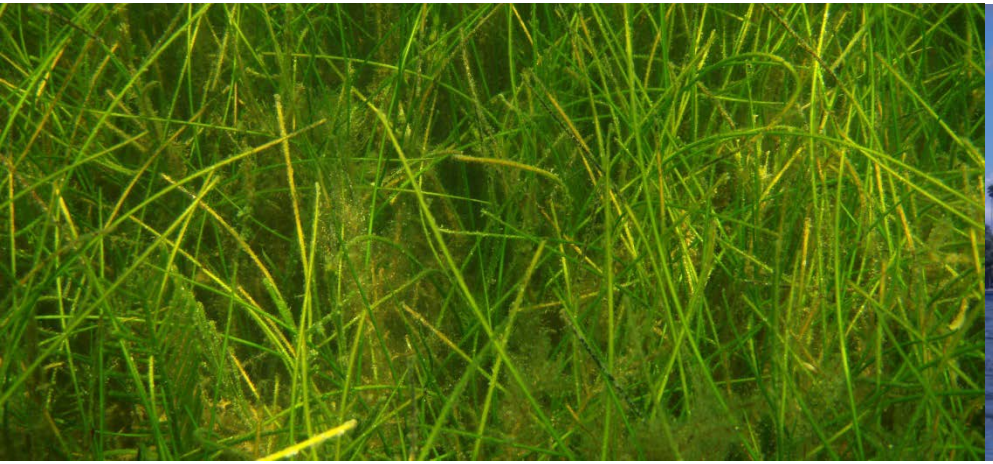


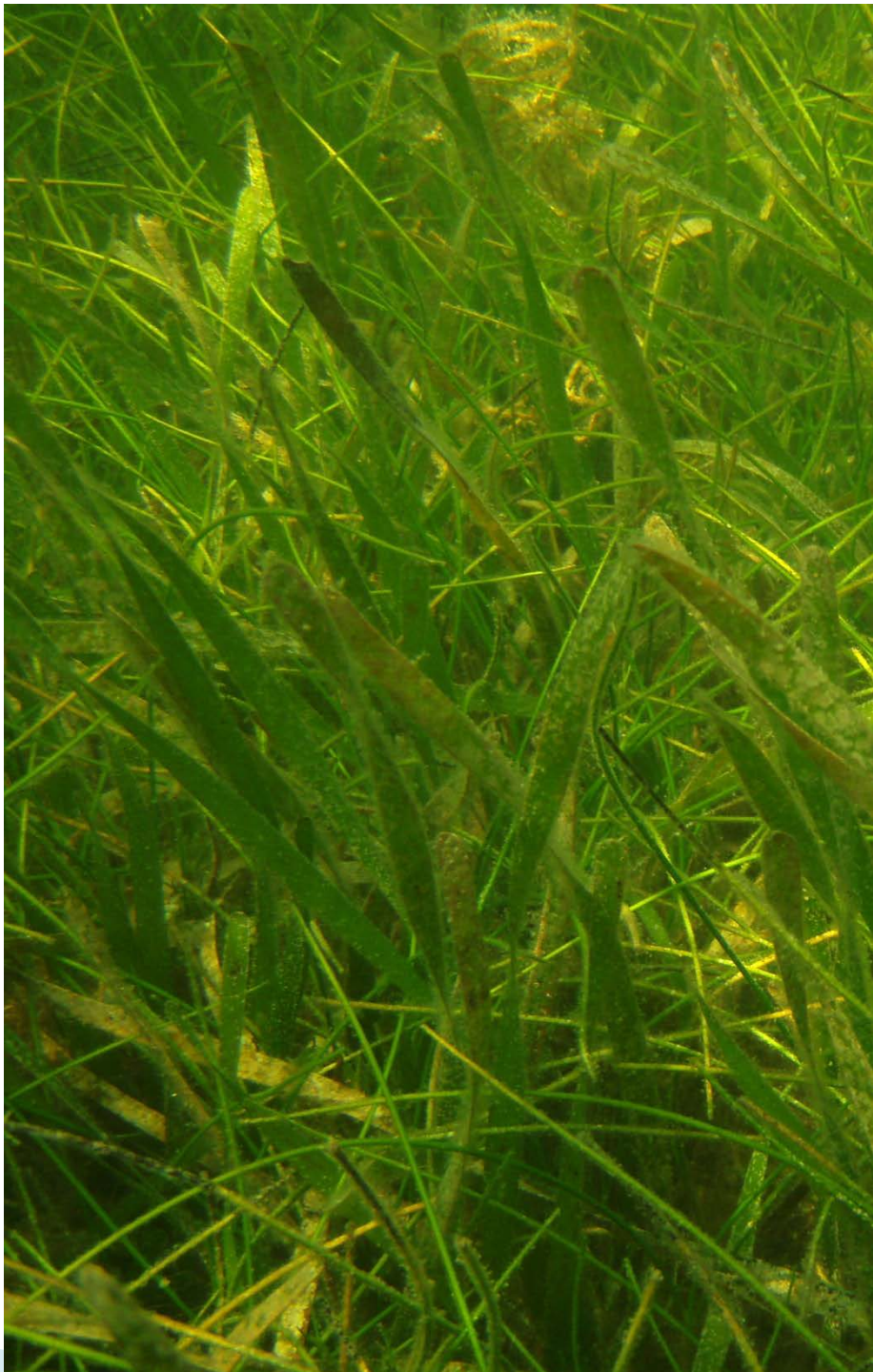
# Seagrass Resource Mapping: Aerial Photos versus Satellite Imagery

