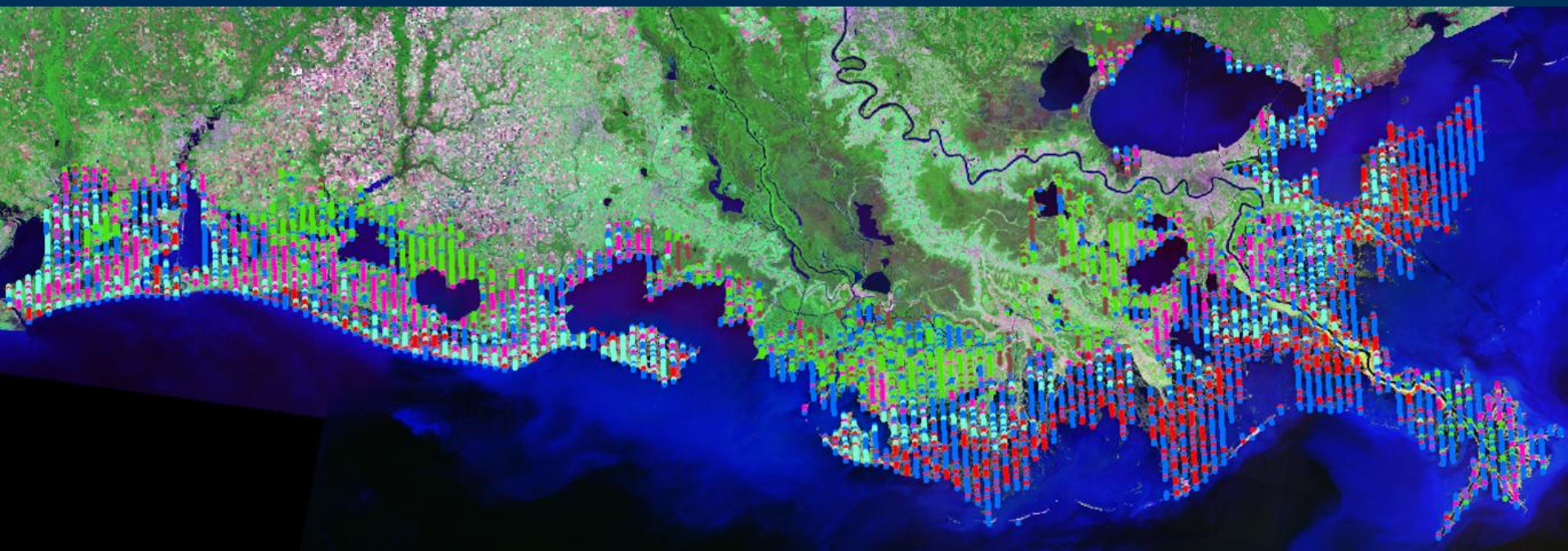
Landscape Characterization

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

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.

