University of California
Los Angeles

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Imaging Spectroscopy Applications for Assessing Wetland Vegetation Distributions and Coastal Resiliency in Louisiana

Author: Daniel Jensen (UCLA, Jet Propulsion Laboratory, California Institute of Technology)
Marc Simard (Jet Propulsion Laboratory, California Institute of Technology), Kyle Cavanaugh (UCLA), Robert Twilley (Louisiana State University), Andre Rovai (Louisiana State University)

Abstract

- The Wax Lake Delta in Louisiana's Atchafalaya Basin is a novel ecosystem that is significantly aggrading, despite widespread degradation throughout the coastline due to relative sea level rise (RSLR).
- In order to understand and model how coastal wetlands are evolving with these dynamics, there is a need for improved vegetation mapping and carbon storage processes.
- The Airborne Visible/Infrared Imaging Spectrometer (AVIRIS-NG) offers high spatial and spectral resolution data that can be integrated with external datasets to study these distributions and processes.
- Spectra derived from AVIRIS-NG imagery were used to map dominant vegetation species and parameterize a partial least squares regression (PLSR) model for herbaceous aboveground biomass (AGB) based on the first-derivative of reflectance. AGB results were in turn used to estimate belowground biomass (BGB) for a compete carbon accounting of the delta's herbaceous vegetation.

Objectives

- Determine methods and develop accurate maps for:
  - Species/vegetation type
  - Aboveground biomass
  - Belowground biomass
- Estimate the total biomass of herbaceous vegetation in the Wax Lake Delta

Study Area

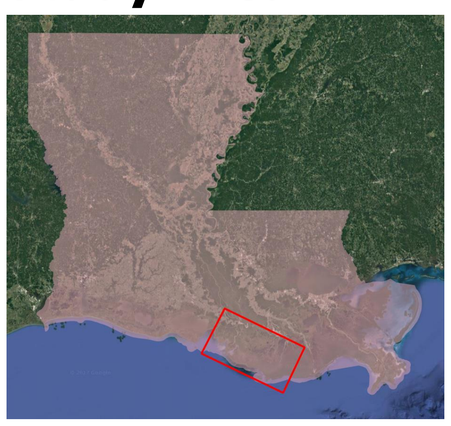
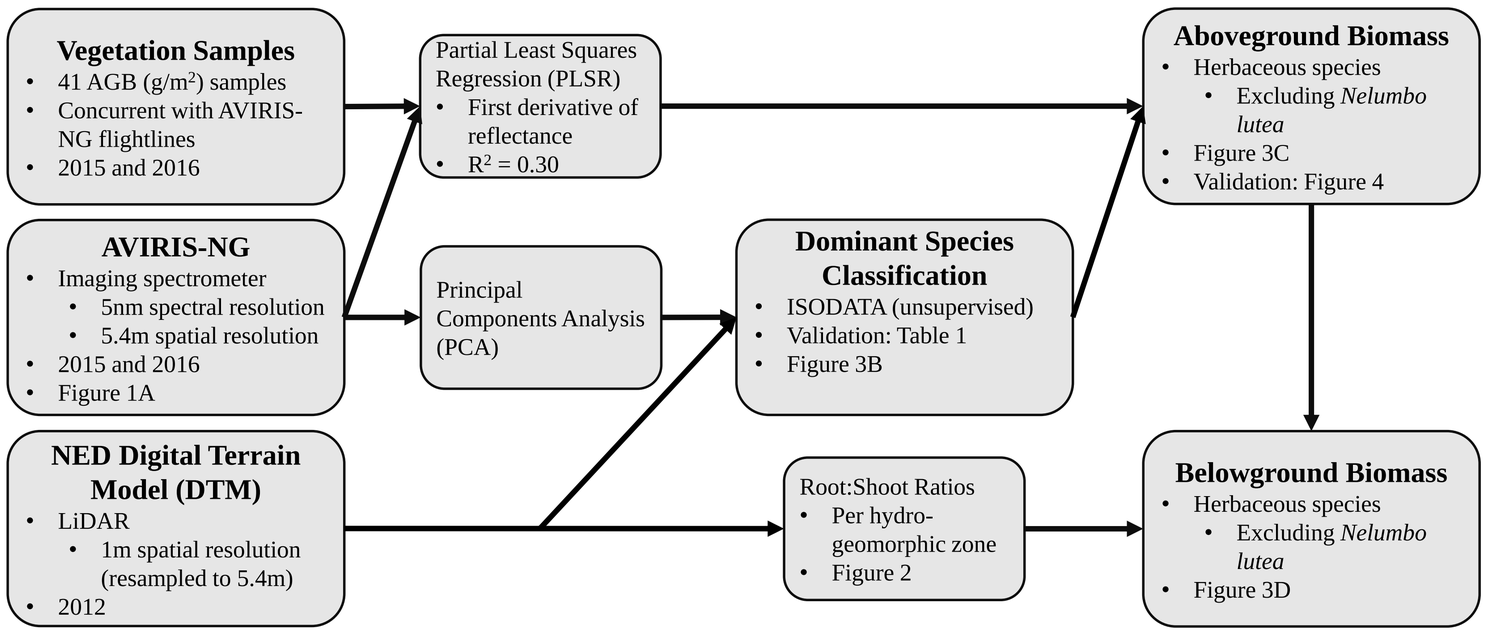


