

ASSESSING TRAJECTORIES, PATTERNS, AND STRESSORS IN MARSH LOSS AT THE LANDSCAPE LEVEL

Michael S. Kearney, PI*

R. Eugene Turner, Co-I**

In-Young Yeo, Co-I*

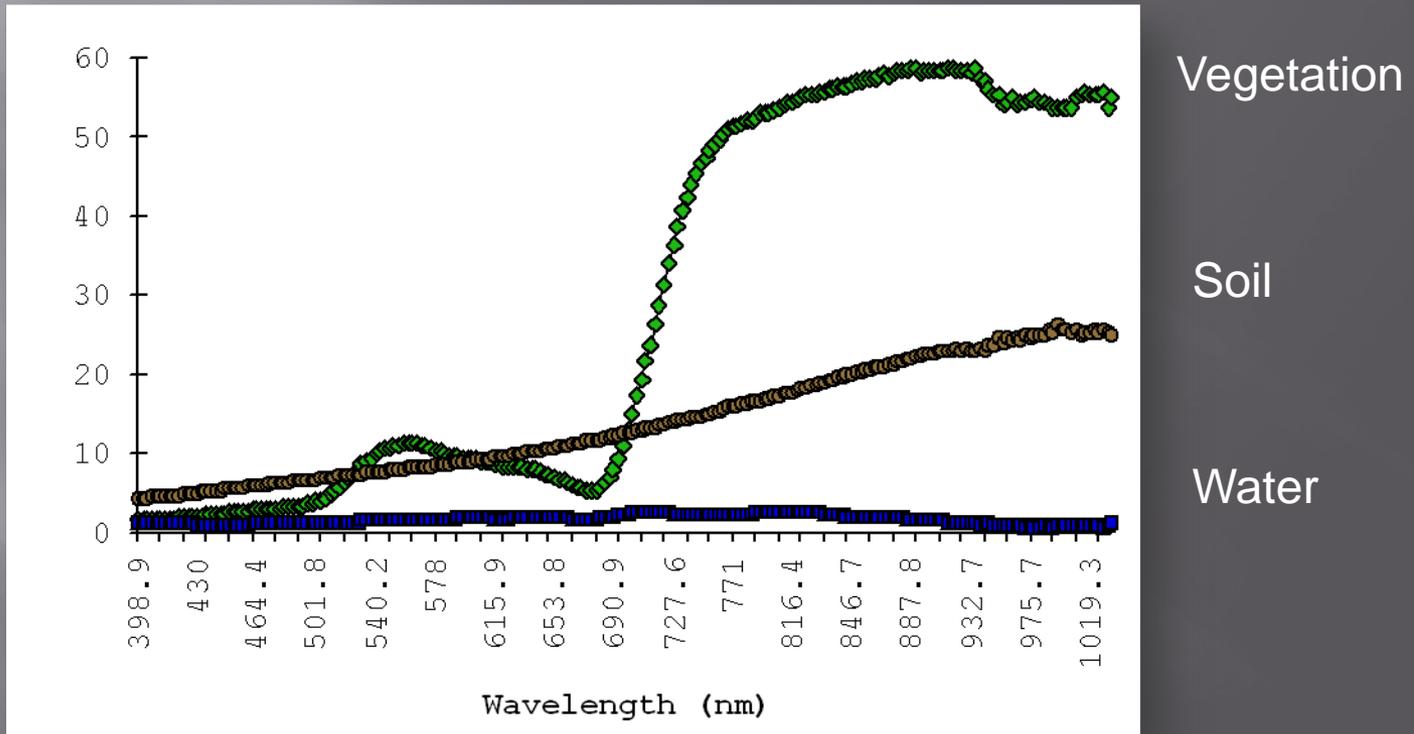
*Department of Geography, University of Maryland, College
Park, MD 20724

**Department of Oceanography and Coastal Sciences
Louisiana State University
Baton Rouge, LA 70803

Project Objectives

- ▣ Adapt for the GOM the existing Landsat Marsh Surface Condition Index Model (MSCI) for deriving synoptic observations of marsh surface condition and delineate how the marsh cycle of marsh develops
- ▣ Link the MSCI observations of marsh condition to characteristics of plant physical structure that reveal physiological functioning
- ▣ Integrate the satellite and field data into a decision support system for the LA DNR and other agencies that includes tools for data visualization and manipulation

Typical Spectral Curves of Vegetation, Soil, and Water



Landsat TM Mixture Model

- Subpixel Look, Decomposes Each Pixel Into Vegetation, Soil, and Water Elements
 - $\rho_{w1}f_w + \rho_{v1}f_v + \rho_{s1}f_s = R_1$
 - $\rho_{w2}f_w + \rho_{v2}f_v + \rho_{s2}f_s = R_2$
 - $\rho_{w3}f_w + \rho_{v3}f_v + \rho_{s3}f_s = R_3$
- The Indices are Independent, and Do Not Rely On Endmember Selection
 - A Critical In General PCA-Based Mixture Models