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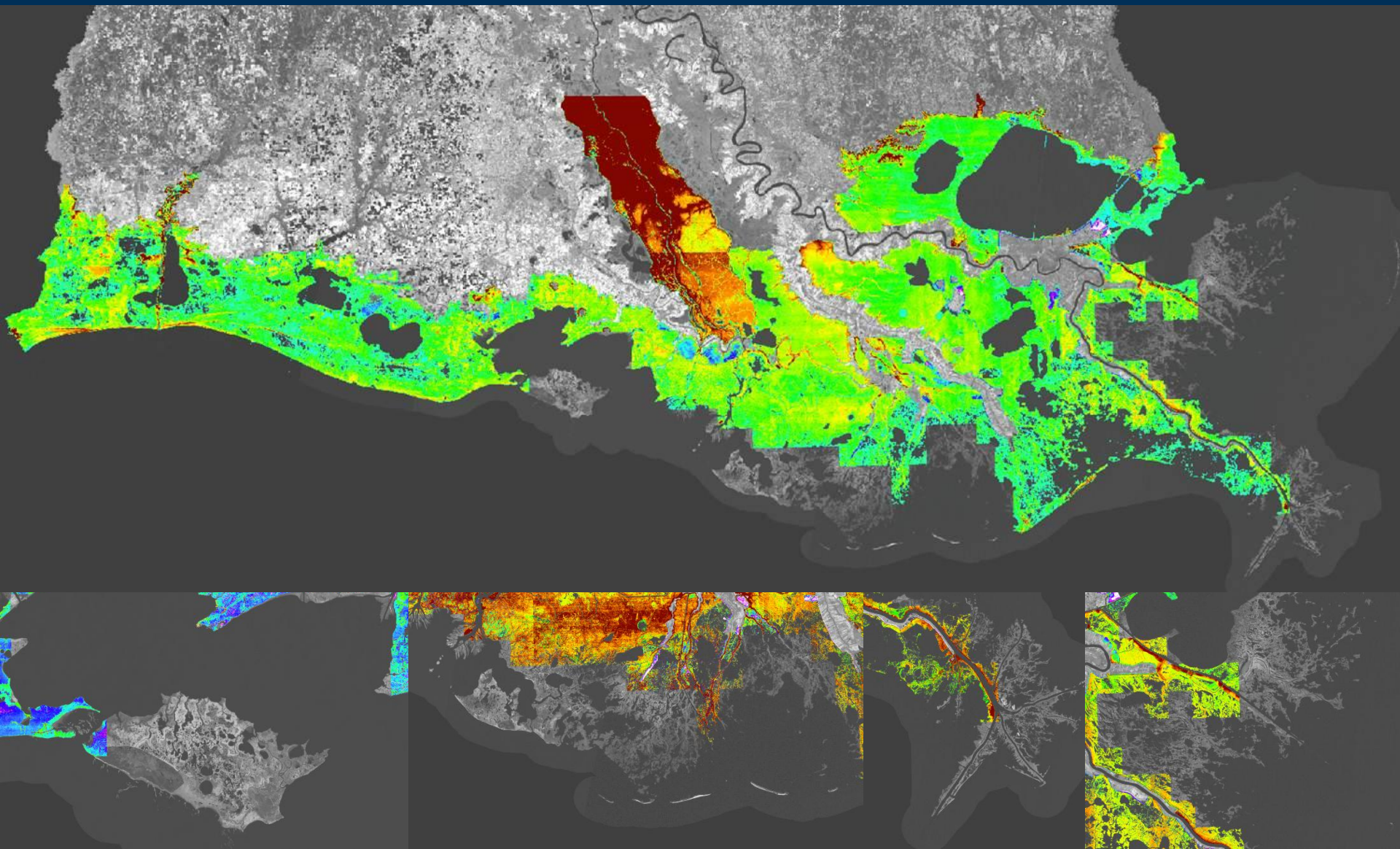
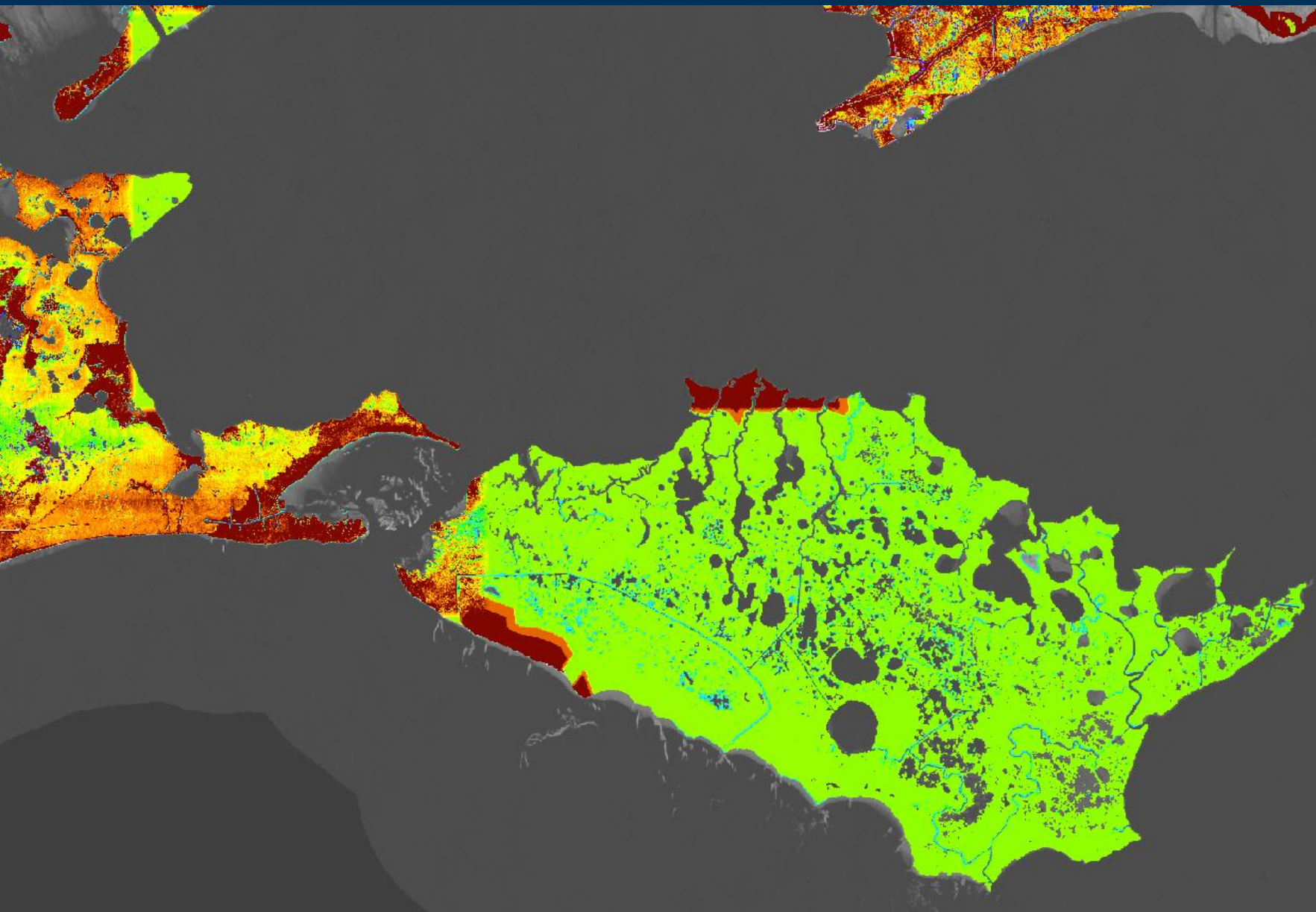
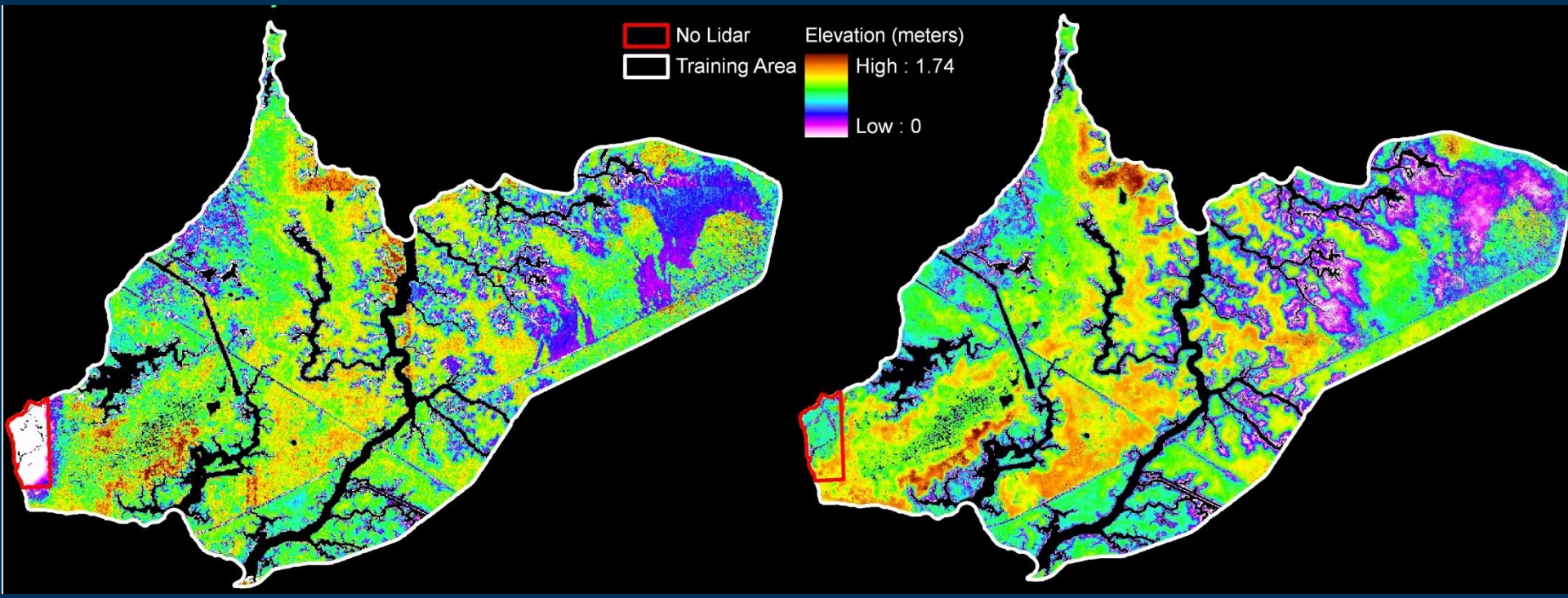
Elevation



NED (National Elevation Dataset)



