DEPARTMENT OF GEOSCIENCES
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Applying Remote Sensing to Map Electrical Conductivity in the Everglades Wetlands

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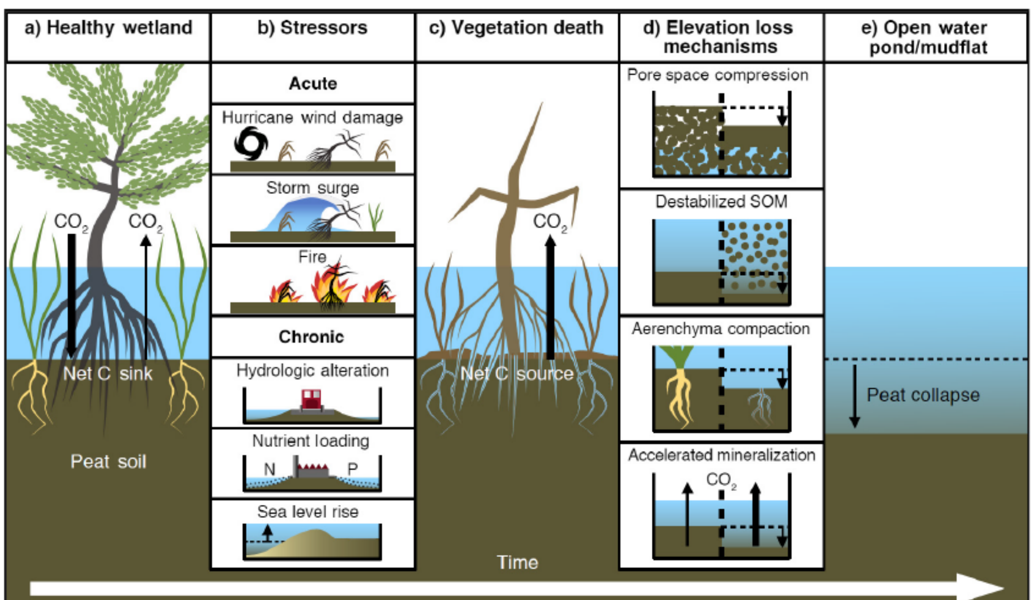
Caiyun Zhang

- Professor of Remote Sensing, Department of Geosciences, Florida Atlantic University (FAU), Boca Raton, Florida.
- Expertise in **remote sensing and AI** with emphasis in wetland mapping, Everglades C flux modeling, flood mapping, Alaska permafrost mapping and modeling.
- Current projects
  - State (2020-present)
    - SJRWMD for wetland mapping in central Florida
    - FWCC for wetland mapping in Lake Okeechobee
  - Federal
    - USACE for central Alaska permafrost thaw modeling and mapping
    - NPS for Canaveral National Seashore to assess hurricane damages
    - NPS for Everglades National Park to assess peat stability with rising sea level

Introduction

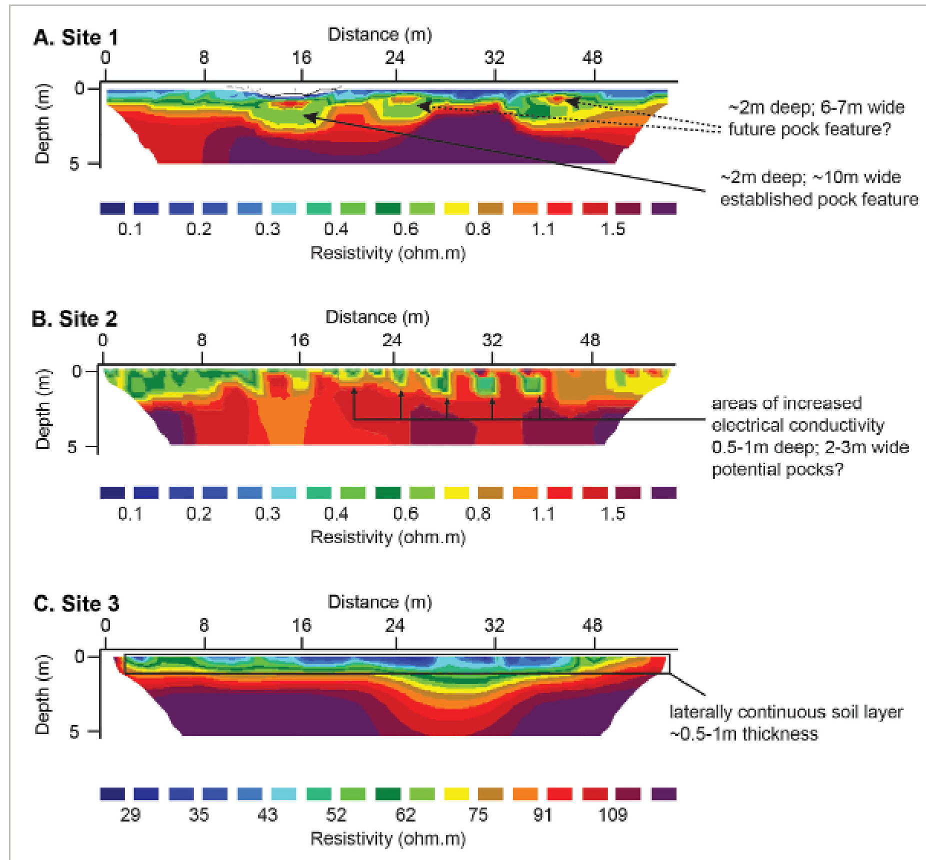
- Soil Electrical Conductivity (EC)
  - Indicator of soil salinity
  - A valuable tool in soil science to determine soil salinity, assess nutrient availability, and soil quality
  - High EC->high concentration of dissolved salts, and potentially a saline soil-> damage plant roots-> peat collapse -> landscape change
  - EC > 4 dS/m (0.4 S/m): soil is considered as saline



