# Quantifying Ecosystem Health and Carbon Capture of Coastal Restoration Using Drones and Machine Learning

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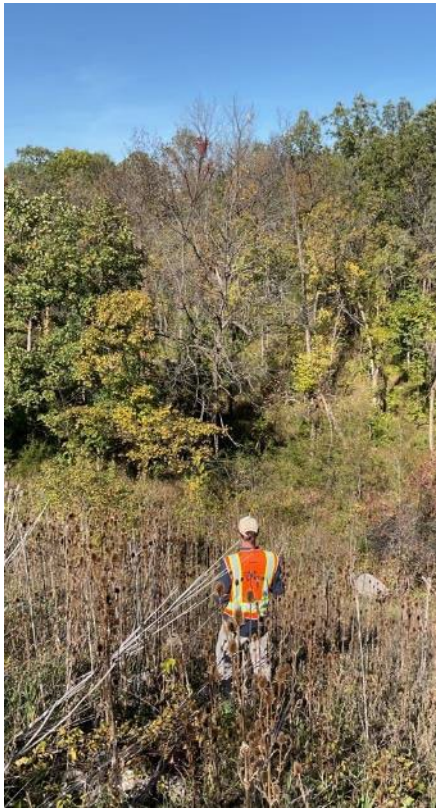
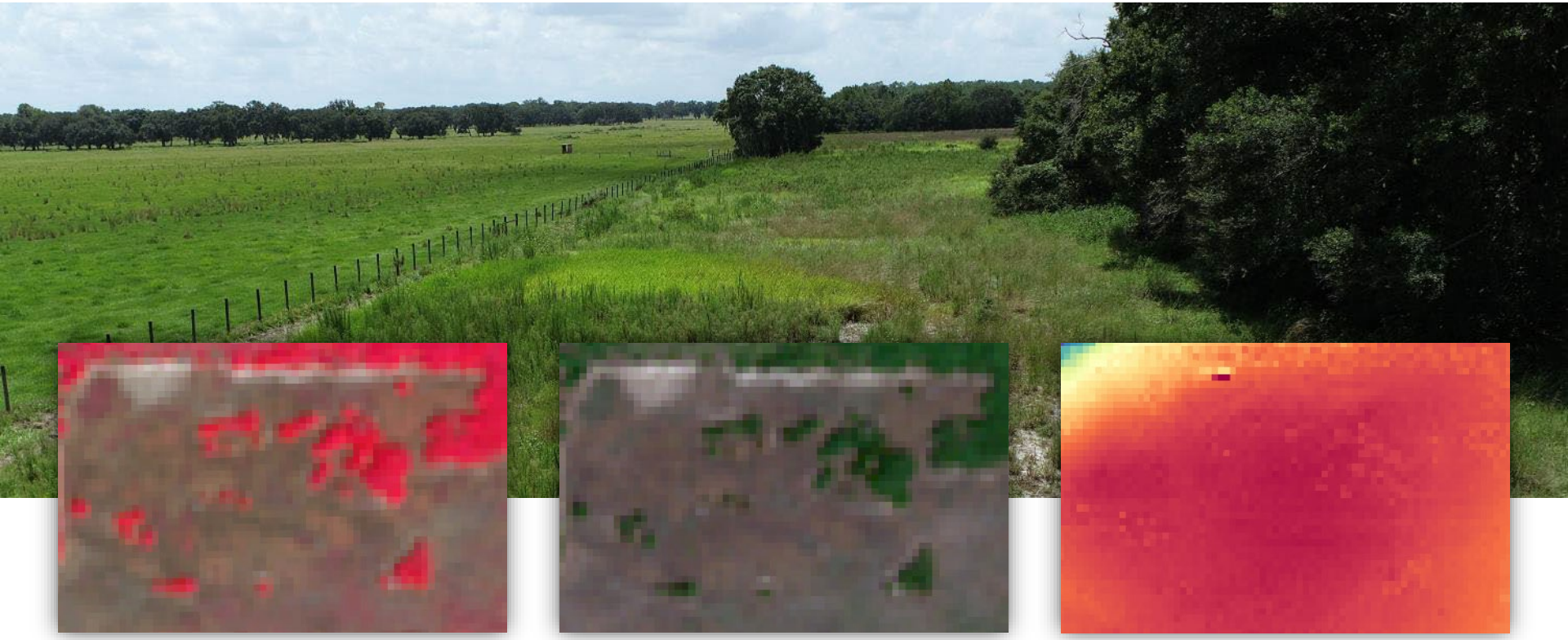
sky wave™ at CDM Smith