Classified Topography Results
Vermilion Example



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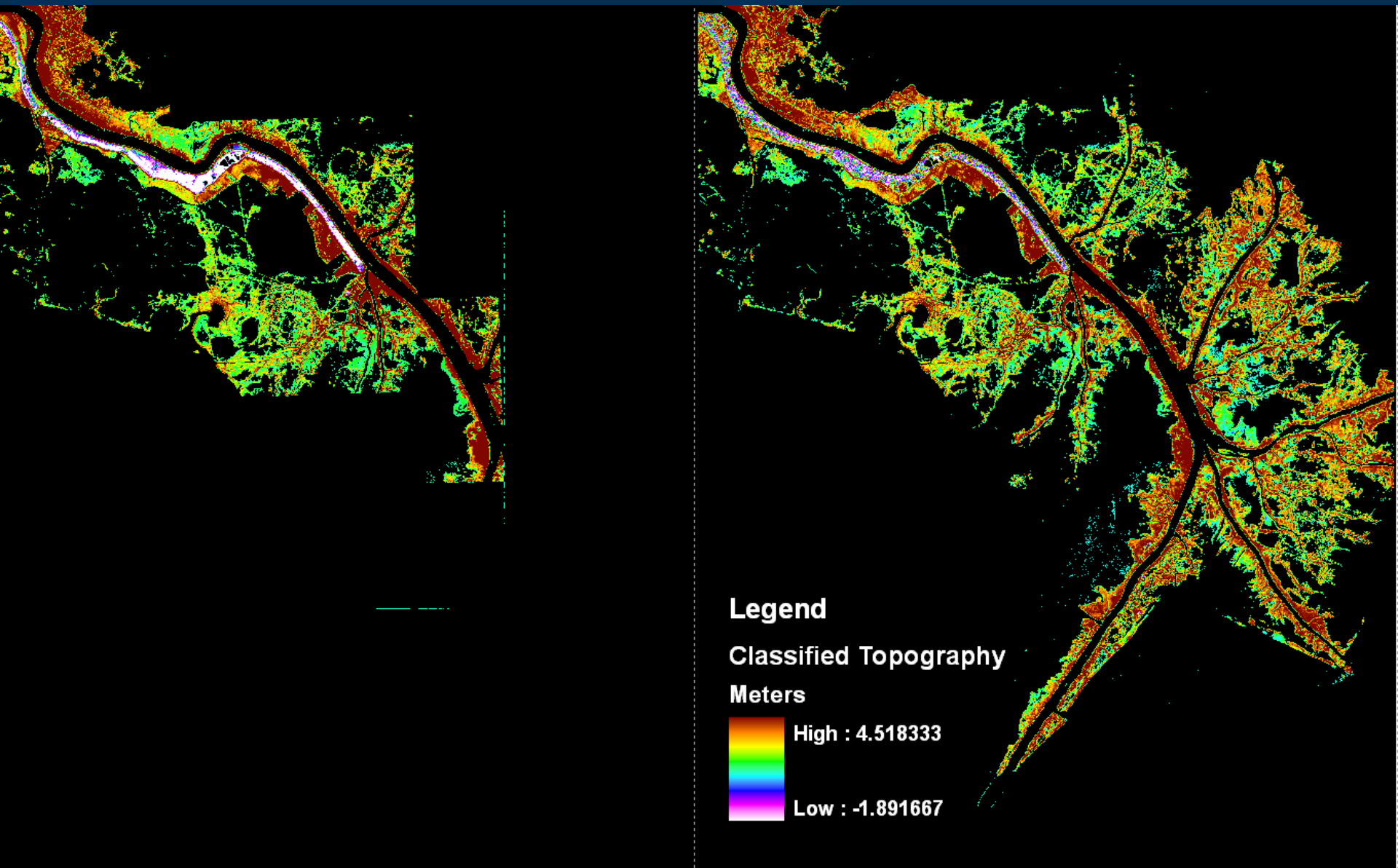
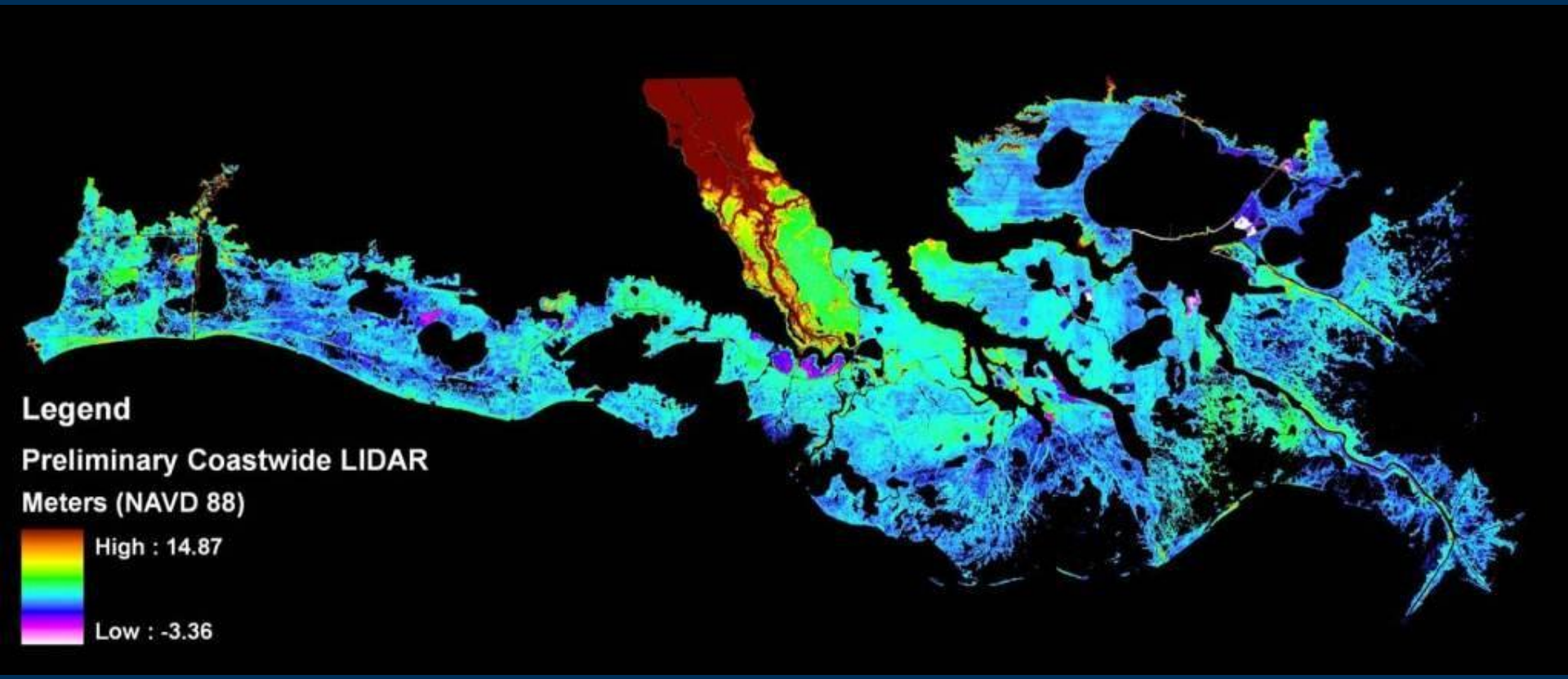
Classified Topography Results