*Cynthia Meyer, Ph.D., GISP*
*NOAA NMFS , USF*
*Ruiliang Pu, Ph.D.*
*University of South Florida*

*13 July 2017*

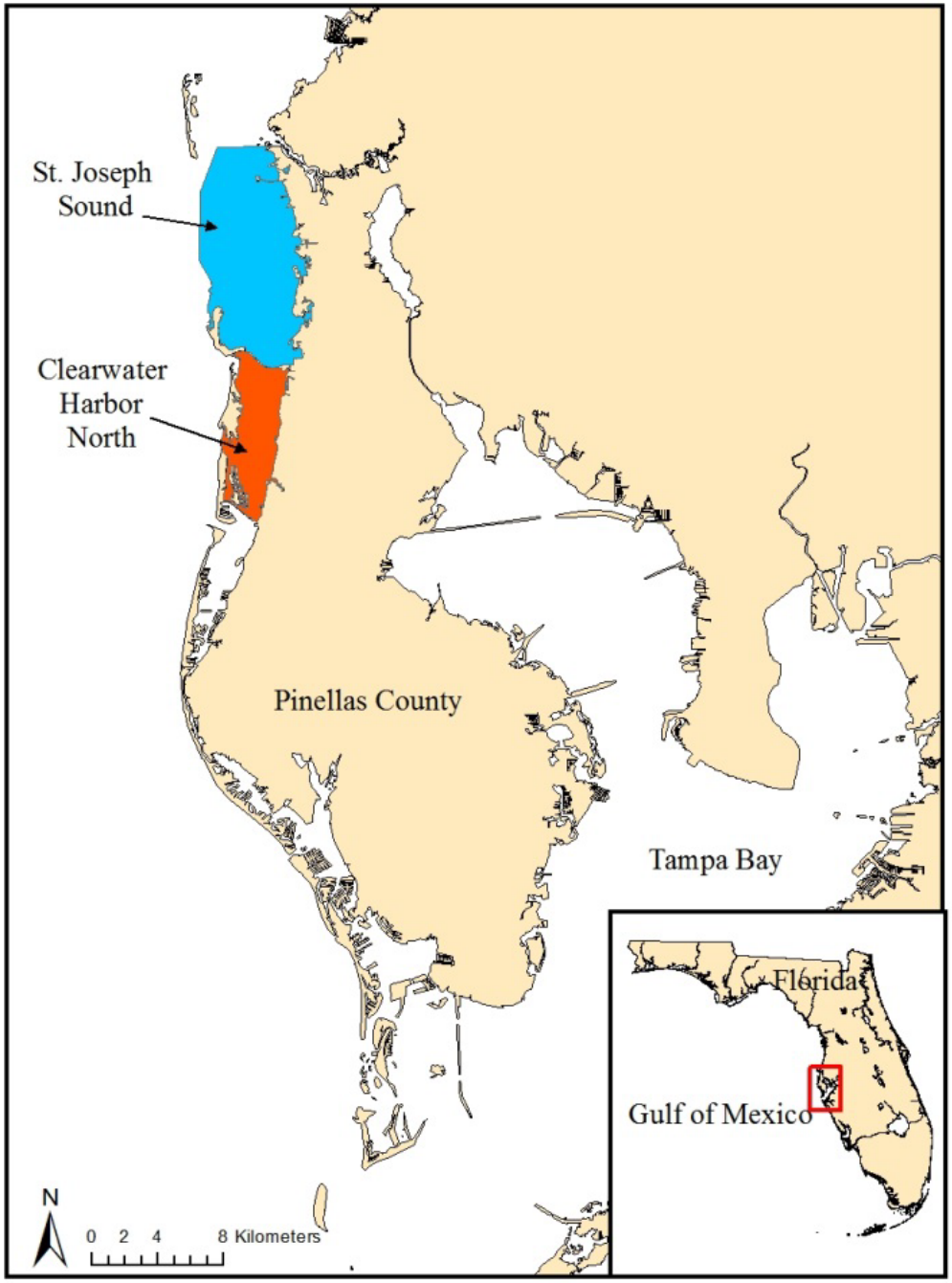
# Overview

- Study Area & Seagrass
- Aerial Photograph Interpretation
- Satellite Imagery Classification
- Comparison
- Conclusion



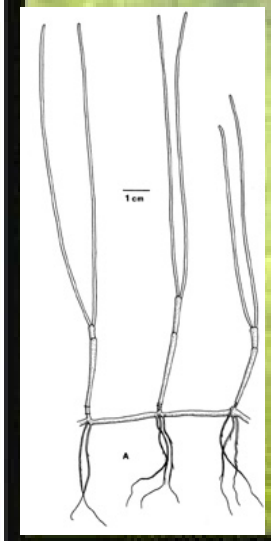
# Study Area

- STJS & CLWN