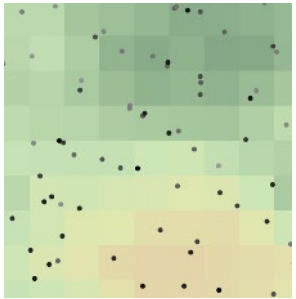
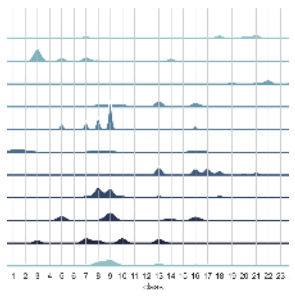
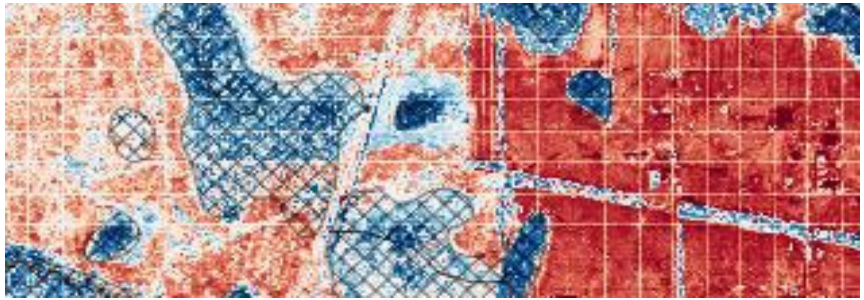
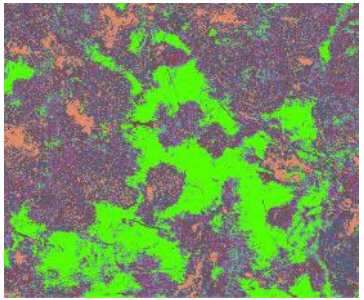
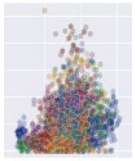
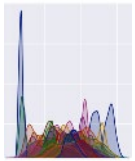
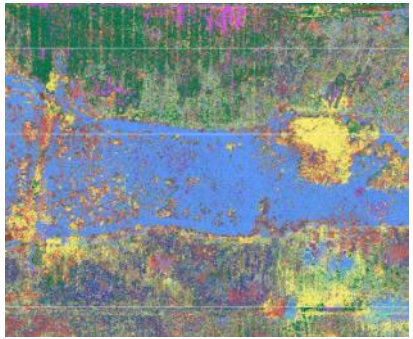
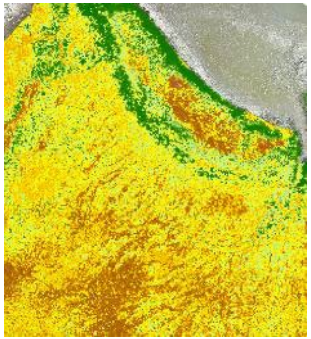
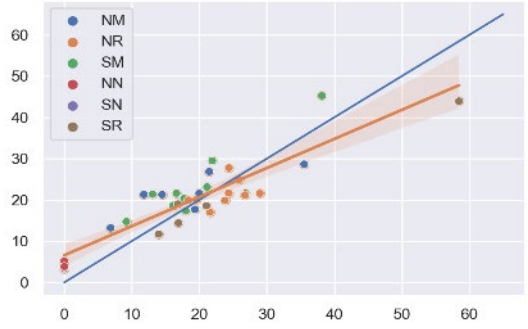
# Field work is an invaluable but limiting factor.

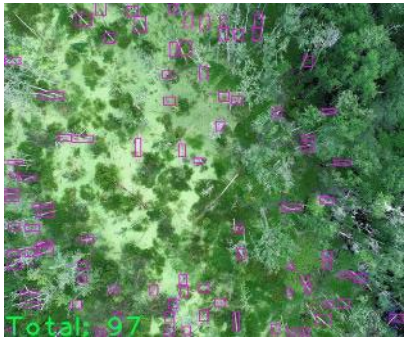


# Satellite/plane data is widely available but low spatial or temporal resolution.



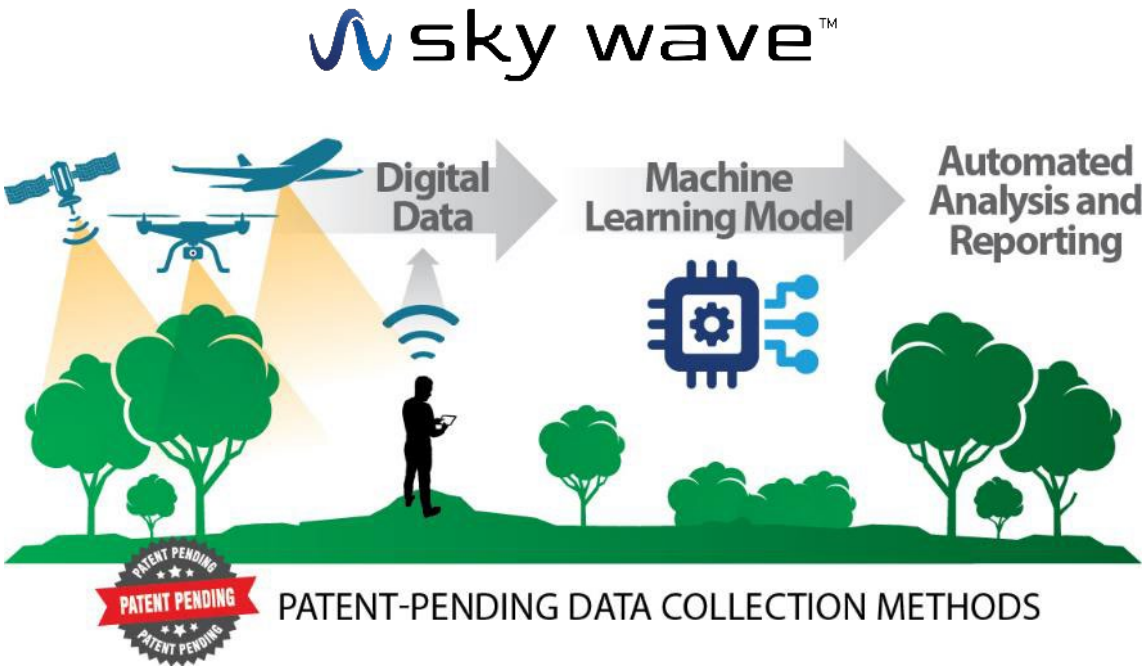
# We are finally seeing the promise of machine learning being delivered, but environmental applications are lagging.