Mississippi River Delta Example



Final Coastwide Data Composite



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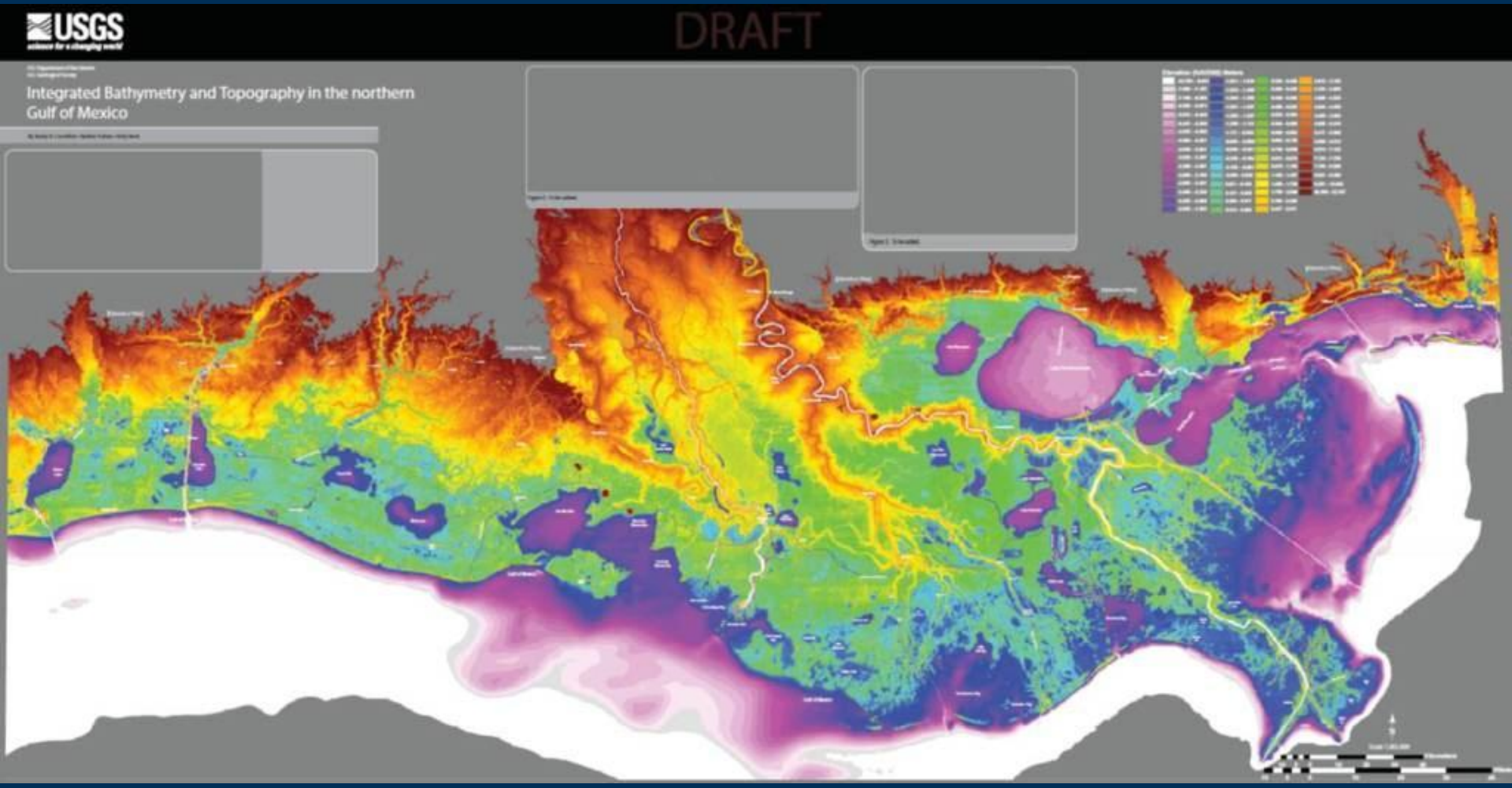
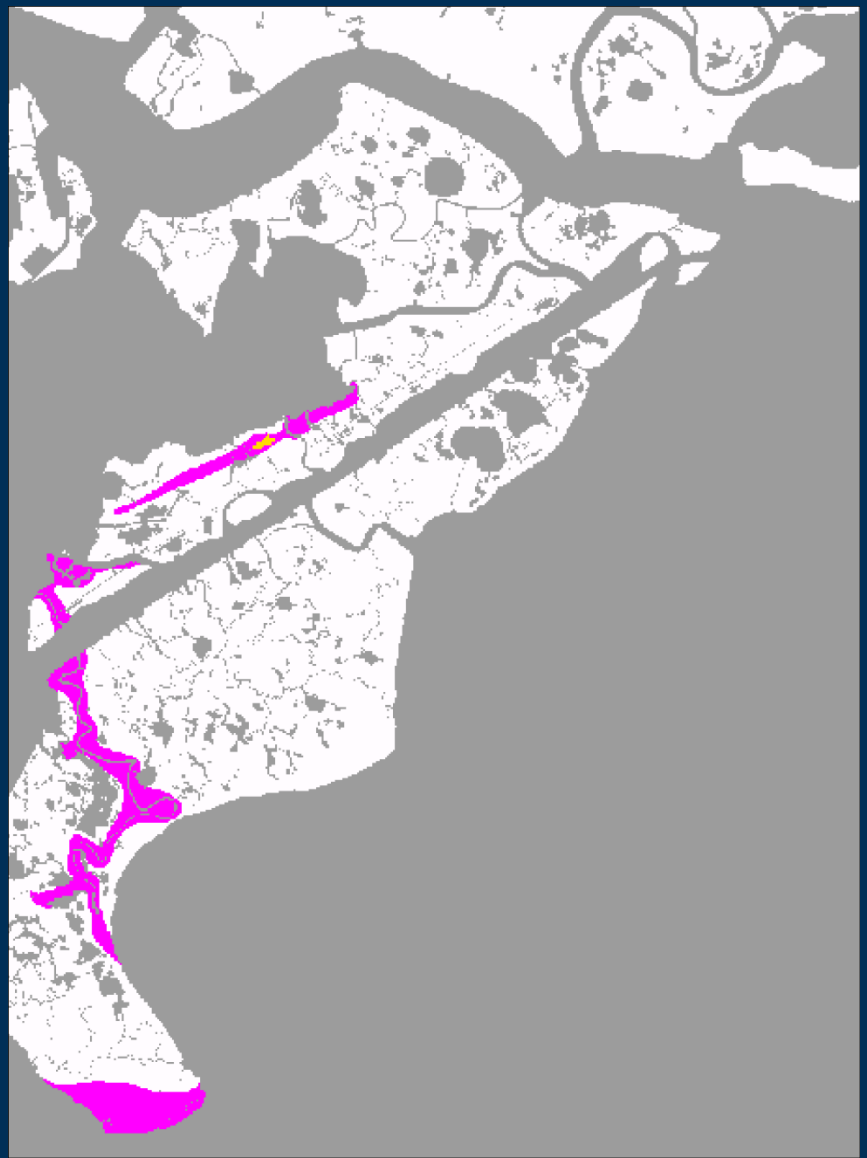
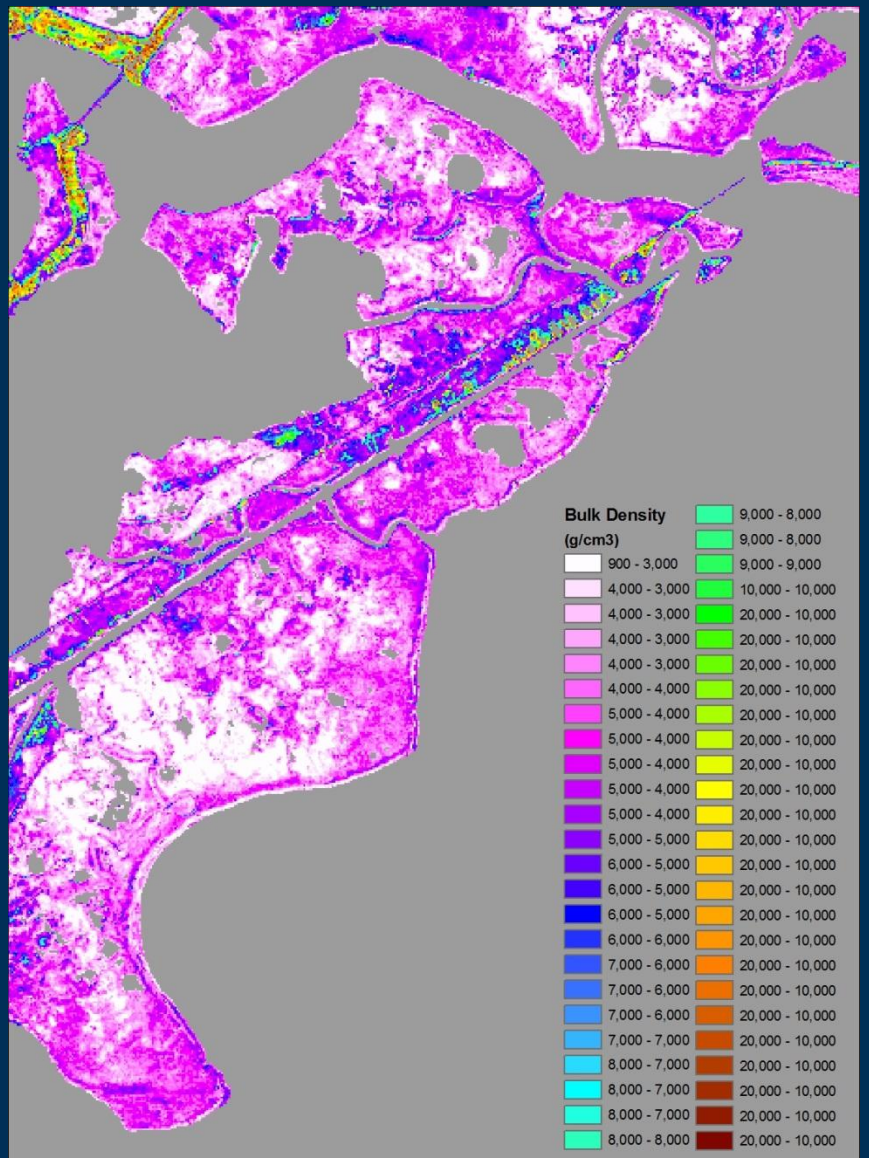
DRAFT