Chambers et al 2019. Toward a mechanistic understanding of "peat collapse" and its potential contribution to coastal wetland loss. Ecology 100(7):e02720. 10.1002/ecy.2720

Introduction

- EC data collection
  - Meters and other point approach
  - Geophysical approach: Electrical Resistivity Tomography/Imaging (ERT/ERI) and Electromagnetic Induction (EMI) to retrieve soil EC

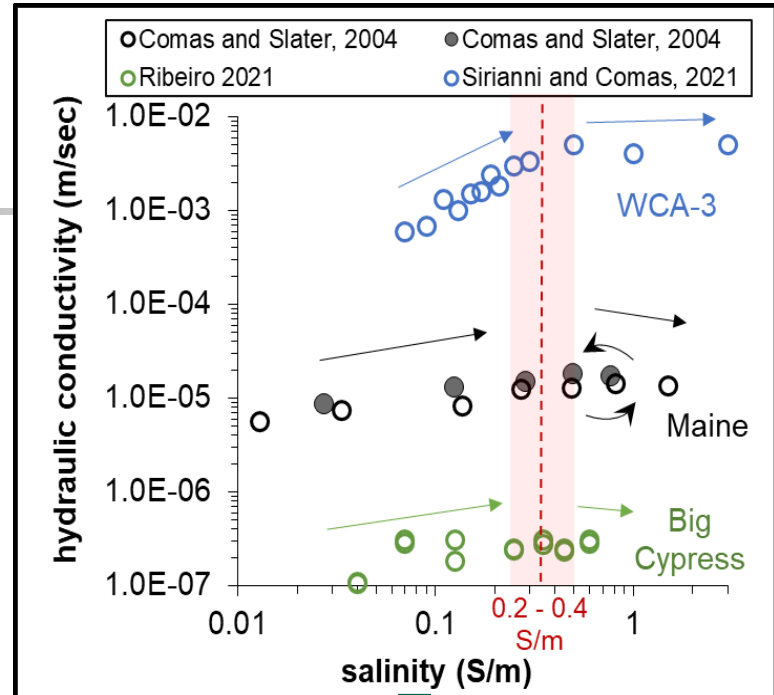


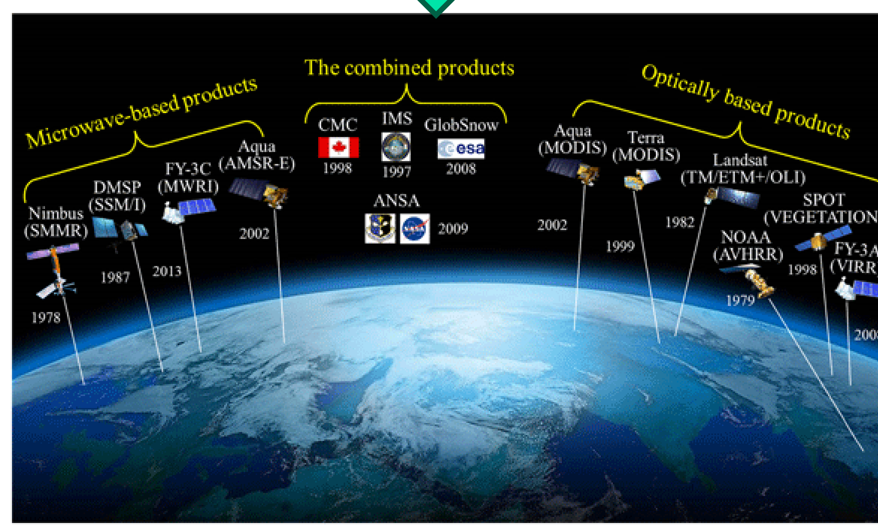
Sirianni, M., X. Comas et al., 2023. Understanding Peat Soil Deformation and Mechanisms of Peat Collapse Across a Salinity Gradient in the Southwestern Everglades. Water Resources Research.