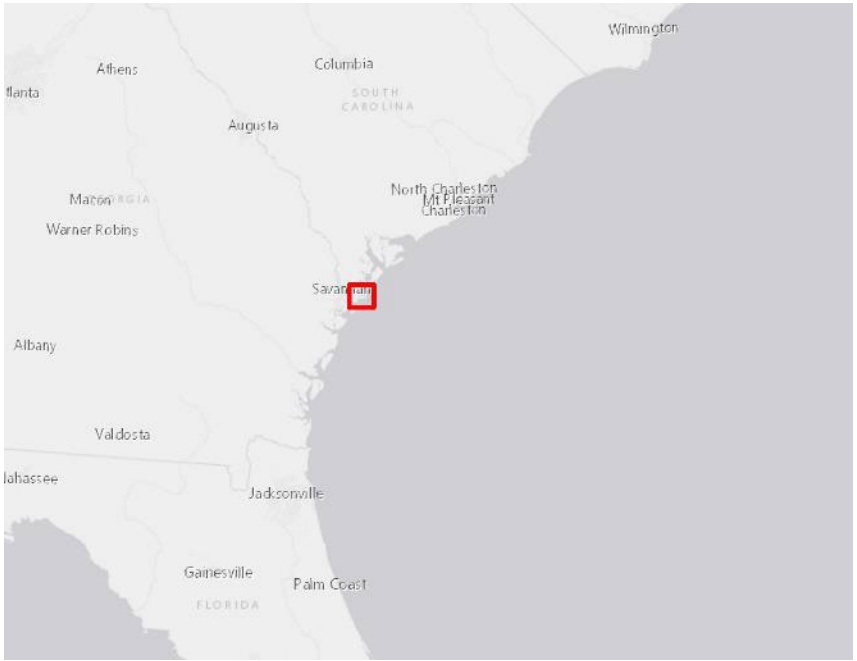
# An expert-centered digital pipeline empowers better decisions.

- Surveyors
- Engineers
- Geologists
- Scientists
- FAA-certified drone pilots
- Remote sensing
- Machine learning

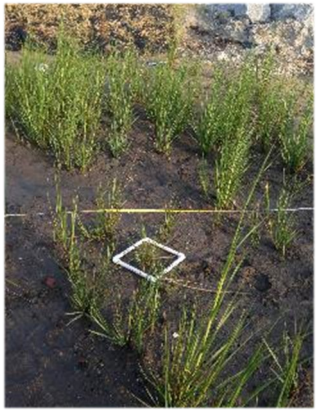


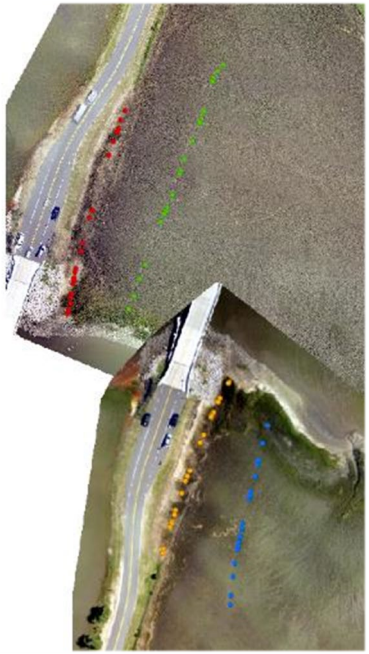
# Restoration: Tidal marsh biomass assessment

- How do we assess restoration success after remediation or construction?