Topography/Bathymetry



Bulk Density





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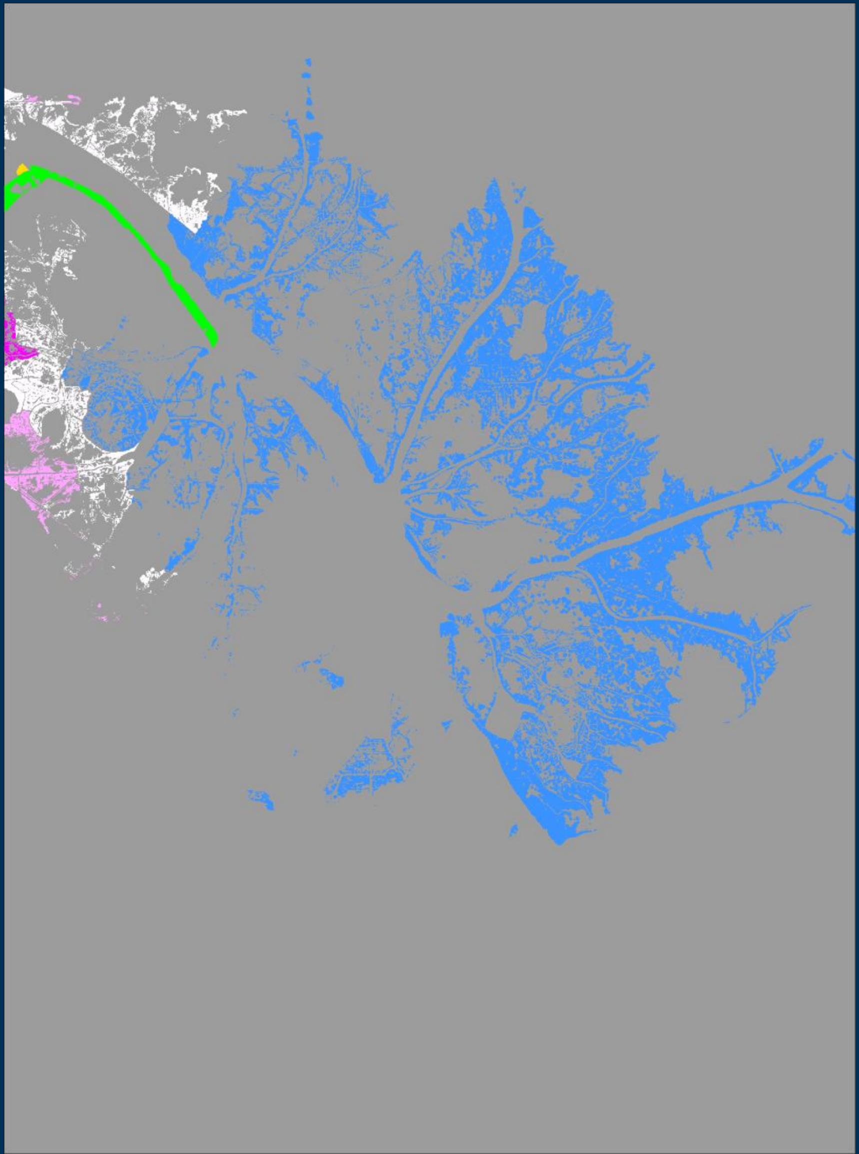