Introduction

- Field measurements: limited space and time
- Remote sensing observations: large coverage and revisit

- Objective: Using AI to estimate/upscale EC by linking spaceborne/airborne remote sensor products data with field measurements



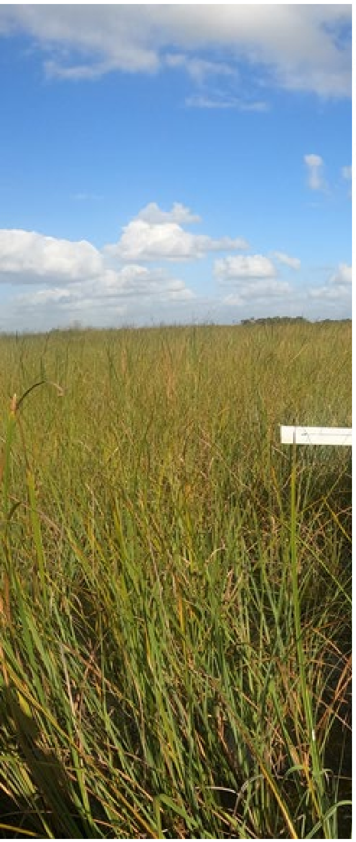


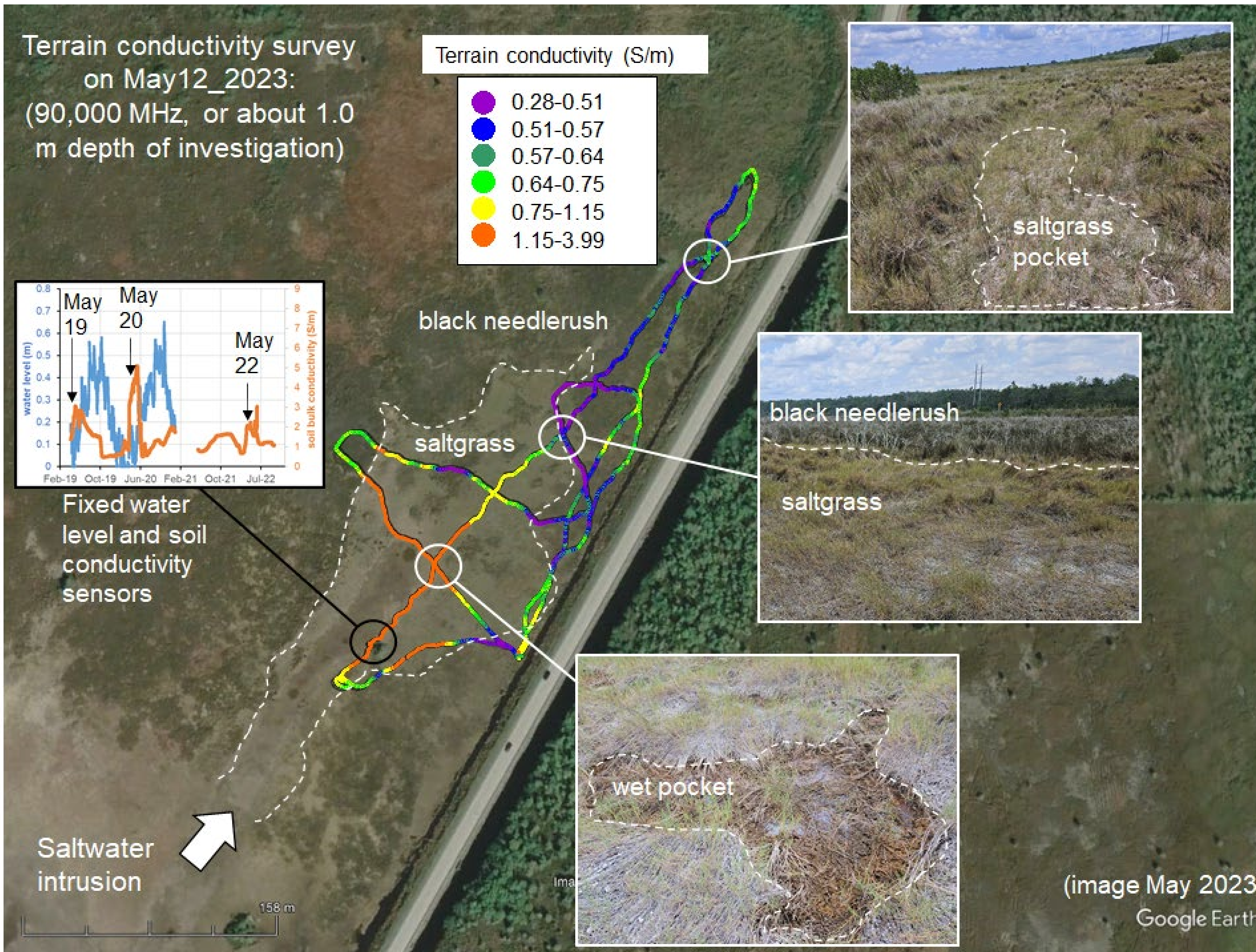
Experimental site and data

Represents the brackish member of the salinity gradient dominated black needle rush