- Intercoastal and open Gulf Waters
- Area: 95 $km^2$
- Seagrass: ~60 $km^2$
- Depths: ~4m
- Data: 2006-2010

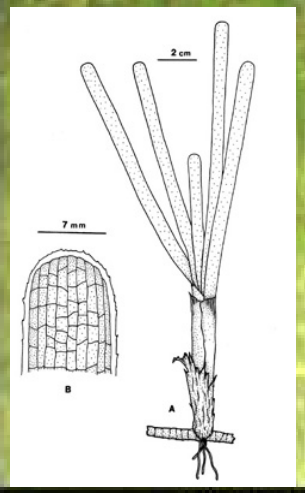


# Seagrass

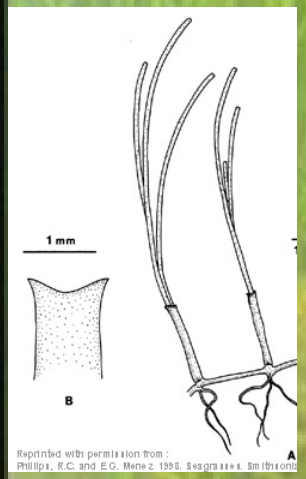
- Seagrass Importance
  - Increase the productivity
  - FOOD
  - Nutrient cycling
  - Detritus production
  - Sediment formation
  - Shelter