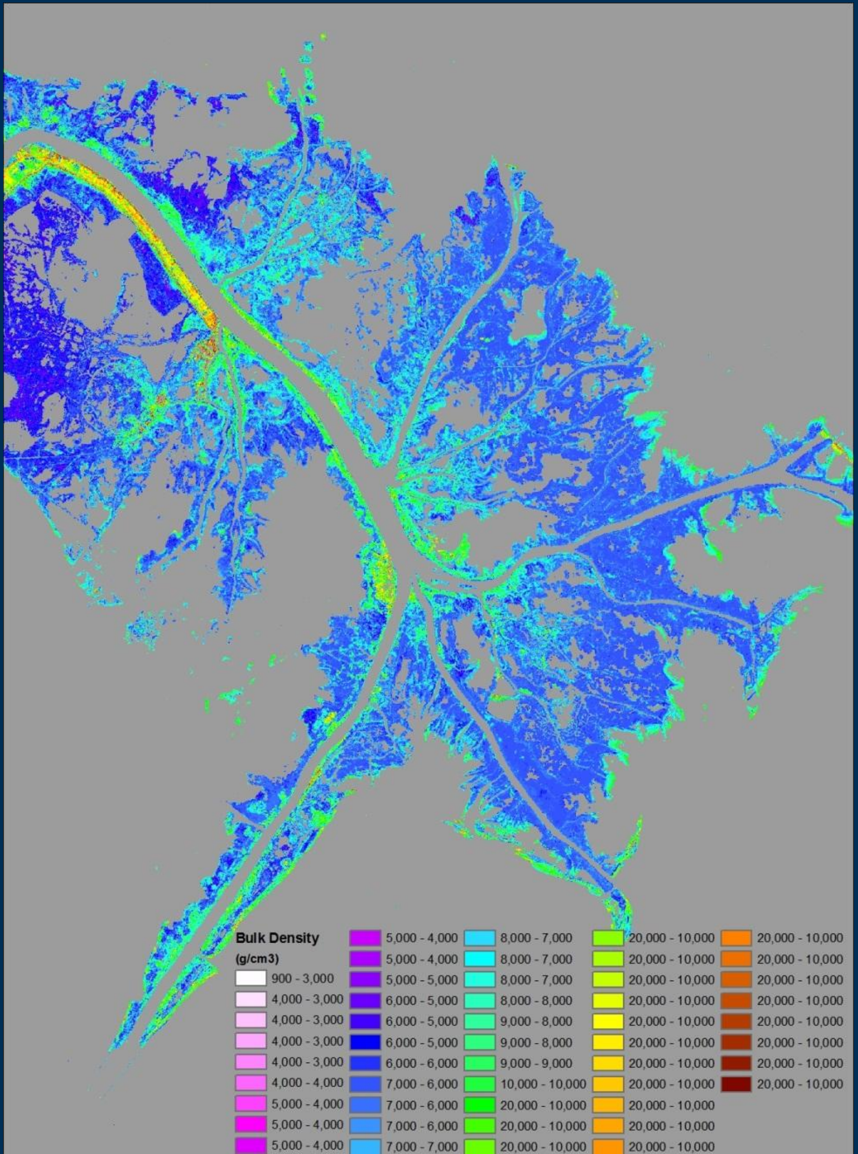

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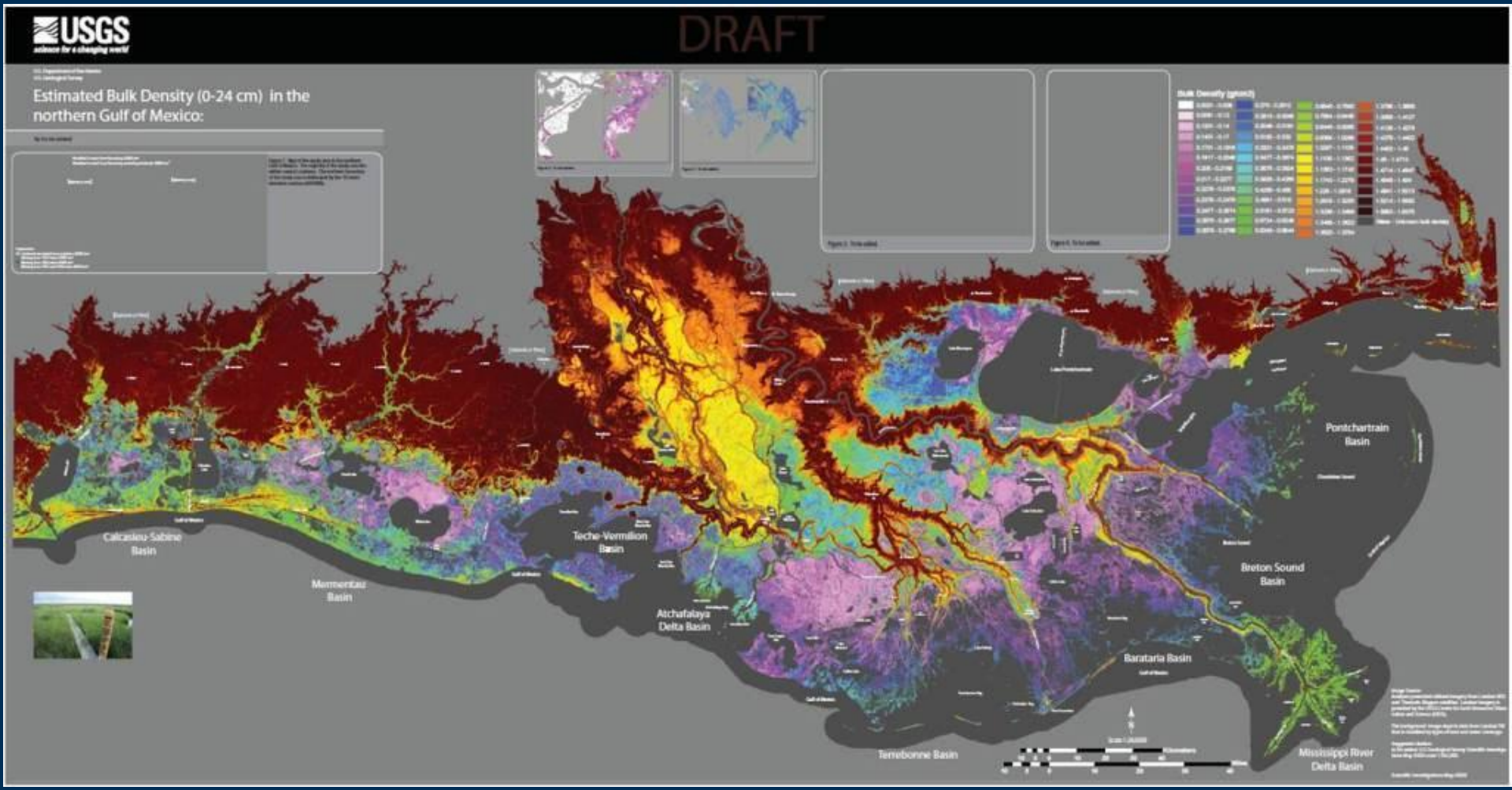