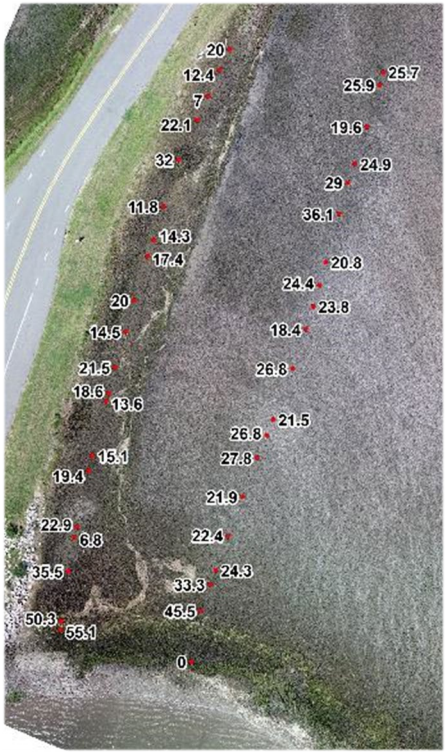

# Established approach for tidal marsh biomass

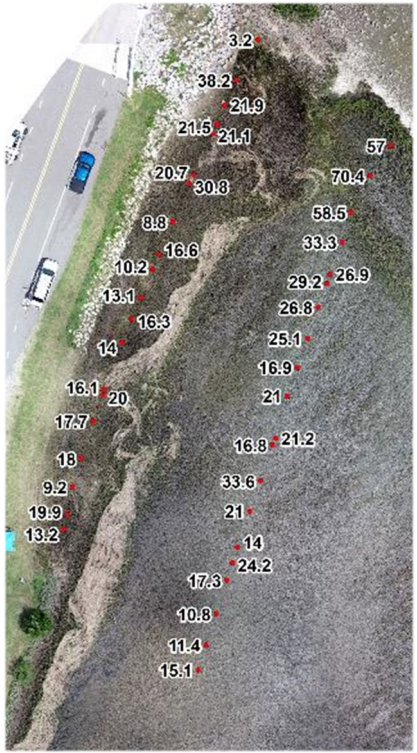




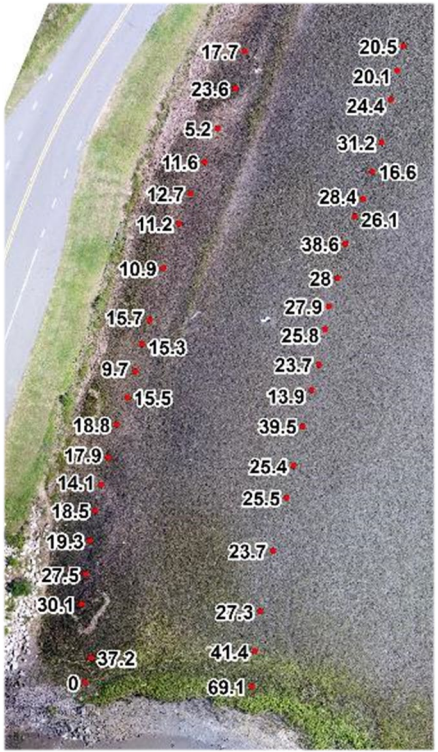
# Field data

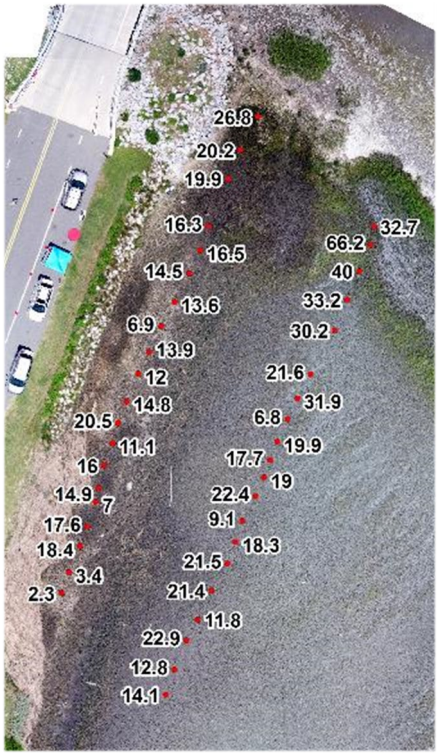
North 2021 South



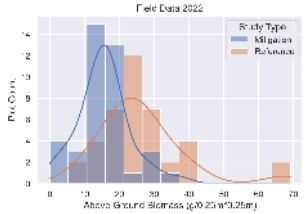



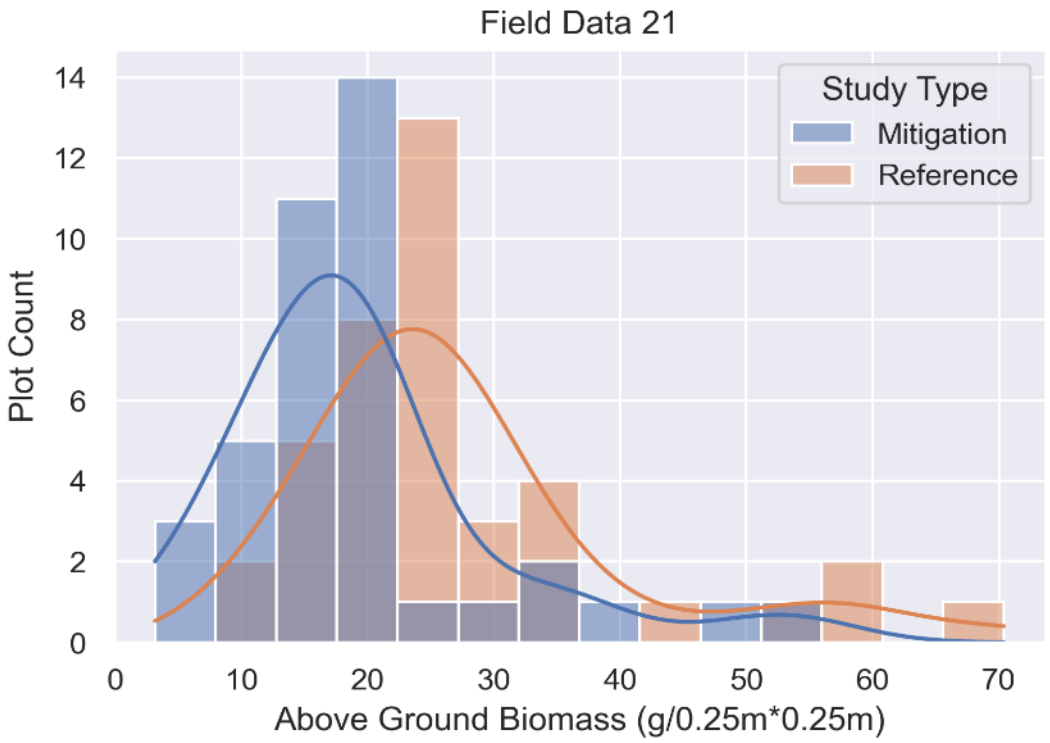

North 2022 South

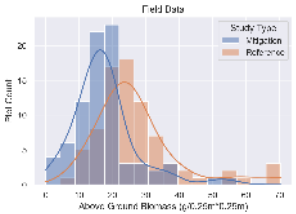


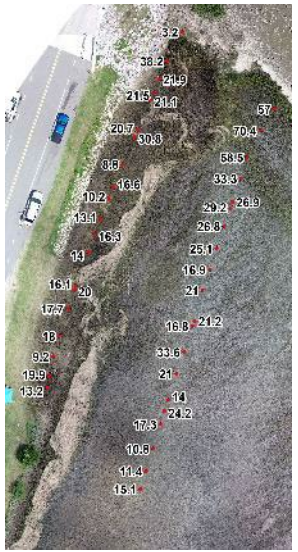



# Traditional Field Collection



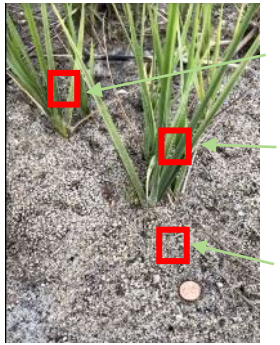



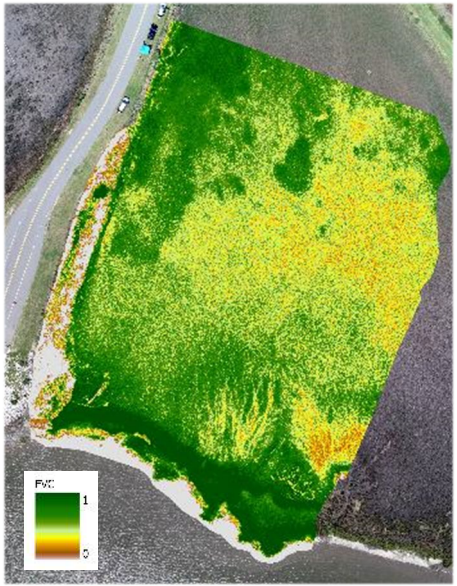



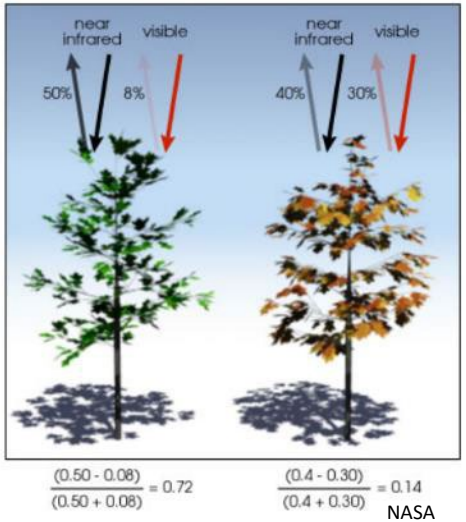
# Multispectral Indices

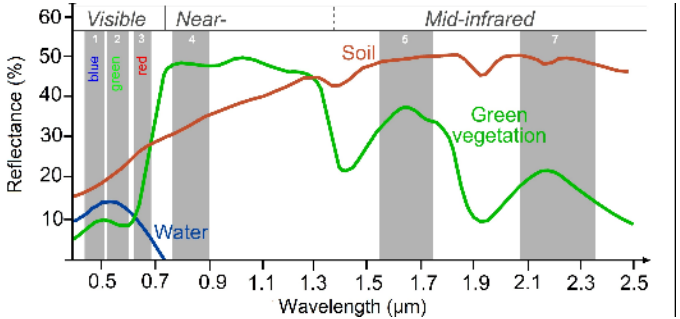