Figure 1:
Wax Lake Delta, Louisiana, USA

Methodology



Results

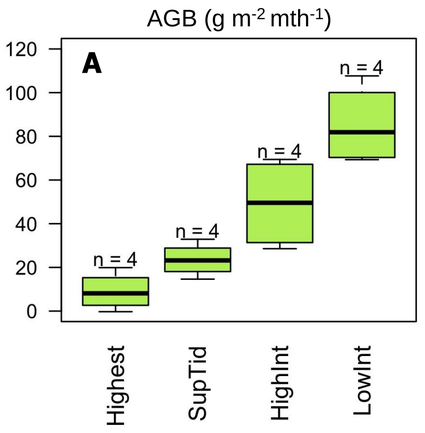
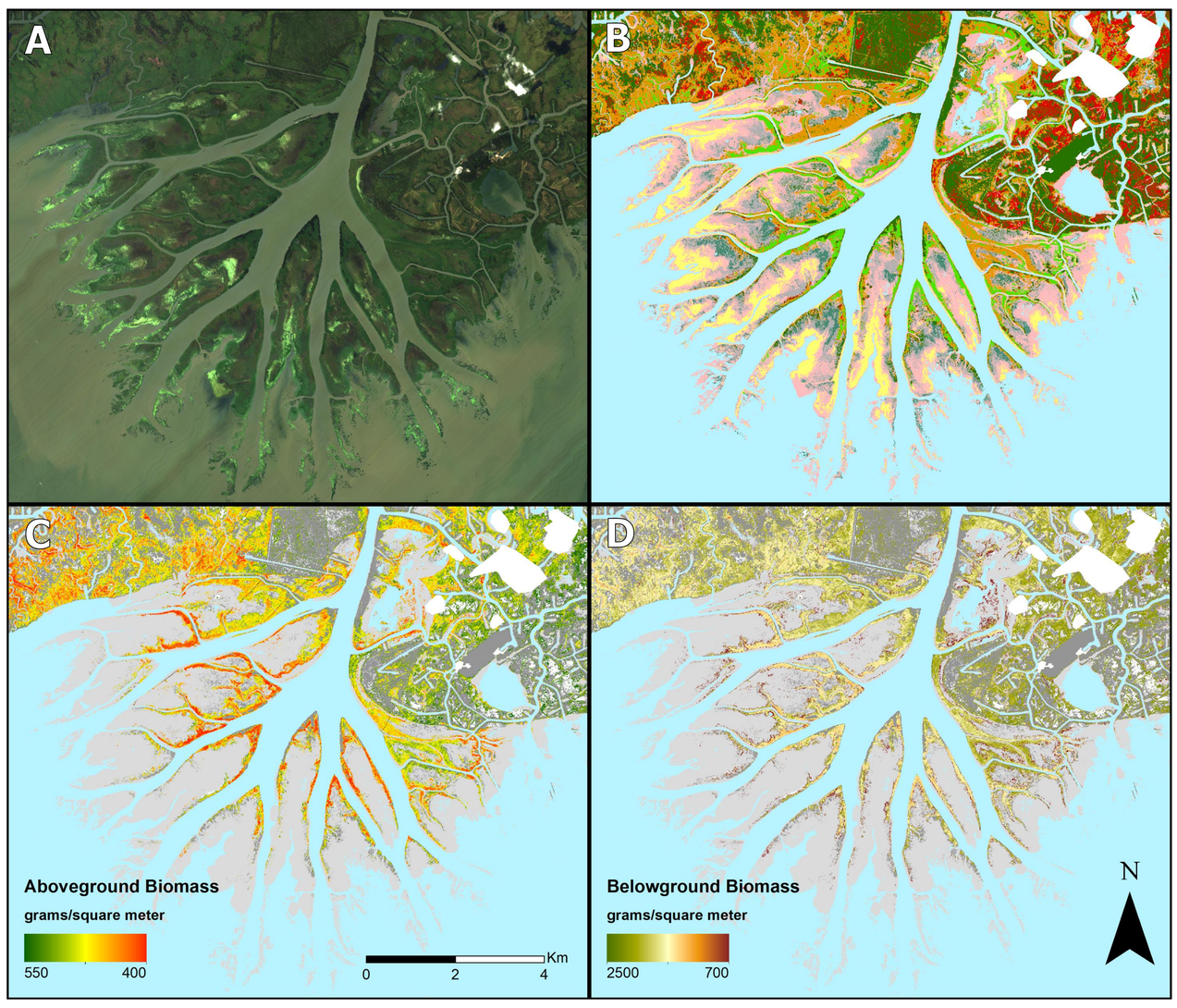
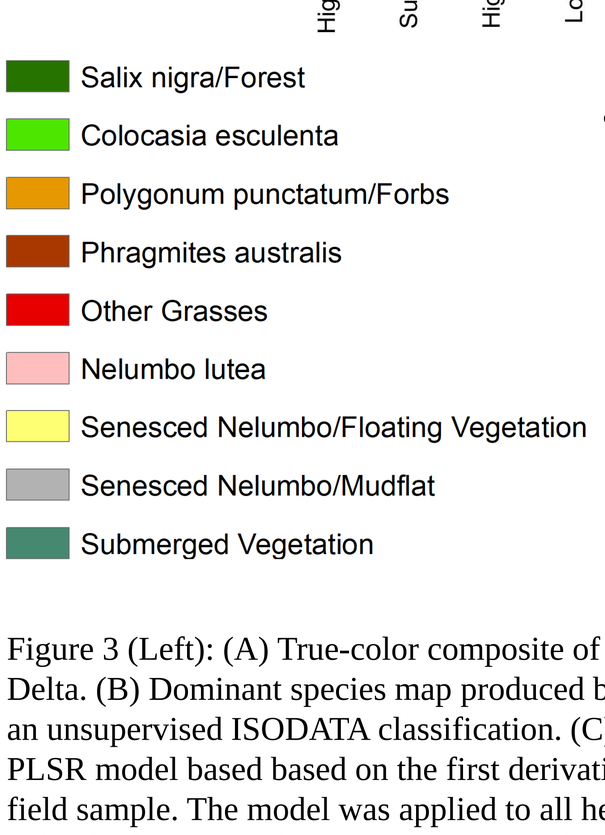