Mixture modeling: Selection of endmembers, continued

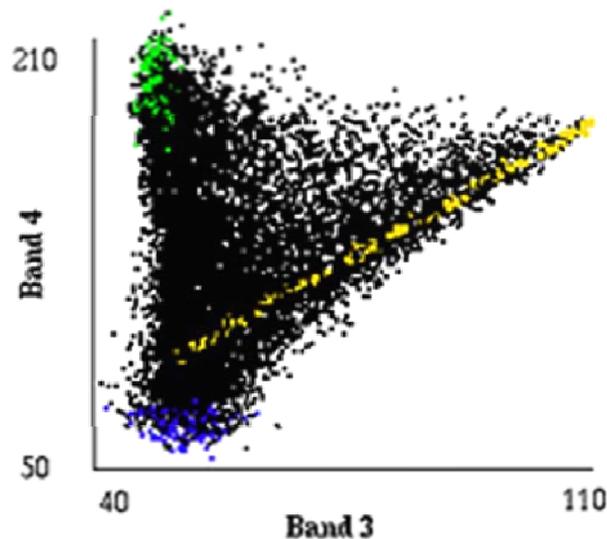


Figure 2. 3-component system: this shows endmembers of water, vegetation, and soil. The yellow stripe represents soil spectra in this spectral space.

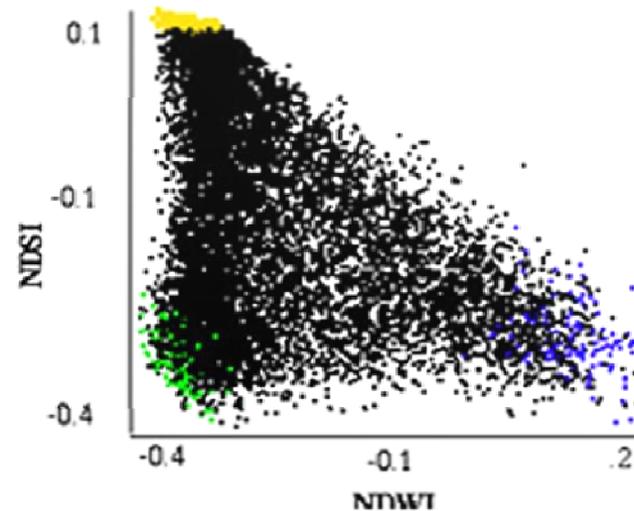
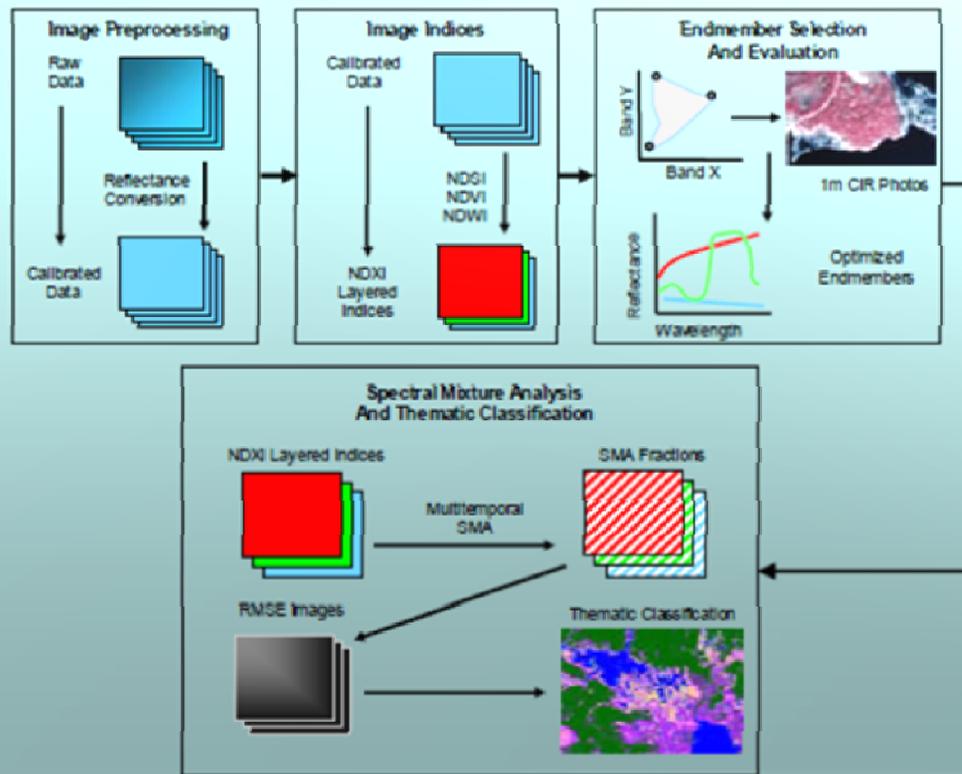


Figure 4. The NDX data space. Note that water, vegetation, and especially soil are all endmembers in this space, so the fractions can be calculated from them.