| Normalized Difference Vegetation Index (NDVI) | Fractional Vegetation Coverage (FVC) | Normalized Difference Red Edge (NDRE) | Normalized Difference Water Index (NDWI) |
|---|---|---|---|
| $\frac{NIR - Red}{NIR + Red}$ | $\frac{NDVI - NDVI_{soil}}{NDVI_{veg} - NDVI_{soil}}$ | $\frac{NIR - Red\ Edge}{NIR + Red\ Edge}$ | $\frac{Green - NIR}{Green + NIR}$ |

FVC



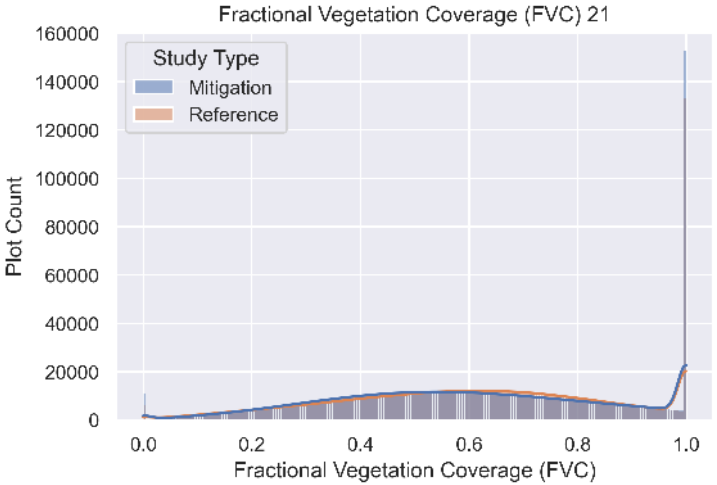



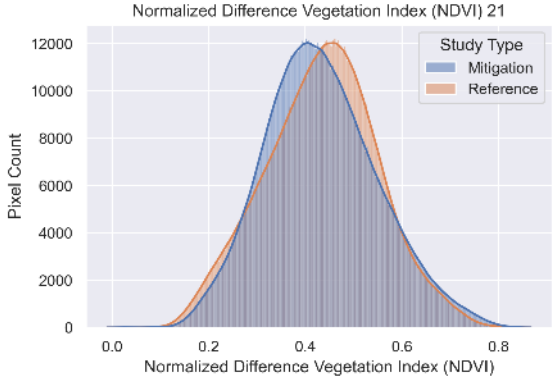



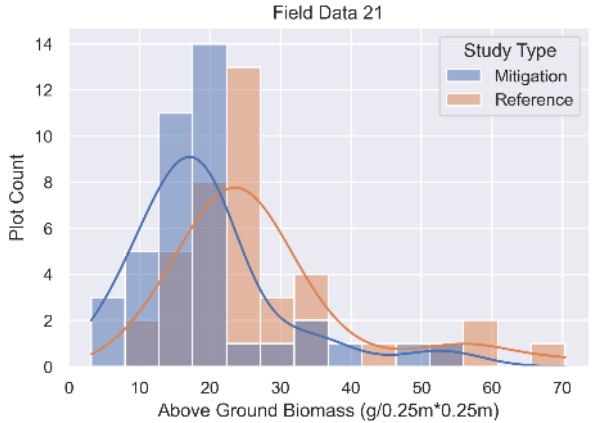



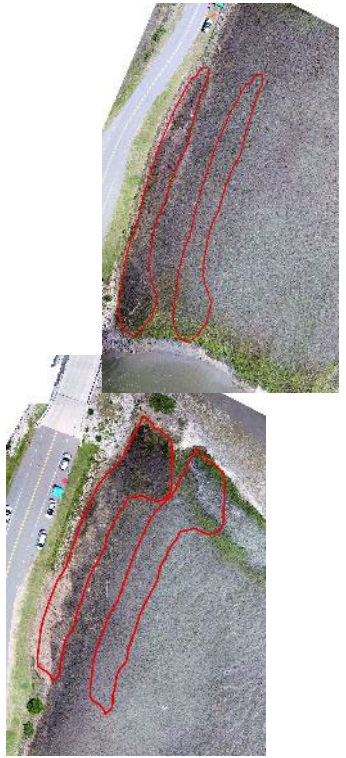

FVC:
Estimating Spartina alterniflora fractional vegetation cover and aboveground biomass in a coastal wetland using SPOT6 satellite and UAV data
Zaiming Zhou, Yanming Yang, Benqing Chen