Experimental site and data

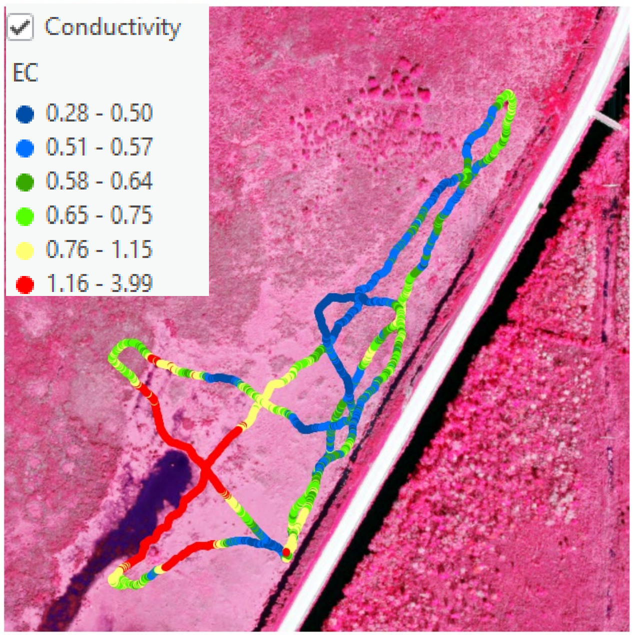
- Field measurements: May 2023, using GEM-2 geophysical technique



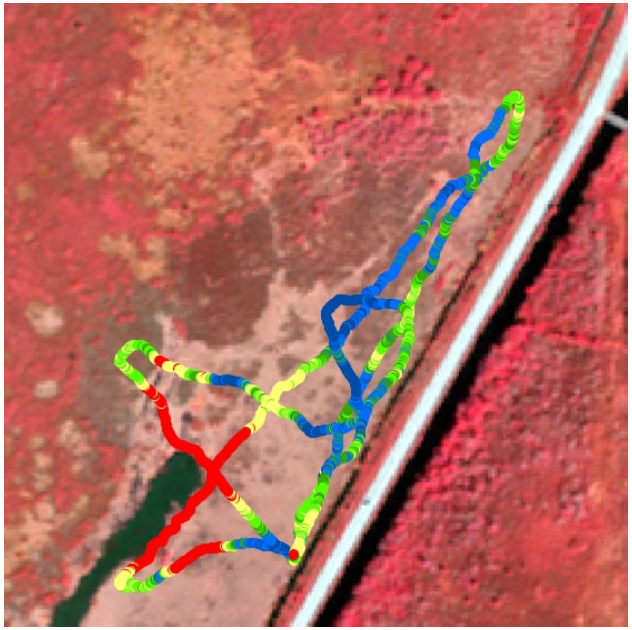


Experimental site and data

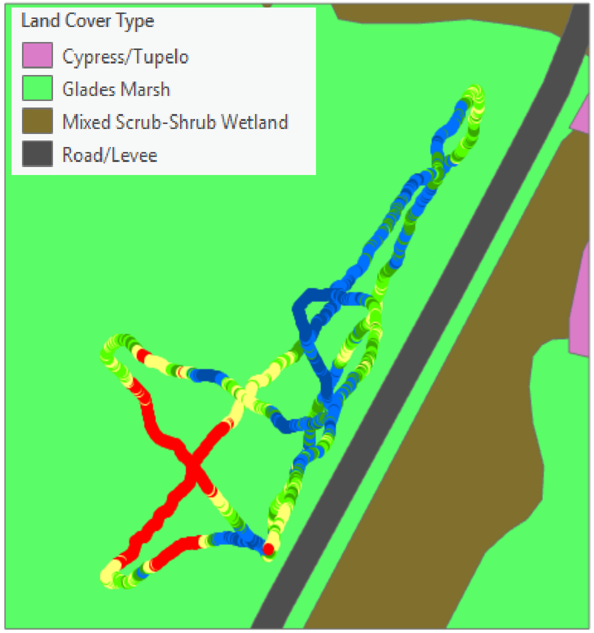
- Aerial photography: 1/10/2023, 1-meter, 4-band, 45 acres
- WorldView-2: 11/29/2024, 2-meter, 8-band