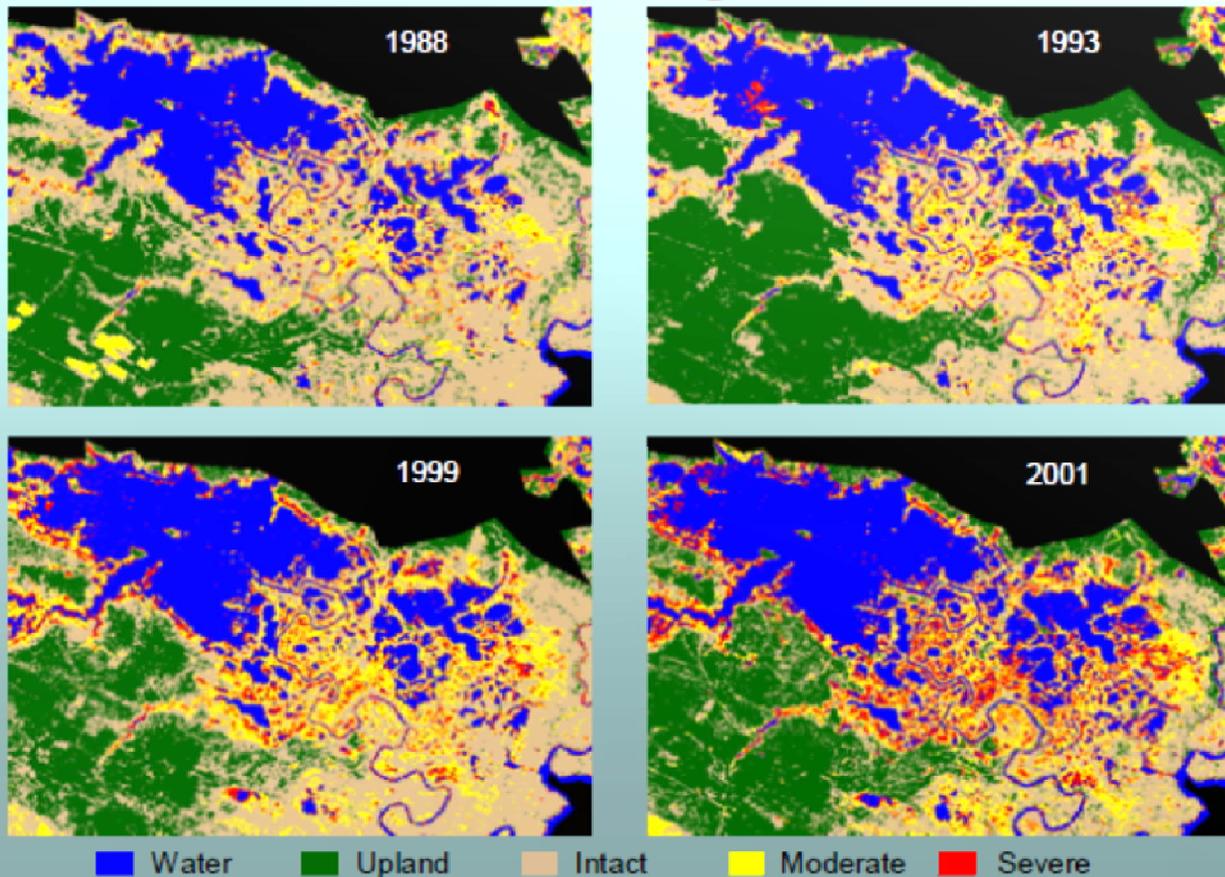
Data Processing in ENVI

Data Processing Flow

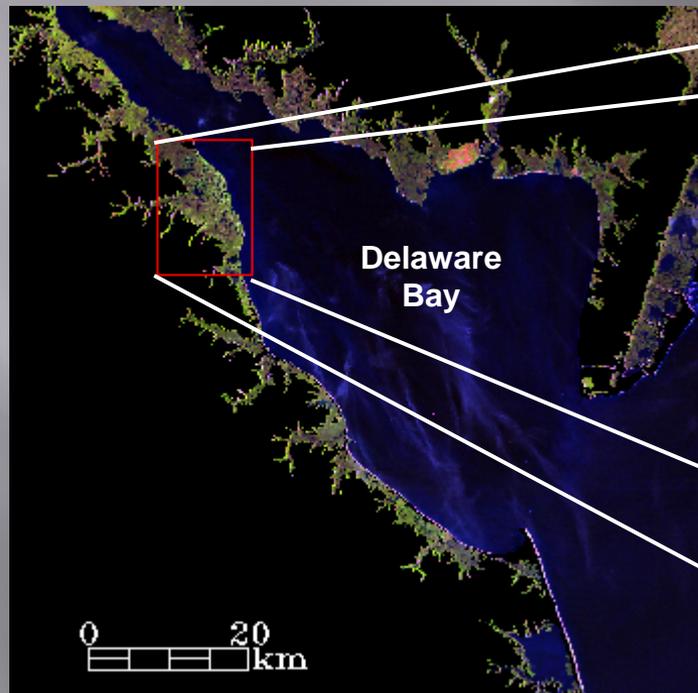


Marsh Surface Condition