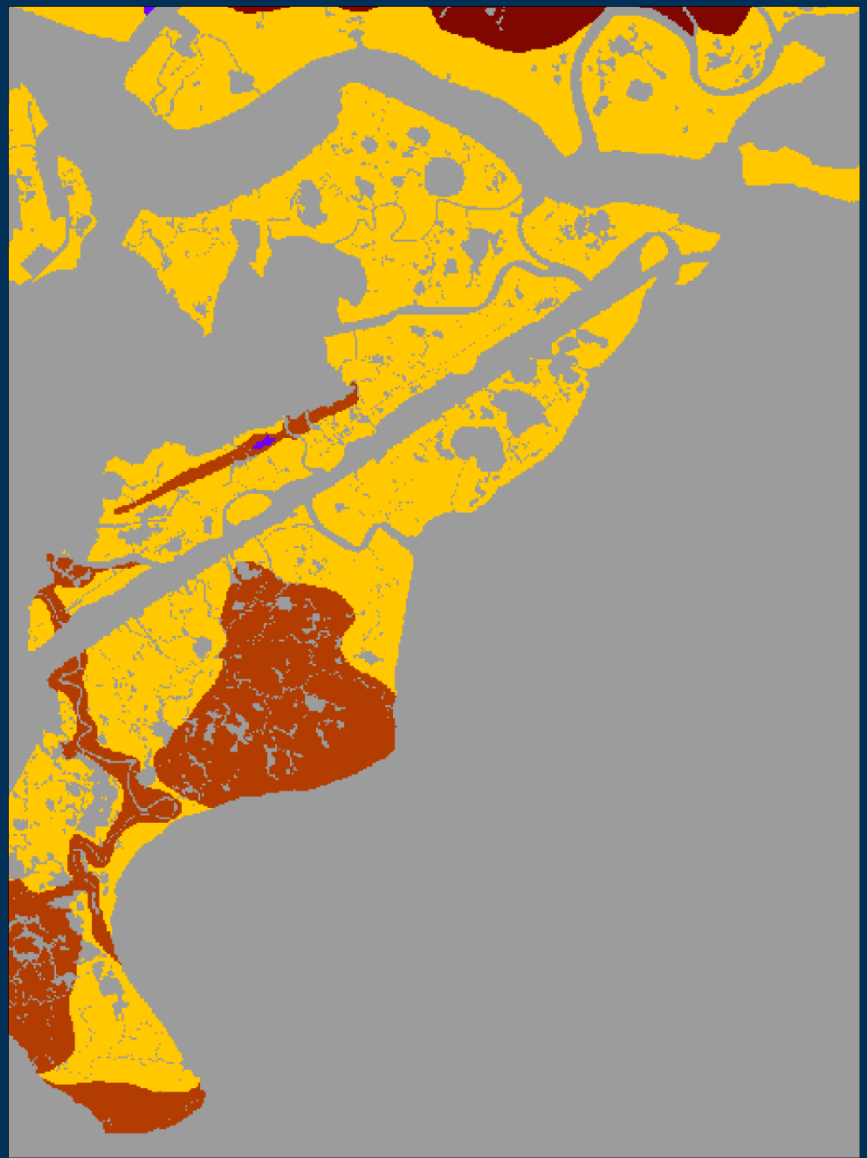
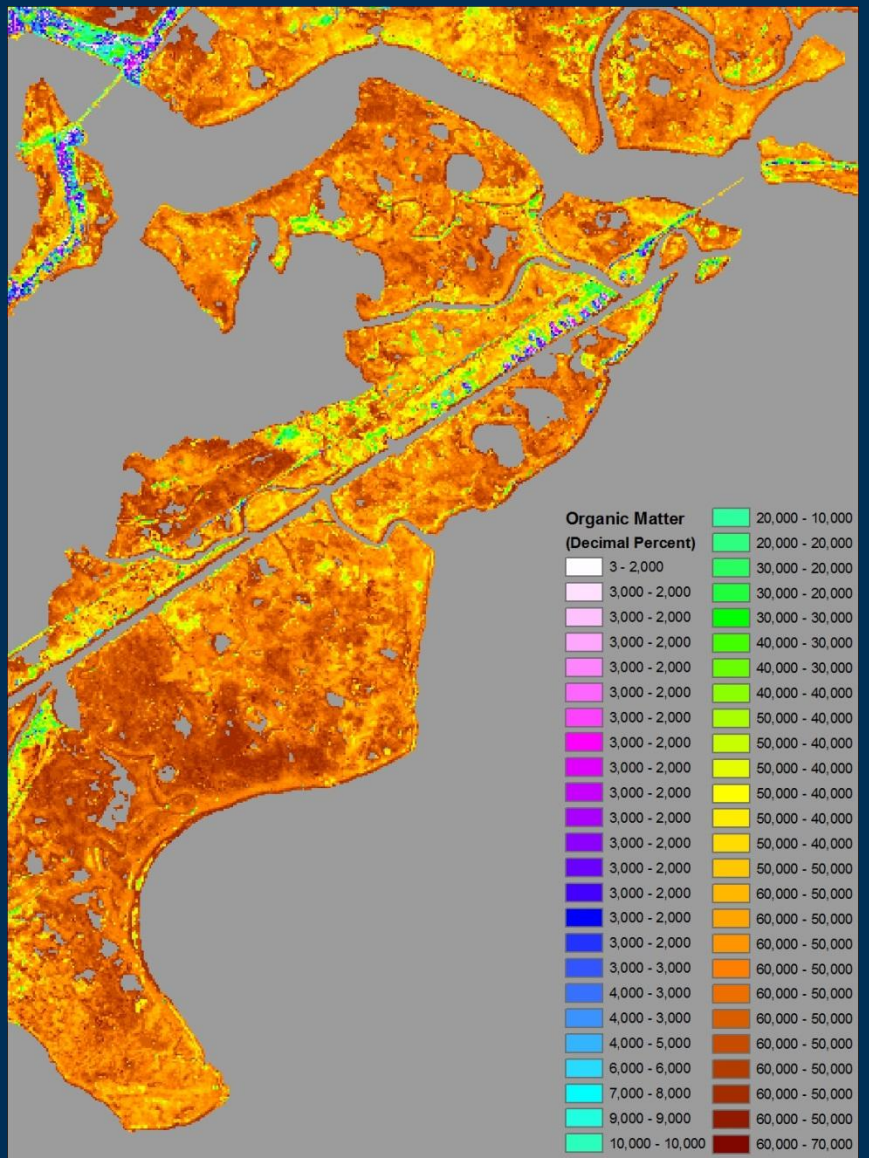
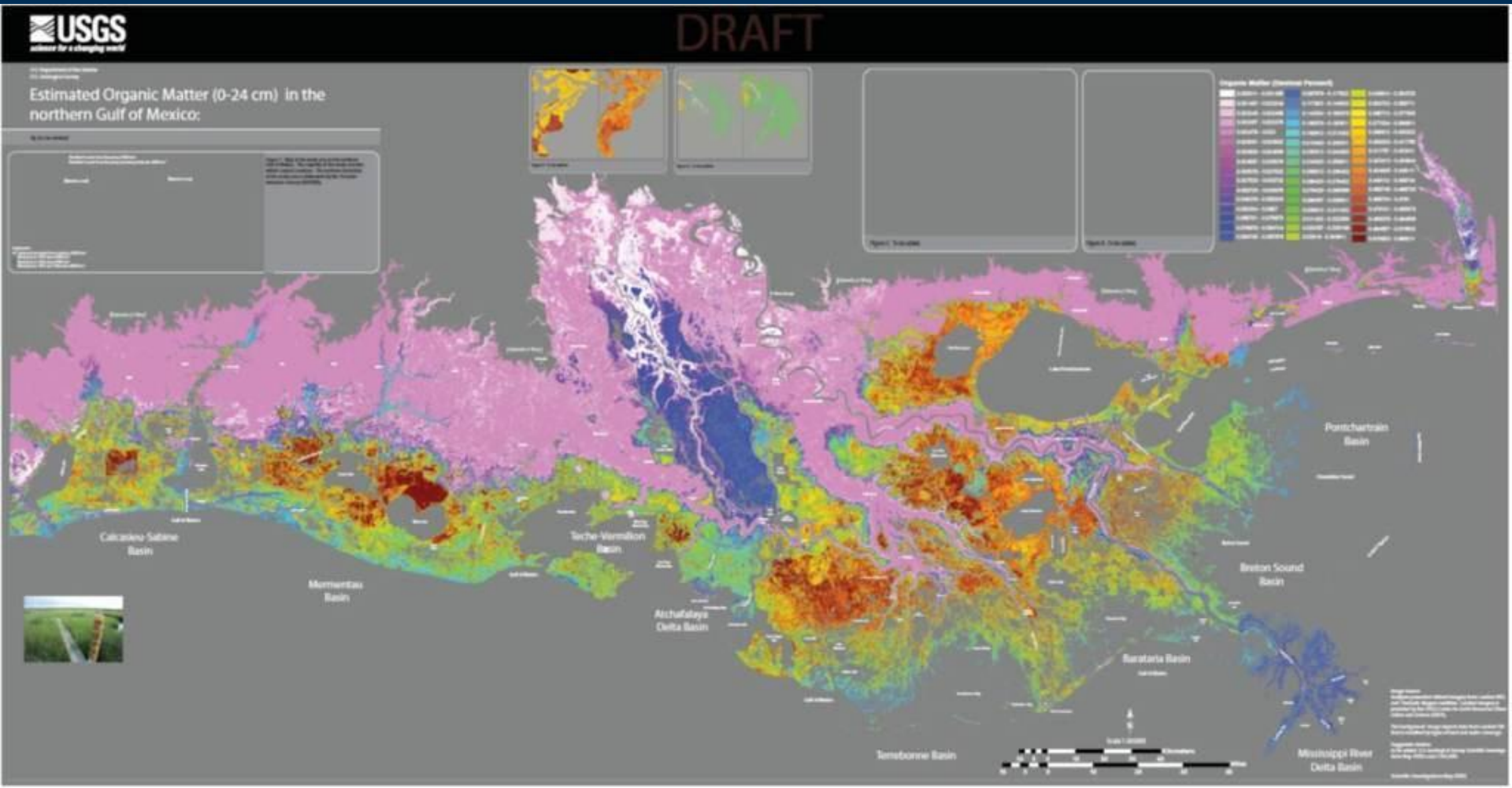