Aerial Photography



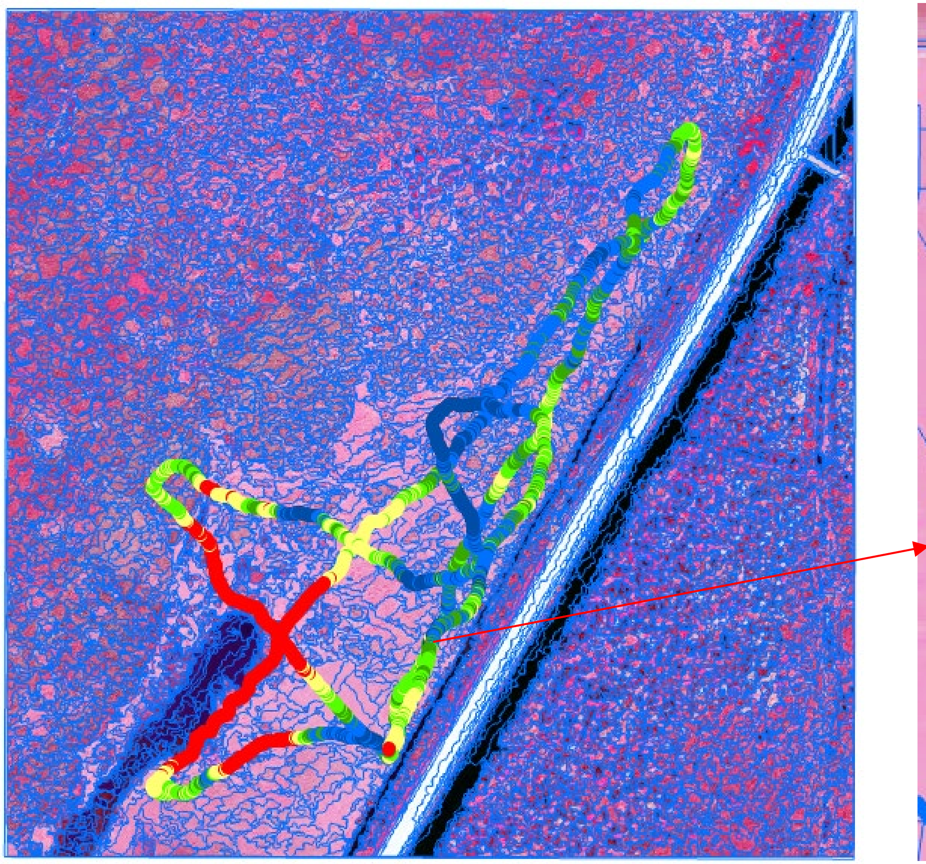
WorldView-2

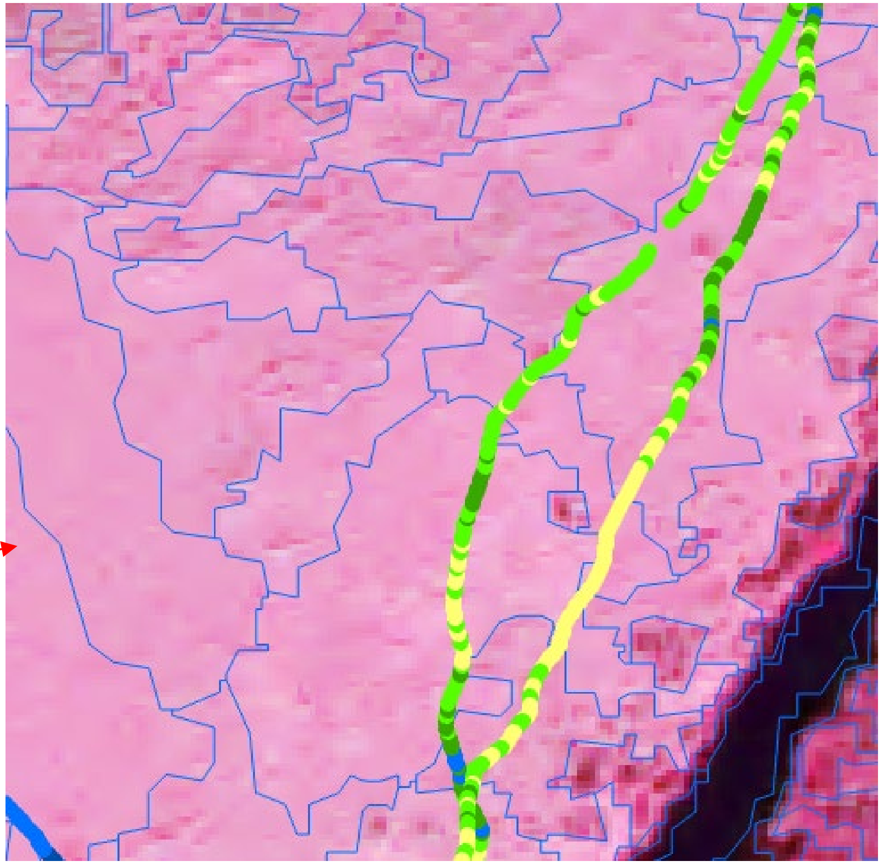


Land Cover Type

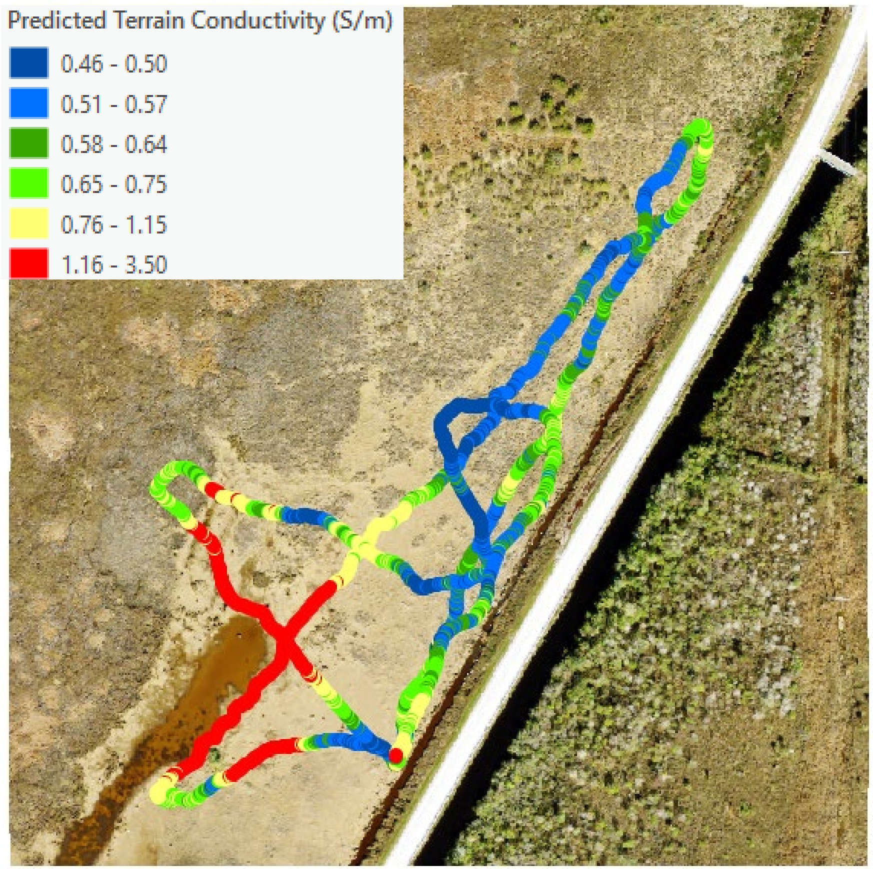
Methodology

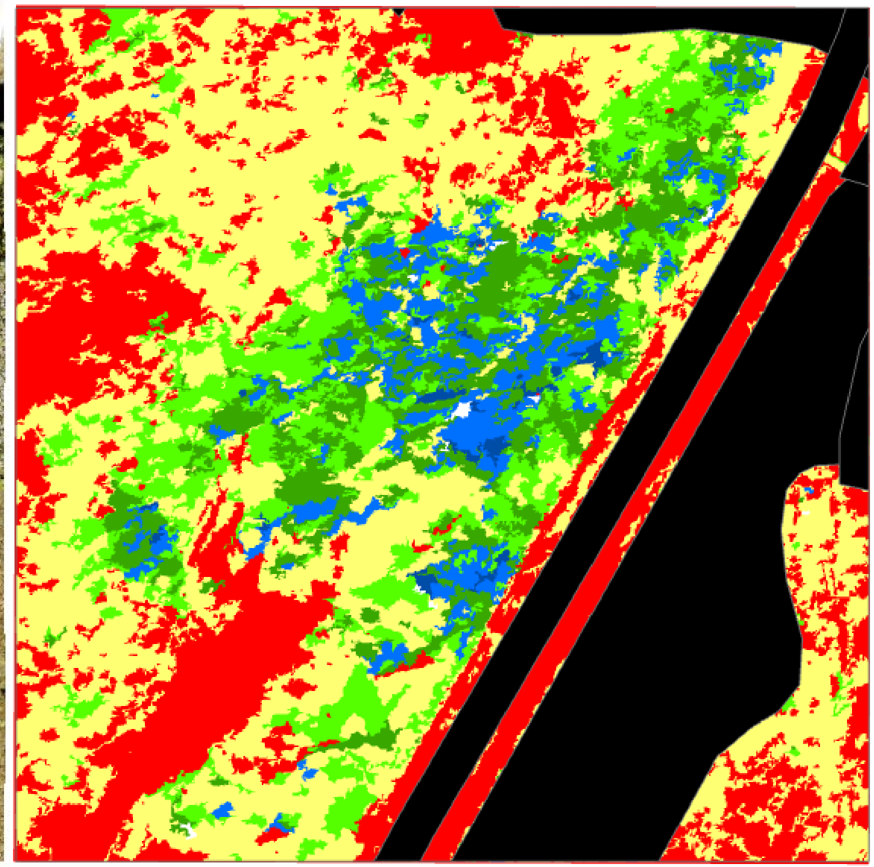
- Applied an object-based machine learning ensemble modeling/mapping technique, and combined outputs of RF, SVM, and ANN; Accuracy assessment was conducted using *k*-fold cross validation.



