High-Resolution Mapping of Vegetation, Elevation, Salinity and Bathymetry to Advance Coastal Habitat Management in Georgia

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Tidal marshes

- Structured by salinity
  - Salt: > 18 PSU
  - Brackish: 0.5 – 18 PSU
  - Tidal Fresh: < 0.5 PSU

- Variation in ecosystem services
  - Brackish and tidal fresh
    - > Biomass
    - > C, N, P storage
    - > Accretion
    - > Denitrification

- Implications for SLR and salt water intrusion

Adapted from Odum et al. 1984
Tidal marshes

- Elevation influences flooding regime and abiotic variables
- Determines vegetation type
  - Longitudinally along the salinity gradient
  - Vertical zonation of vegetation
- Need high accuracy data to predict:
  - Vegetation
  - Storm surge
  - SLR
  - Erosion

http://oceanservice.noaa.gov
Light Detection and Ranging (LIDAR) in Tidal Marshes

Salt Marshes

• Mean vertical errors of:
  – 0.07 to 0.17 m in Southeastern marshes
  – 0.03 to 0.25 m in Georgia

• Species-specific and increases with height

Brackish/Tidal Fresh

• Mean vertical errors of:
  – 0.11 to 0.98 in San Francisco Bay, CA
  – 0.33 to 0.76 m St. Johns River, FL wetlands

• Species-specific and increases with height
Predicting Marsh Distributions

• Sea Levels Affecting Marshes Model (SLAMM Version 6.2)
  – Habitat shifts due to SLR and salinity based on elevation
  – Improvements: accretion, salinity, FW flows
  – Coastal management and resiliency

• To model future marsh distributions need accurate:
  – DEMs
  – Habitat maps
  – Salinity
  – Bathymetry
Project Objectives

**Overall goal:** Provide datasets needed to effectively model future wetland distributions

1. Evaluate accuracy of LIDAR-derived DEMs
2. Delineate salt and brackish marsh habitat
3. Derive and apply habitat-specific correction factors to produce corrected DEMs
4. Document the extent of high-water salinity intrusion
5. Update detailed bathymetry of the five major Georgia rivers
Methods: LIDAR Data

FEMA DEM-Bathymetry

- Data sources
  - Coastal GA Elevation Project (2010)
  - Chatham (2009)
  - Liberty (2006)
  - Glynn (2001)
- 1 m point spacing
- 4 m DEM
- NAVD 88 vertical datum
Methods: DEM Accuracy Assessment

- 596 RTK sampling locations
  - *J. roemerianus/Schoenoplectus sp* (JR)
  - Marsh meadow (MM)
  - *S. cynosuroides/S. tabernaemontani* (SC)
  - Medium *S. alterniflora* (SM)
  - Short *S. alterniflora* (SS)
  - Tall *S. alterniflora* (ST)
- Training (297) and validation (299)
- Mean error (correction factor)
  - Predicted (DEM) – Observed (RTK)
Results: Training Data RTK vs. DEM

Mean Error = 0.12 m
Habitat Delineation

- Orthoimagery (0.15 m)
  - Coastal Imagery Project and Camden
  - 3 or 4 bands (B, G, R, NIR)

- Classification
  - Eight classes
  - Training/validation data digitized from field maps
  - Random forest classifier
    - Orthoimagery
    - DEM
    - NWI
  - Overall accuracy of 90%
    - Class accuracies of 55-99%
    - JR: 97%
    - SM: 88%
  - DEM and NIR most important
DEM Correction: Habitat-specific corrections

Uncorrected DEM  Classification + Correction Factors  Corrected DEM
DEM Mean Errors

- **Unmodified DEM**
  - Over-predicted
  - Brackish had the largest errors (0.25 m)
  - Taller vegetation significantly different from RTK

- **Modified DEM**
  - Slightly under-predicted
  - Not significantly different from RTK

![Graph showing mean elevation errors for unmodified and modified DEMs.](image)
Salinity Cruises

Salinity Cruises 2014
Low Discharge Conditions

Salinity Cruises 2015
High Discharge Conditions
Summary

• Accuracy assessments are necessary in densely vegetated habitats
  – DEM overestimated tidal marsh elevations and need correction
  – DEM interpolation and surface conditions

• Classification of tidal marsh
  – Eight class habitat delineation
  – Ancillary elevation and NIR band

• Bathymetry and salinity
  – New and improved bathymetry
  – Baselines for salt water intrusion in rivers and salt marsh estuaries
Implications and Future Work: SLAMM

- Improved Data
- Ready for SLAMM
- Management:
  - Marsh migration
  - Land use planning
  - Restoration priorities
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