Index (MSCI) for Blackwater Wildlife Refuge, Maryland

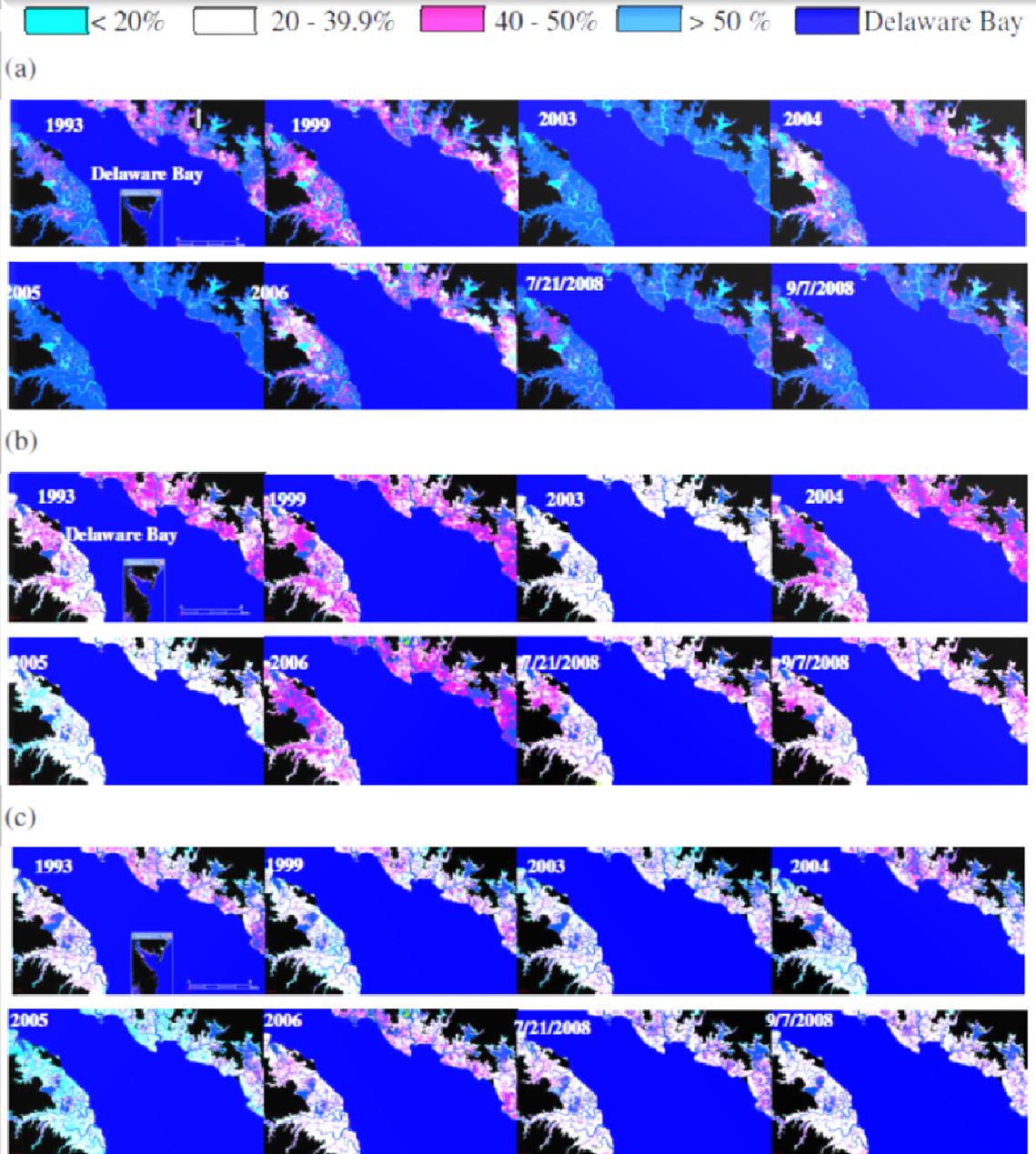
Thematic class change: 1988 - 2001



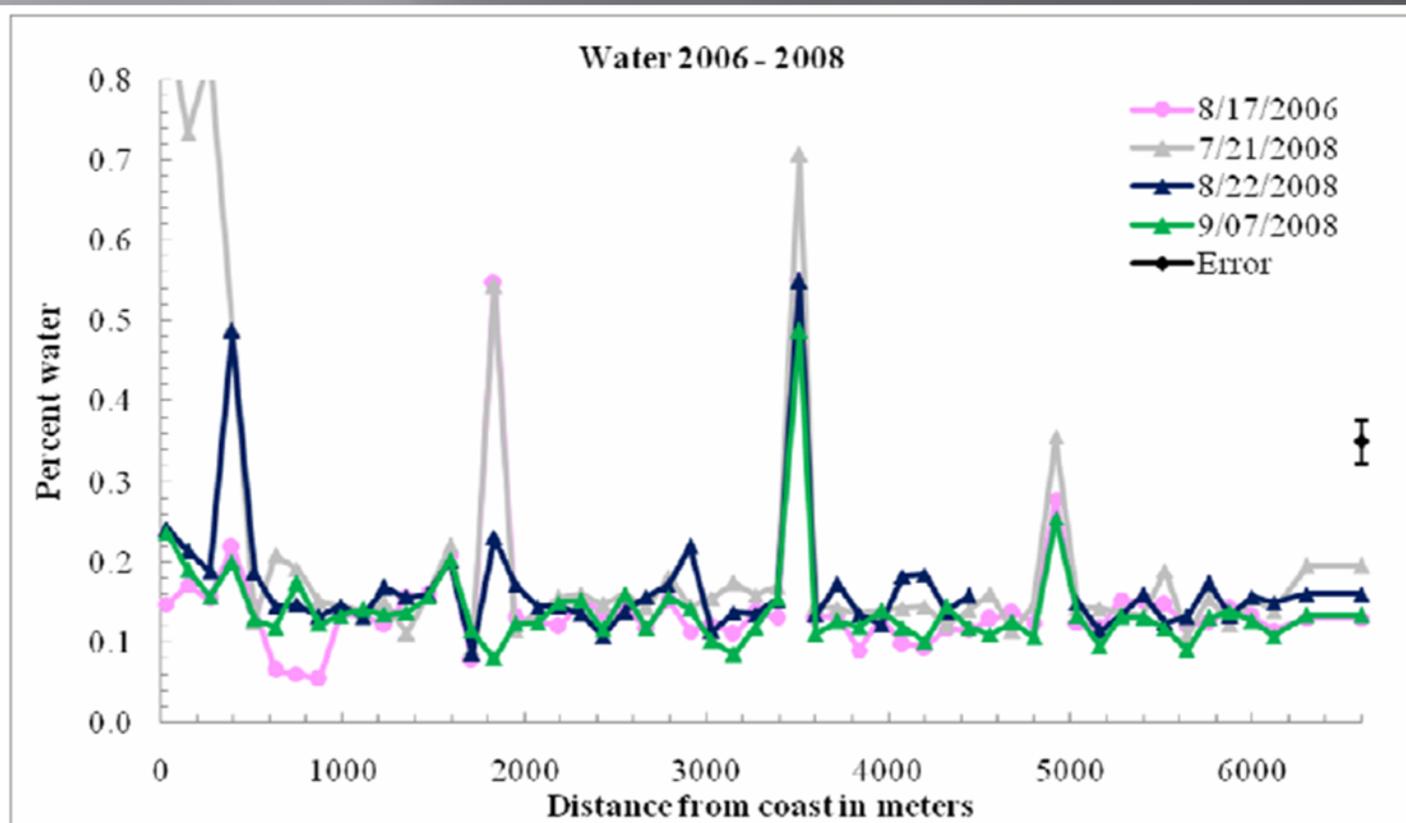