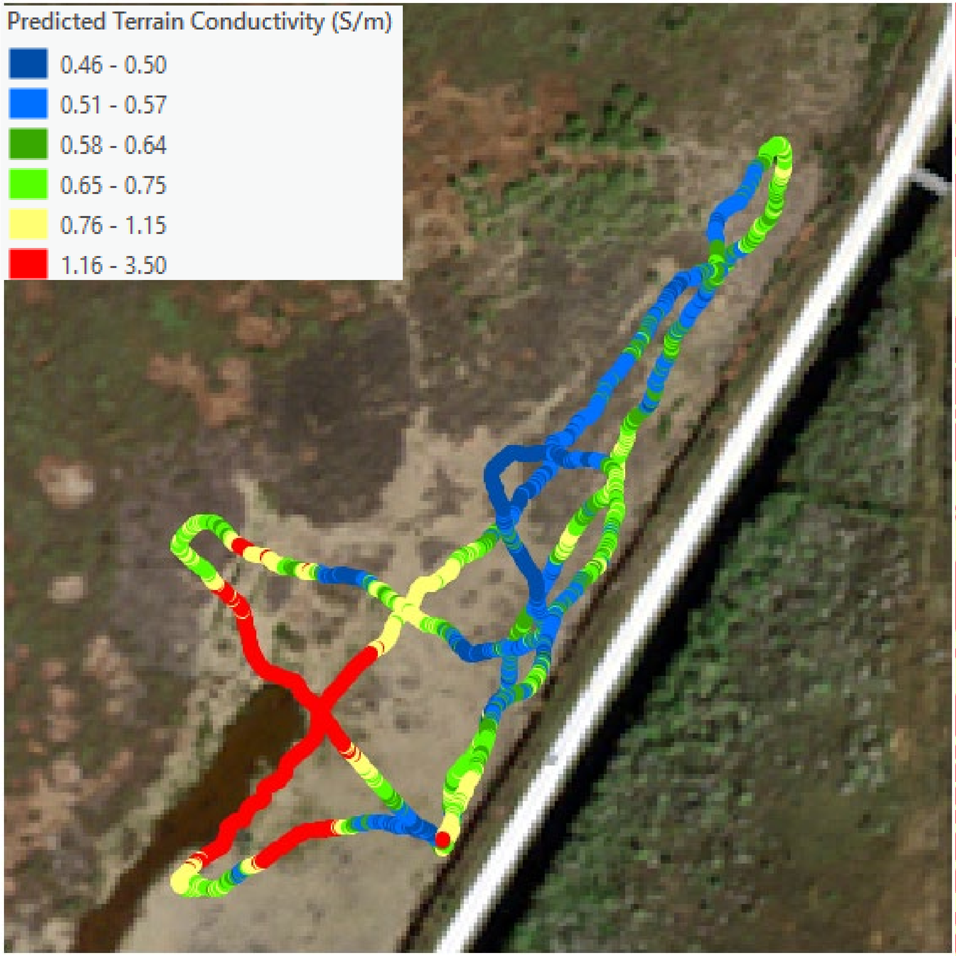


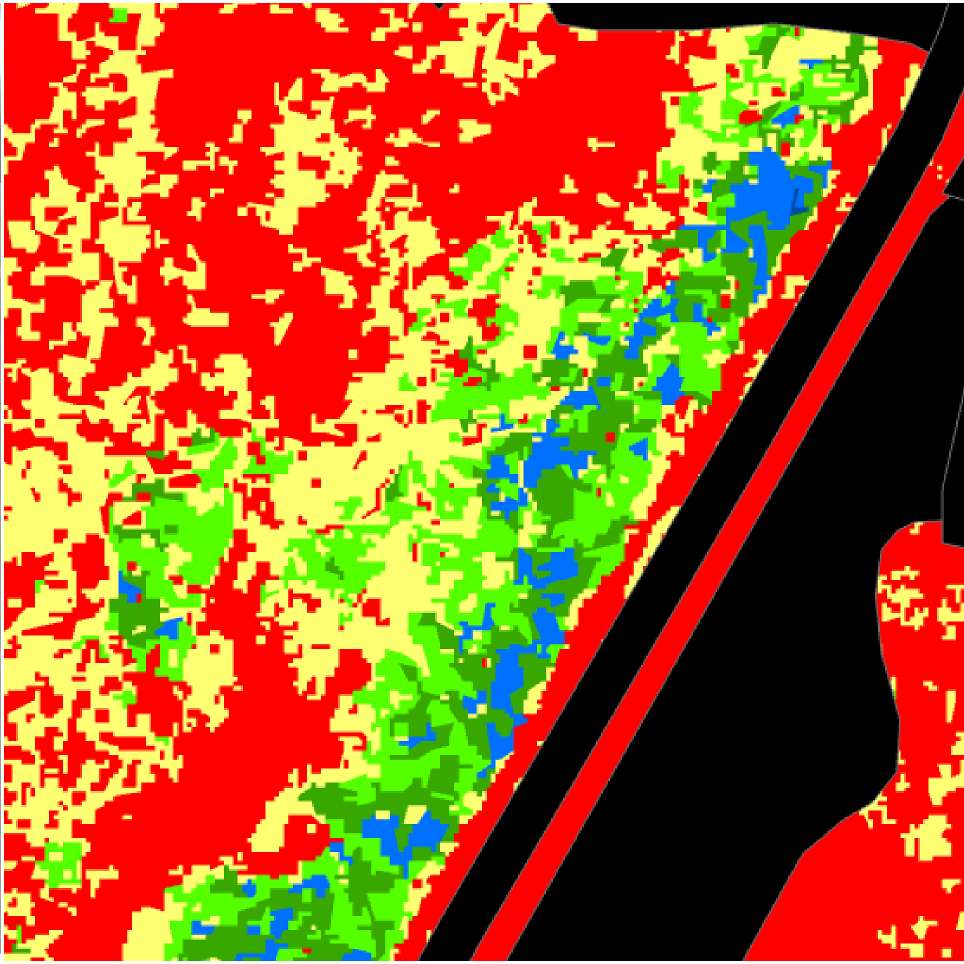
Results: Aerial Photography





Results: WorldView-2



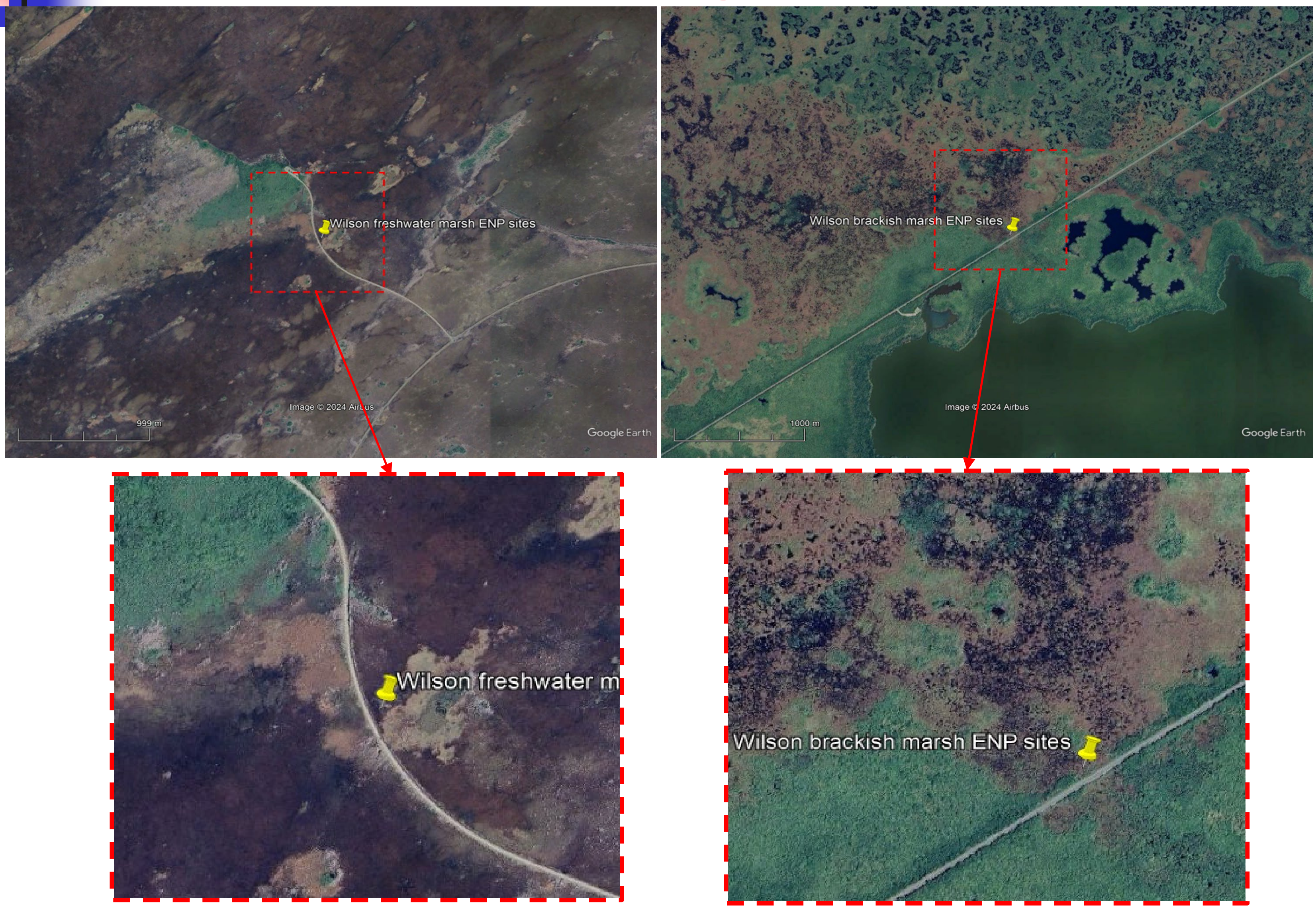


Results: Accuracy assessment

	NAIP		
	RF	SVM	ANN
R^2	0.57	0.64	0.69
RMSE	0.44	0.41	0.38
MAE	0.28	0.25	0.25
	WV-2		
	RF	SVM	ANN
R^2	0.63	0.64	0.76
RMSE	0.44	0.44	0.36
MAE	0.29	0.29	0.23

Conclusions and future work

- **AI and RS tools are powerful and valuable in EC estimation and mapping**



Team Zhang at FAU and Collaborators

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