Organic Matter Improvements





Organic Matter



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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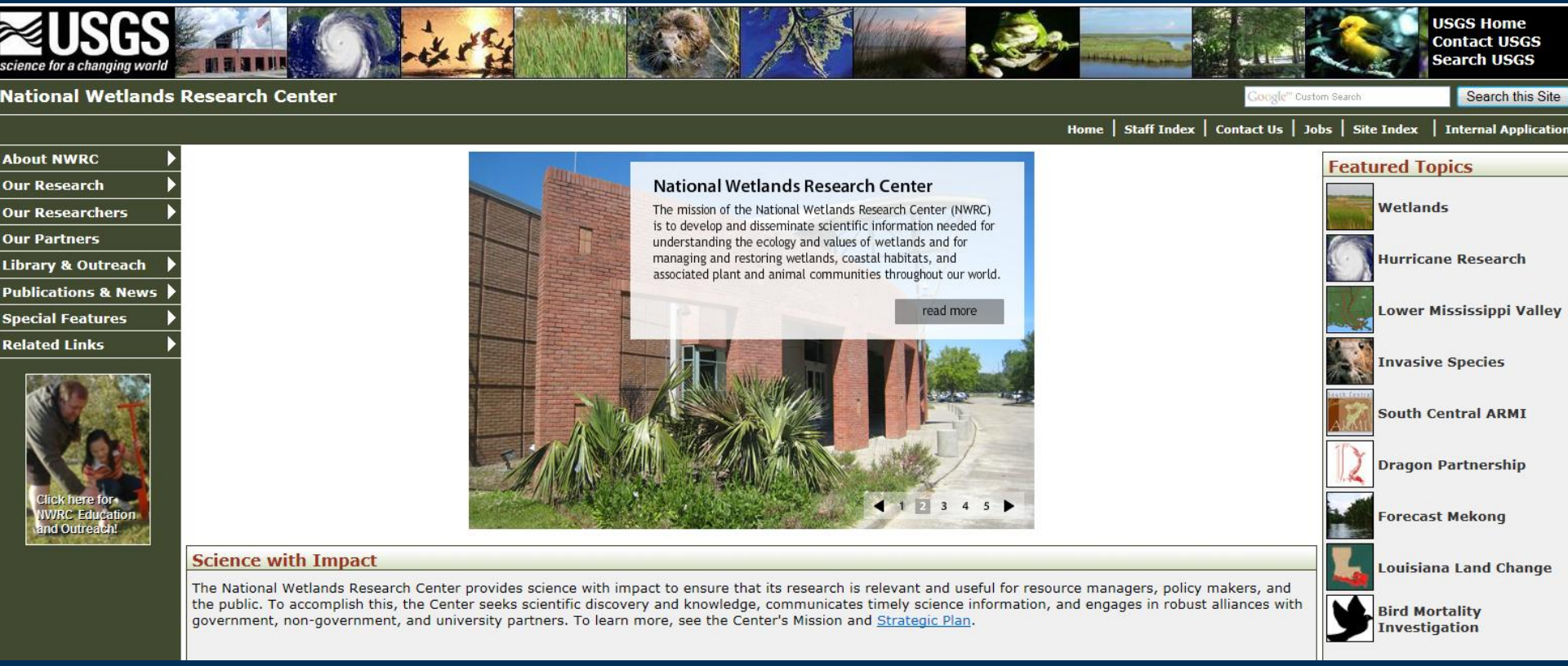

http://www.nwrc.usgs.gov/

Questions

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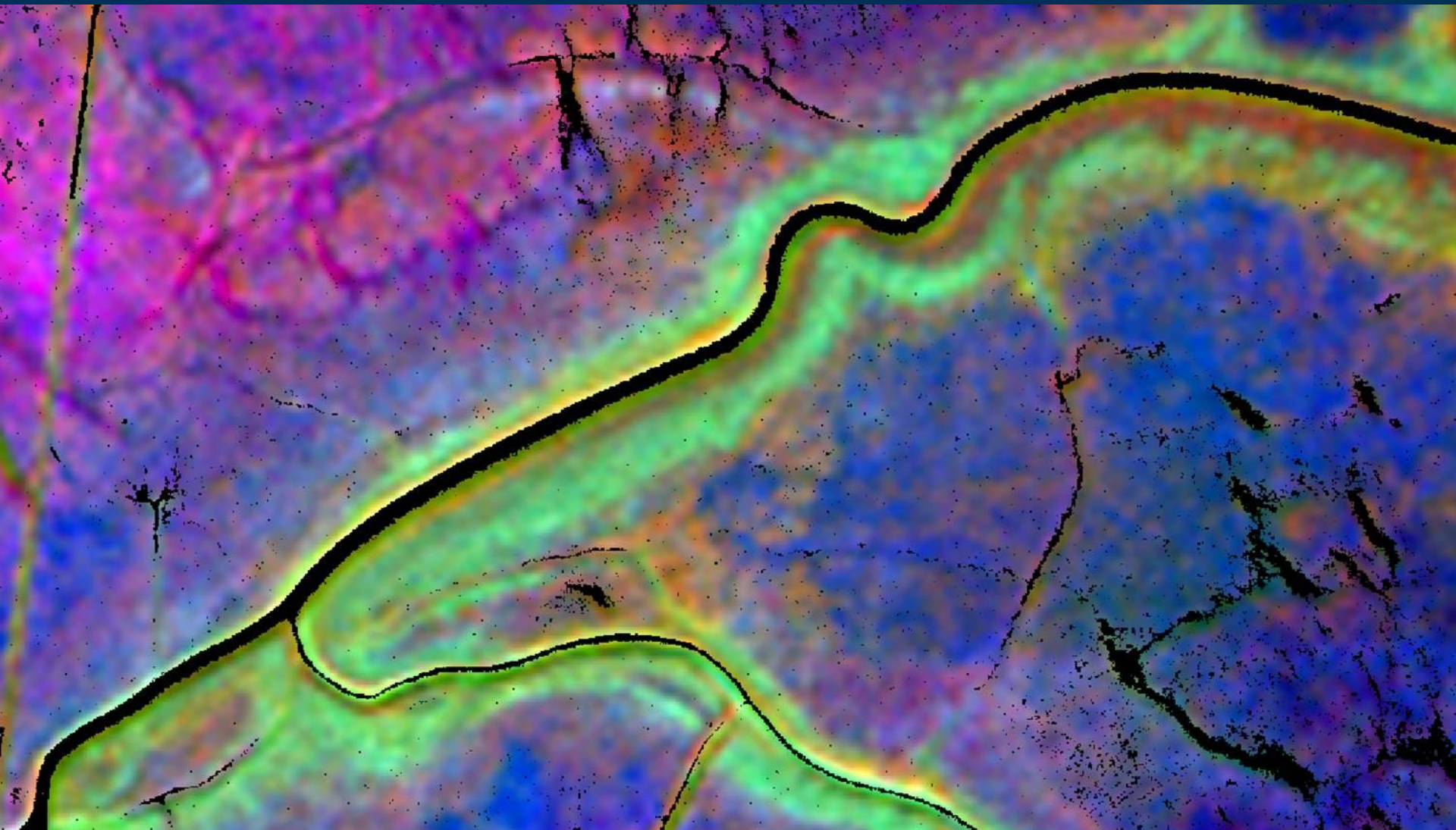
Wetting/Drying Cycles evident in multi-temporal imagery



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