Study Area



Changes in Percent Vegetation (a), Water and Soil (b), and Water (c) 1993 - 2008

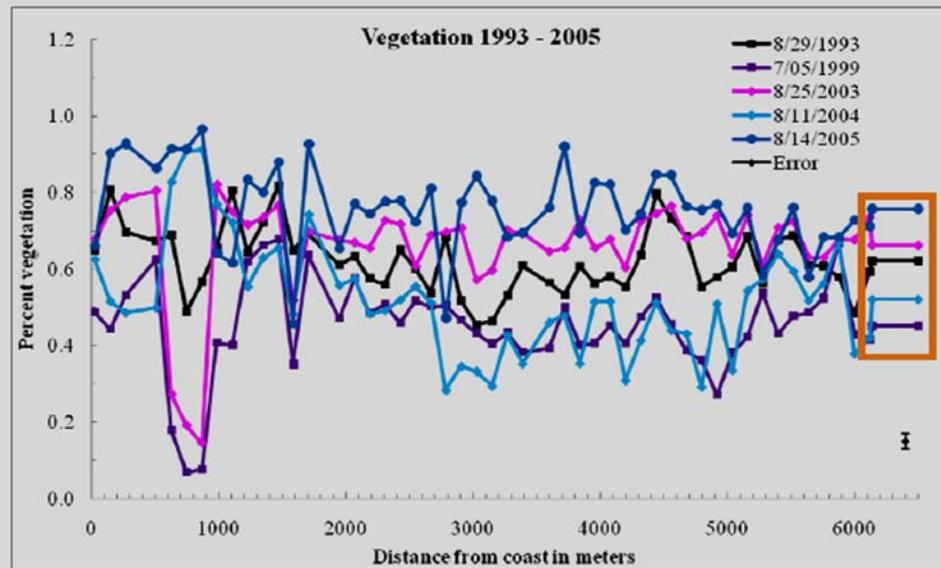