# Fractional Vegetation Coverage (FVC)



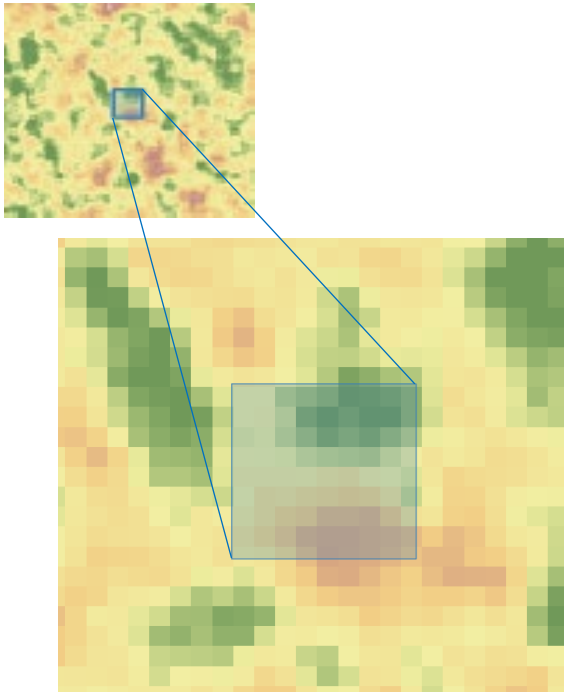



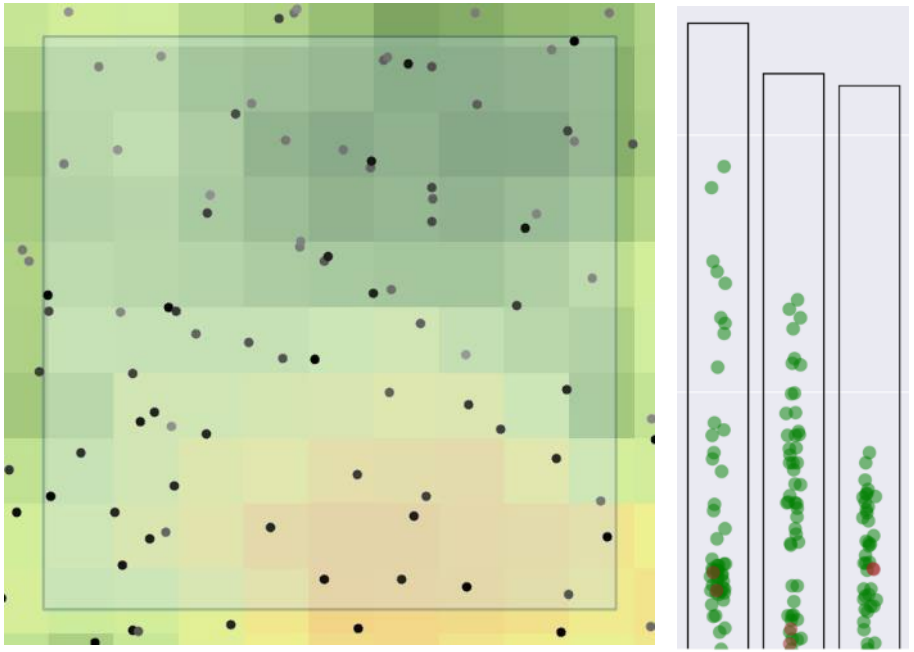



# Features to predict biomass

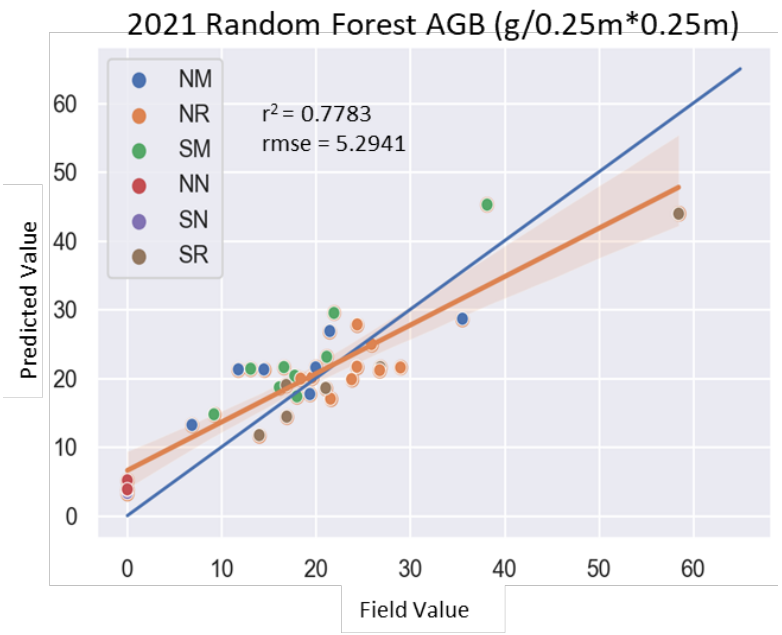
- 3 multispectral indices

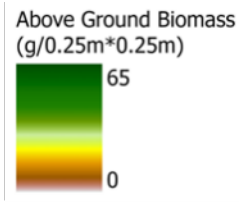


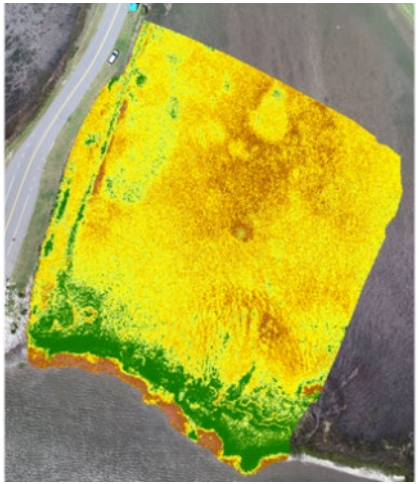
- Elevations from surface model