Figure 2 (Left): (A) Aboveground and (B) belowground biomass productivity results from *colocasia esculenta* samples grown at different simulated hydrogeomorphic zones. Low intertidal = -0.04—0.1m, High intertidal = 0.1—0.3m, Supratidal = 0.3—0.6m (elevation, NAVD88). Root:Shoot ratios were calculated by dividing BGB by AGB for each zone.

Figure 4 (Below): Validation of the AGB PLSR model. Of the 41 AGB samples, 15 were randomly selected and withheld for cross-validation. The model attained an RMSE of 99.7 g/m² and an R^2 of 0.65, indicating a valid correlation relative to the 1:1 line.





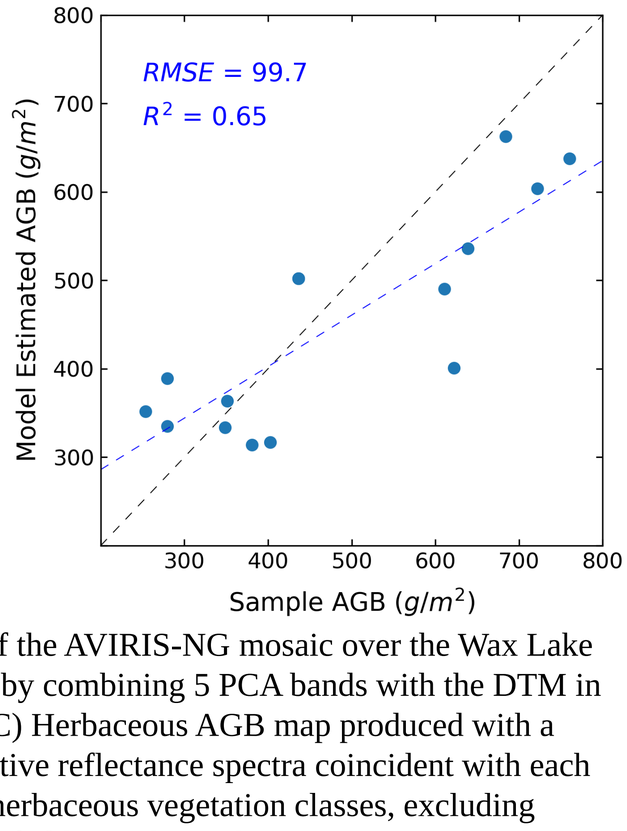


Figure 3 (Left): (A) True-color composite of the AVIRIS-NG mosaic over the Wax Lake Delta. (B) Dominant species map produced by combining 5 PCA bands with the DTM in an unsupervised ISODATA classification. (C) Herbaceous AGB map produced with a PLSR model based based on the first derivative reflectance spectra coincident with each field sample. The model was applied to all herbaceous vegetation classes, excluding *nelumbo lutea*, which was not present in the field samples and is senescing at the time of image capture. (D) BGB map produced by classifying the DTM elevations into hydrogeomorphic zones and applying the corresponding Root:Shoot ratio to the estimated AGB.

Table 1: Classification Validation	Nelumbo	Polygonum/ Forbs	Colocasia	Salix/Forest	Grasses
In Situ Points	50	10	18	30	8
Correct Points	46	19	13	23	16
Percent Correct	92.0	52.6	72.2	76.7	50.0

Conclusions

- Imaging spectroscopy enables accurate discrimination of wetland vegetation species and aboveground biomass, which may be further applied towards estimating belowground biomass for total vegetation carbon accounting.
- In the 21.8 km² of herbaceous vegetation analyzed, there is an average biomass concentration of 2,653.0 g/m² and a total of 57,793.9 metric tons.

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National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California
www.nasa.gov