Changes in Percent Water 2006 - 2008

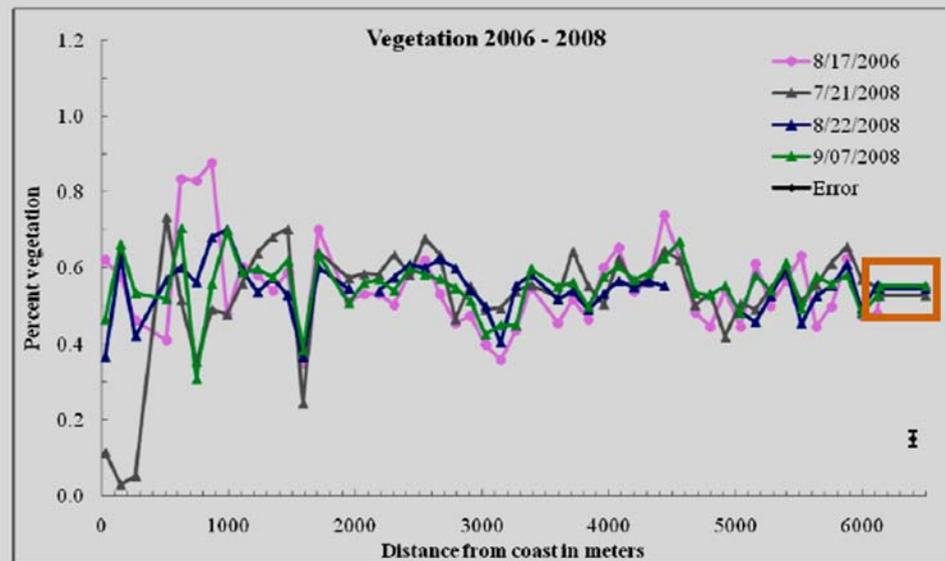


Percent Vegetation Changes

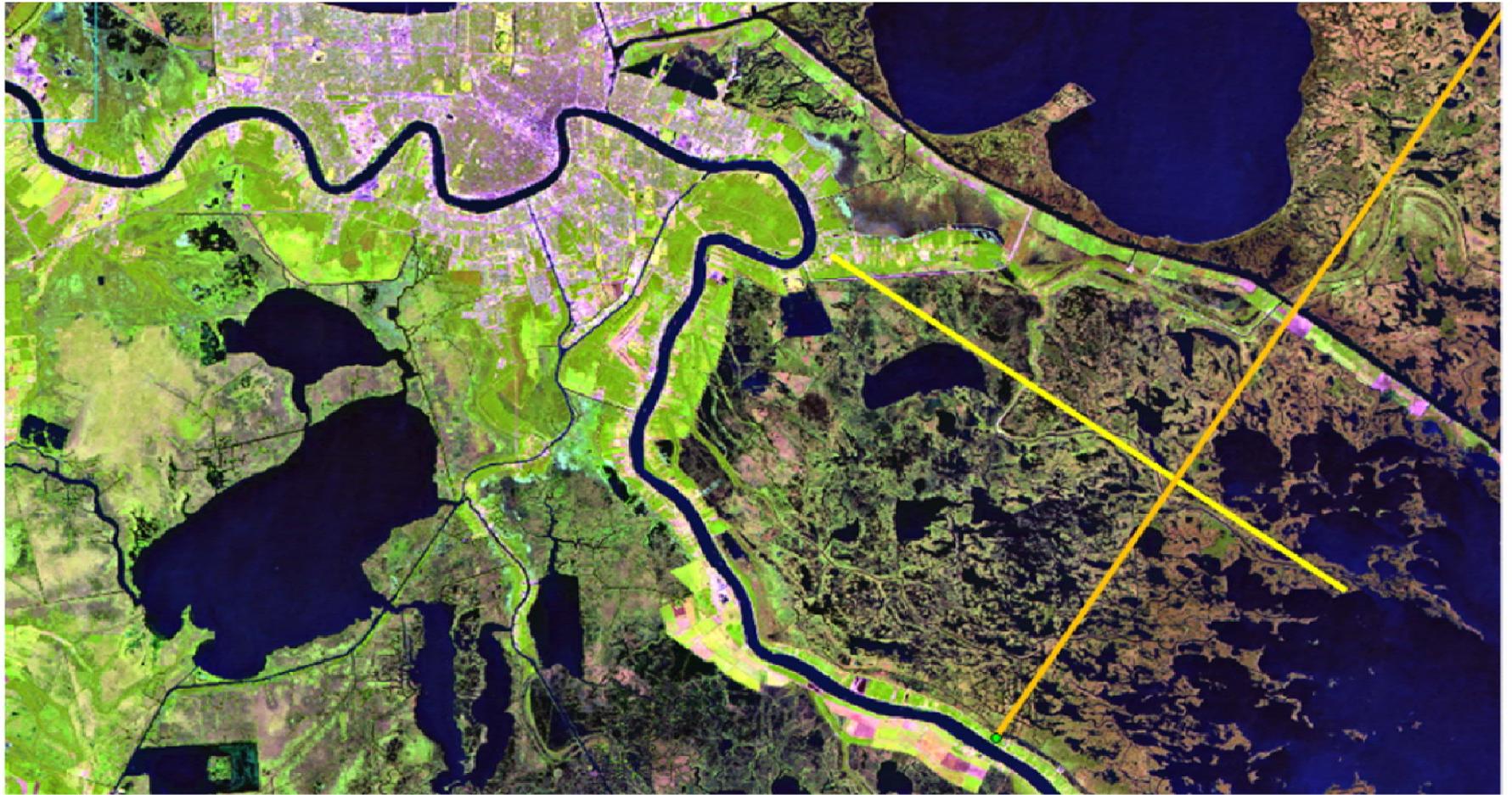
(a)