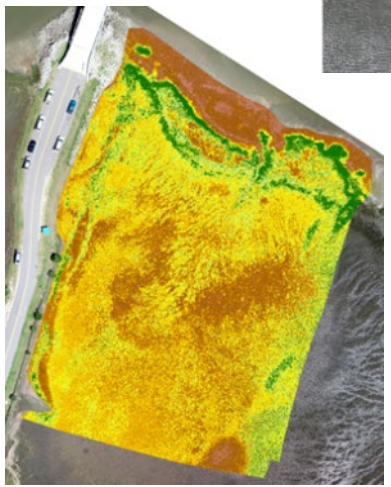


# Biomass model results

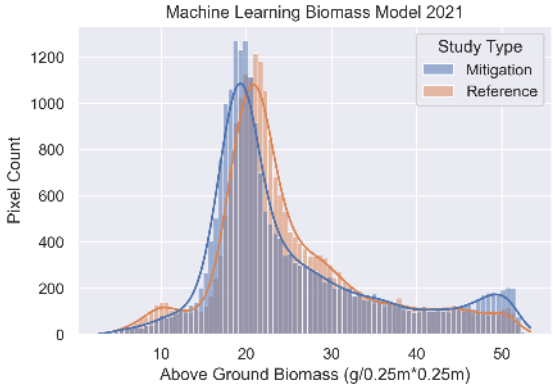


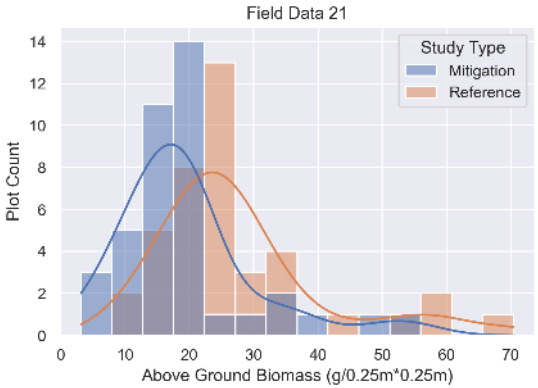



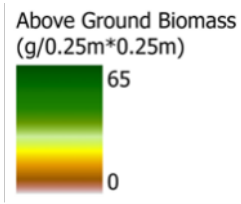



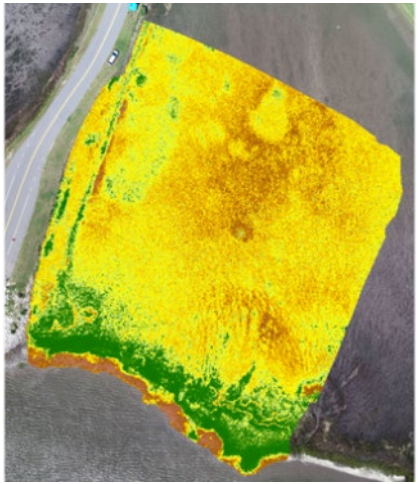


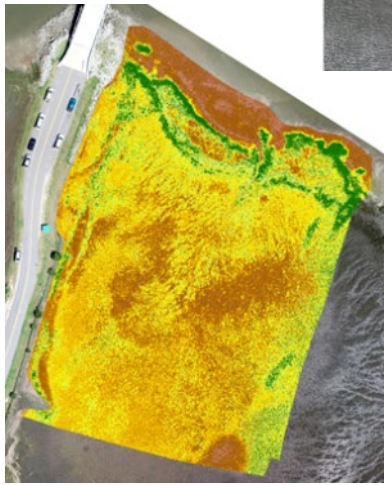
# Biomass distributions





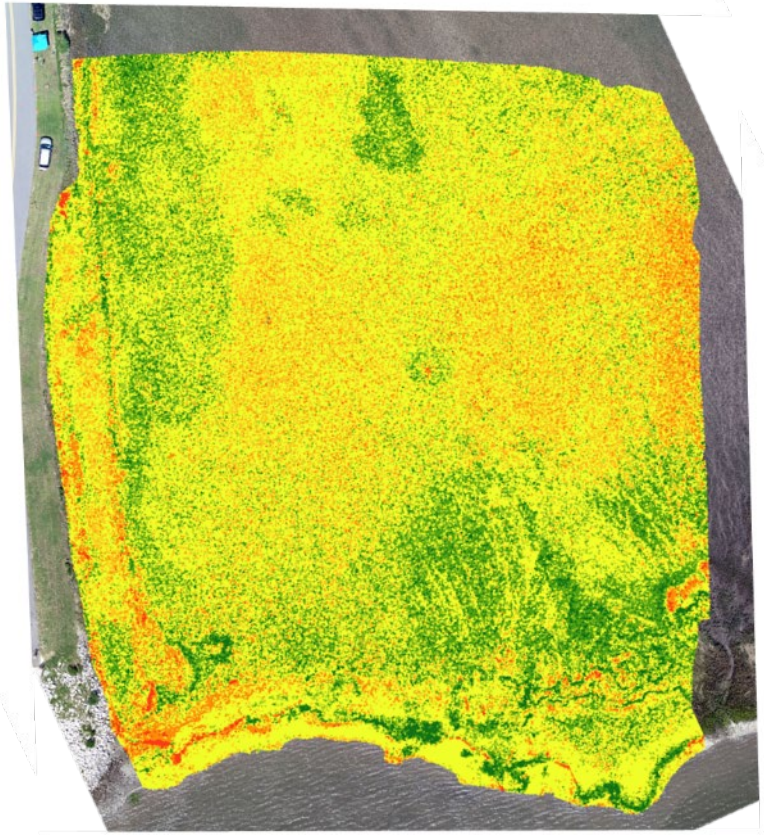
