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
1,883 square mile decrease
Hurricane Impacts
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
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

Land Use/Land Cover and Wetland Vegetation Community Classification in the northern Gulf of Mexico: 2009

Legend:
- Forested Land
- Wetland
- Coastal Wetland
- Shrubland
- Grassland
- Agriculture
- Urban

Representative vegetation communities occupying land areas:
- Coastal grassland
- Wetland
- Shrubland
- Forested land

Representative wetland species occupying land areas:
- Spartina alterniflora
- Salicornia sp.
- Juncus effusus
- Phragmites australis
- Scleria globulosa

This map is a draft and is subject to change.
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 revision 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 3,500 quarter quadrangles (3.75 minute DEM tiles). 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 quadrangle) and second phase (473 quarter quadrangles) completed in 2003. Over 900, 5-meter DEM data files, 1-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 QGs are scheduled to be collected 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 scenes 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 Cline 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 unit (IMU), and an active laser sensor as the source to measure distance (ranging) and angles to specific and densely spaced points (2-6 m) 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 revision studies and map modernization programs designed to update the Flood Insurance Rate Maps (FIRM). Previous flood
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.
NED (National Elevation Dataset)
Classified Topography Results
Vermilion Example
Final Coastwide Data Composite

Legend

Preliminary Coastwide LIDAR
Meters (NAVD 88)

High: 14.87
Low: -3.36
Topography/Bathymetry
Bulk Density
Organic Matter Improvements
Organic Matter

Estimated Organic Matter (0-24 cm) in the northern Gulf of Mexico:
Summary

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

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http://www.nwrc.usgs.gov/
Questions
Wetting/Drying Cycles evident in multi-temporal imagery
Wetting/Drying Cycles evident in multi-temporal imagery