(b)

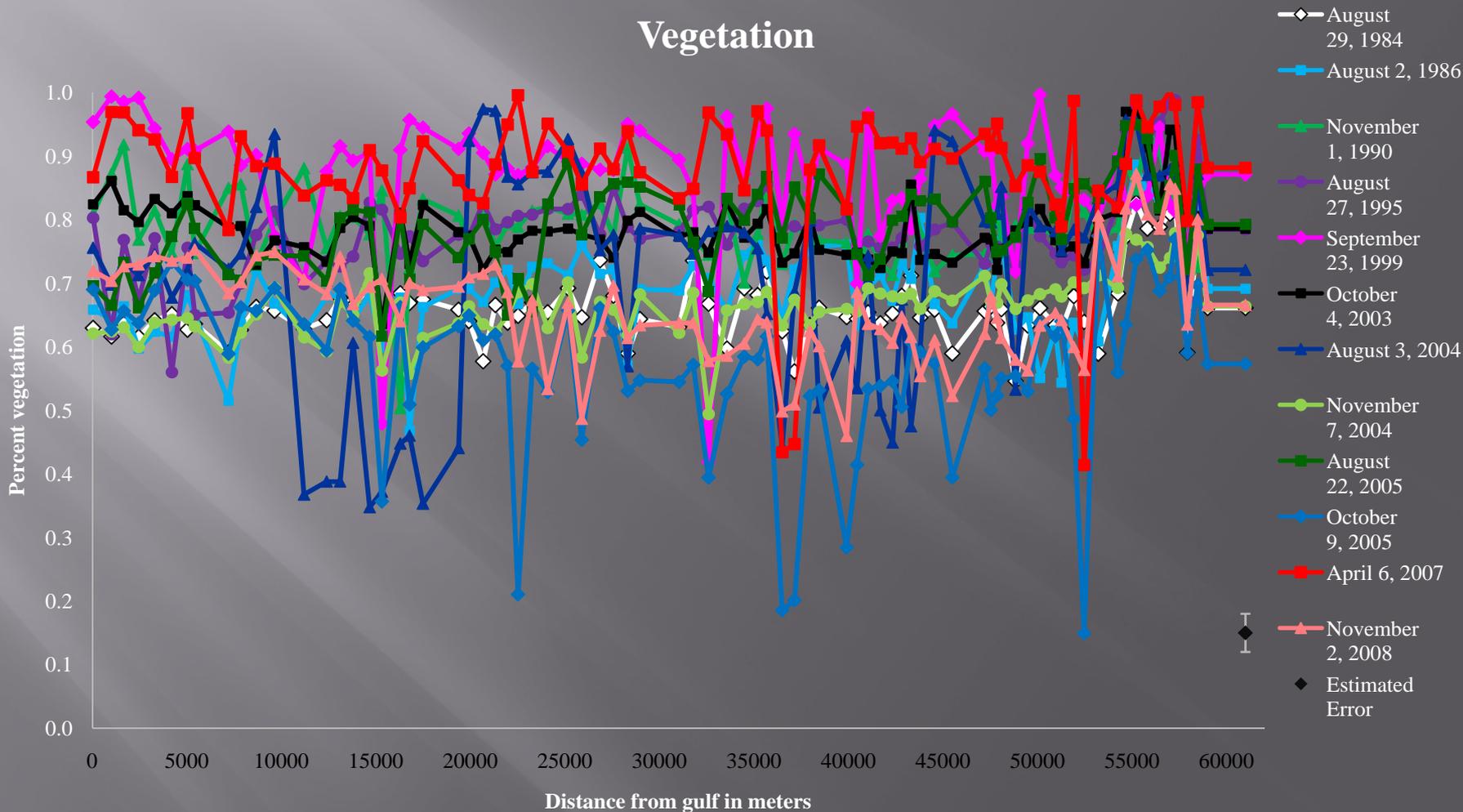


Transect Area



Caernarvon Percent Vegetation Change 1984-2008

Vegetation



Decision Support System

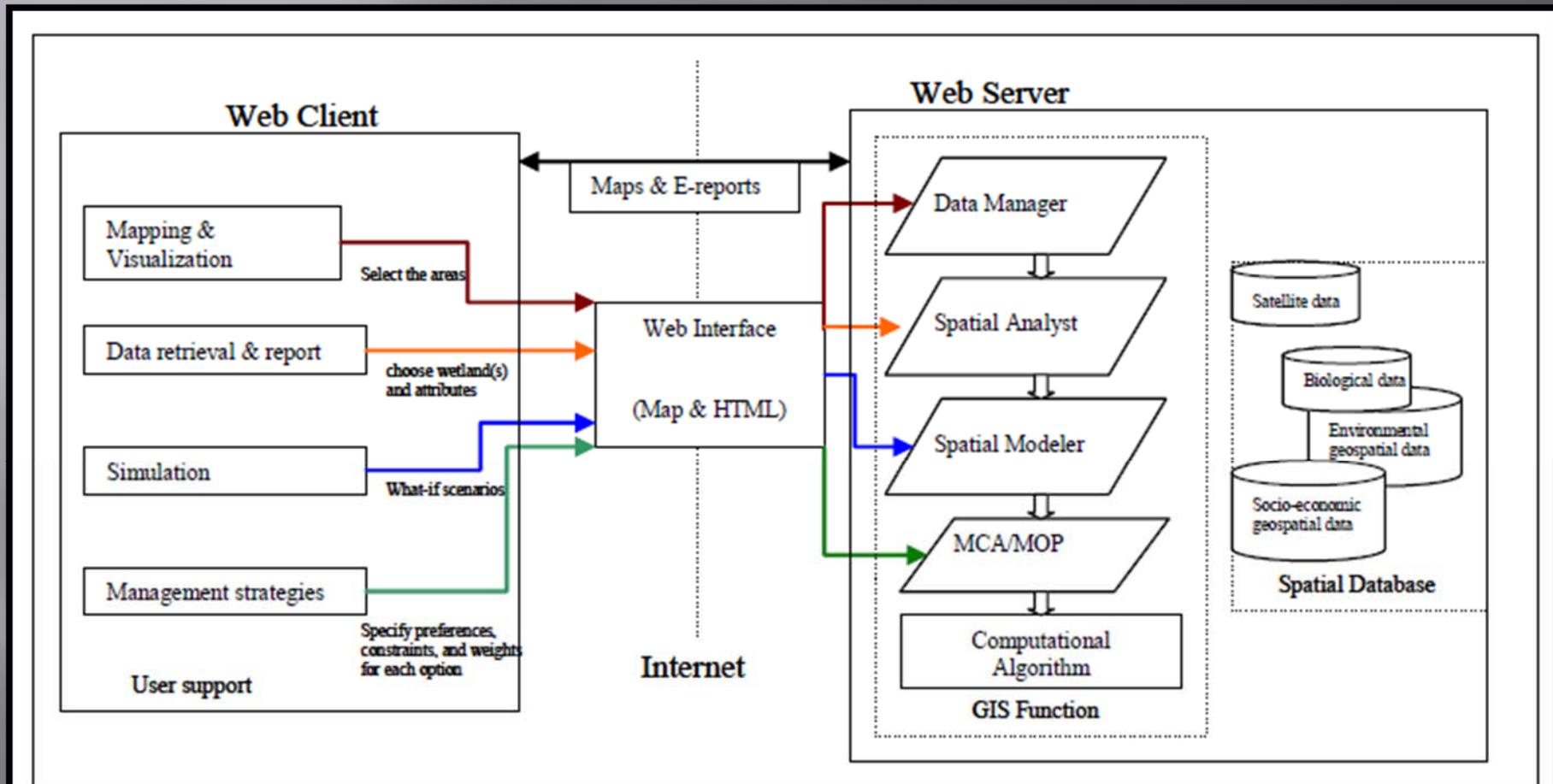


Figure 5. Conceptual Framework of Spatial Decision Support System (SDSS).

Field Validation: Comparison of MSCI Data with Plant Characteristics

Response Categories and Variables to Be Measured:

(i) *Plant Structure*. Measures of the plant structure will include determination of characteristics such as culm height, above-ground biomass, below-ground biomass, stems per unit area, and species cover and richness (Bonham, 1989). Depending on the density of plant cover, 2.5 m² plots will provide for overall assessment of percent cover and species richness. Subplots (0.25 m²) will be sampled for live above-ground biomass, with culms at the marsh substrate surface and dried to a constant weight at 65° C. Seasonal determination of these characteristics will be undertaken at a subset of the many overall collection sites, where marsh conditions appear to be representative of major degradation changes in the MSCI model and of restoration.

Similarly, sampling of below-ground biomass will be based on the same subset for the above-ground biomass. Stressed marshes have few roots and rhizomes (Turner et al., 2004).

Phases in Decision Support Transition

- Phase 1: Train managers and scientists at Louisiana Department of Natural Resources in application of data use of interpretative tools
 - Instructional workshops held at end of Year 1
- Phase 2: Delivery of overall Louisiana coastal marsh condition from MSCIC
 - Workshop on use of visualization and GIS tools for LA DNR and other agencies
 - Data access and archiving at LA DNR and LSU

Deliverables

- Maps of marsh condition for the major areas of the Louisiana Coastal Area (LCA)
- Trends in percent vegetation, soil, and water for areas identified as “hot spots”
- Maps of inferred physical plant characteristics based on MSCCI to in situ investigations
- Visualization / modeling tools for scenario building