# Biomass change over time

2022 - 2021

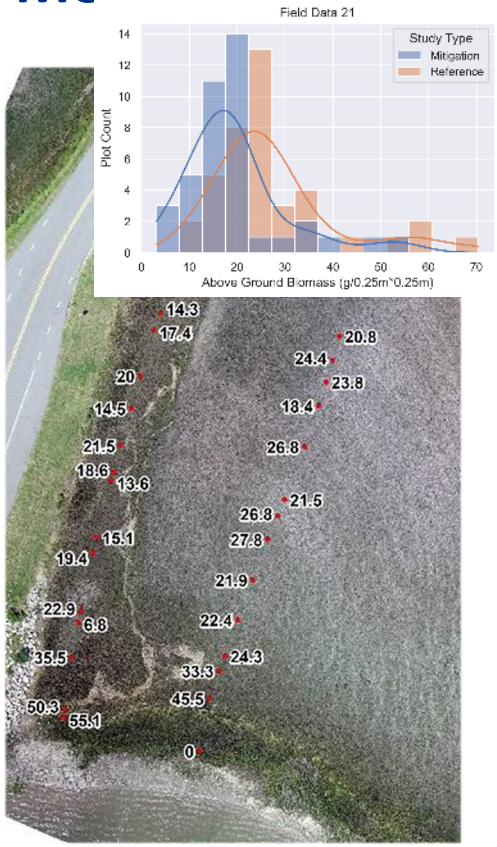
Biomass Loss

Biomass Stable

Biomass Gain

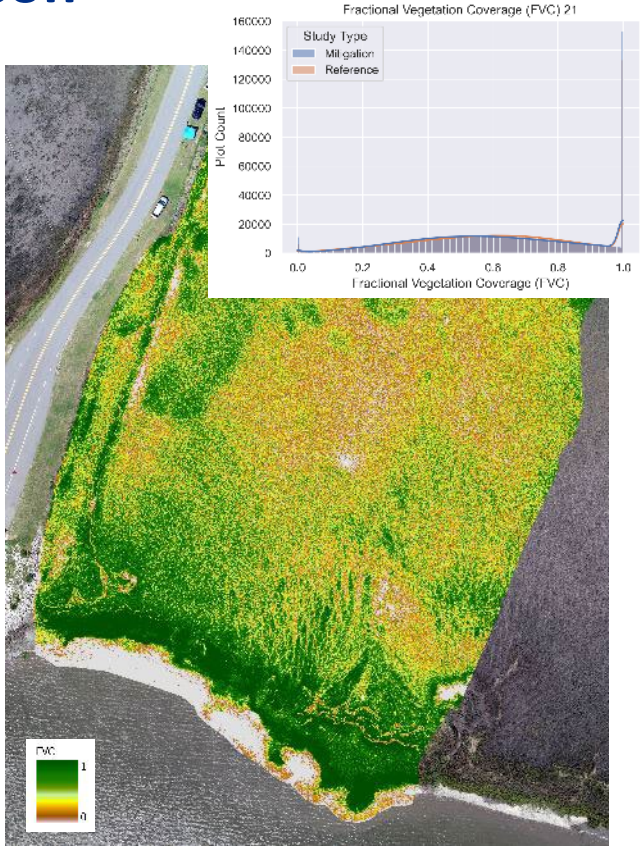


# Methods Comparison



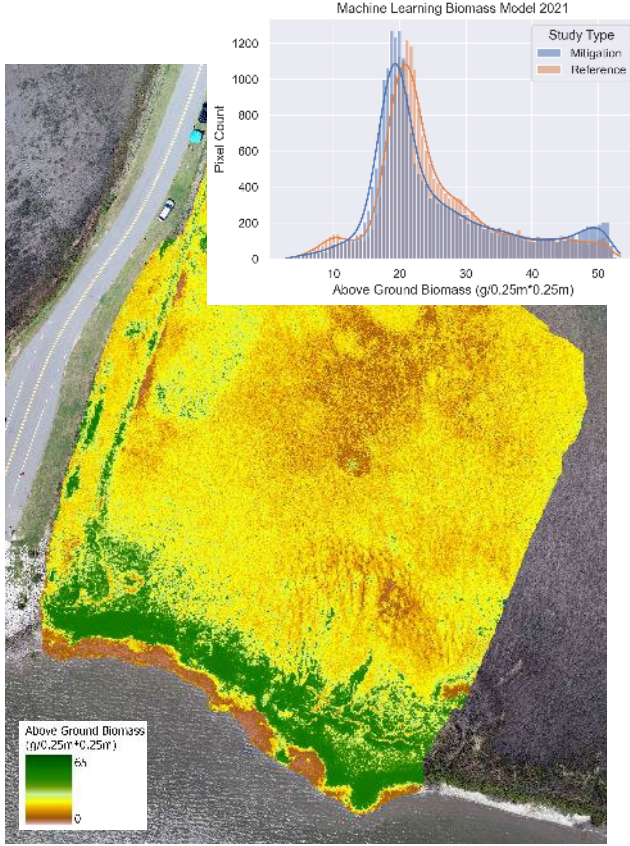












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