*Syringodium*




*Thalassia*

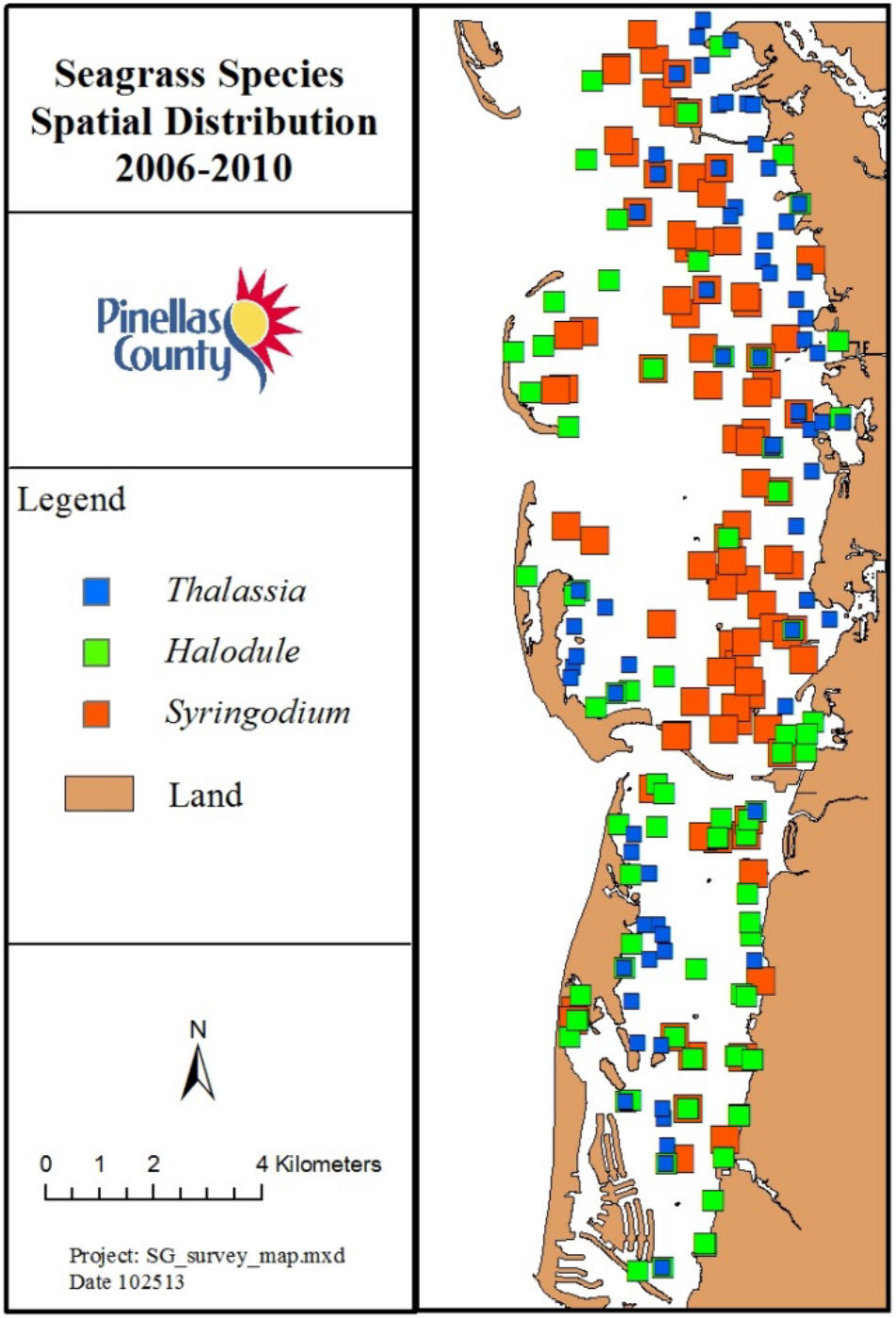


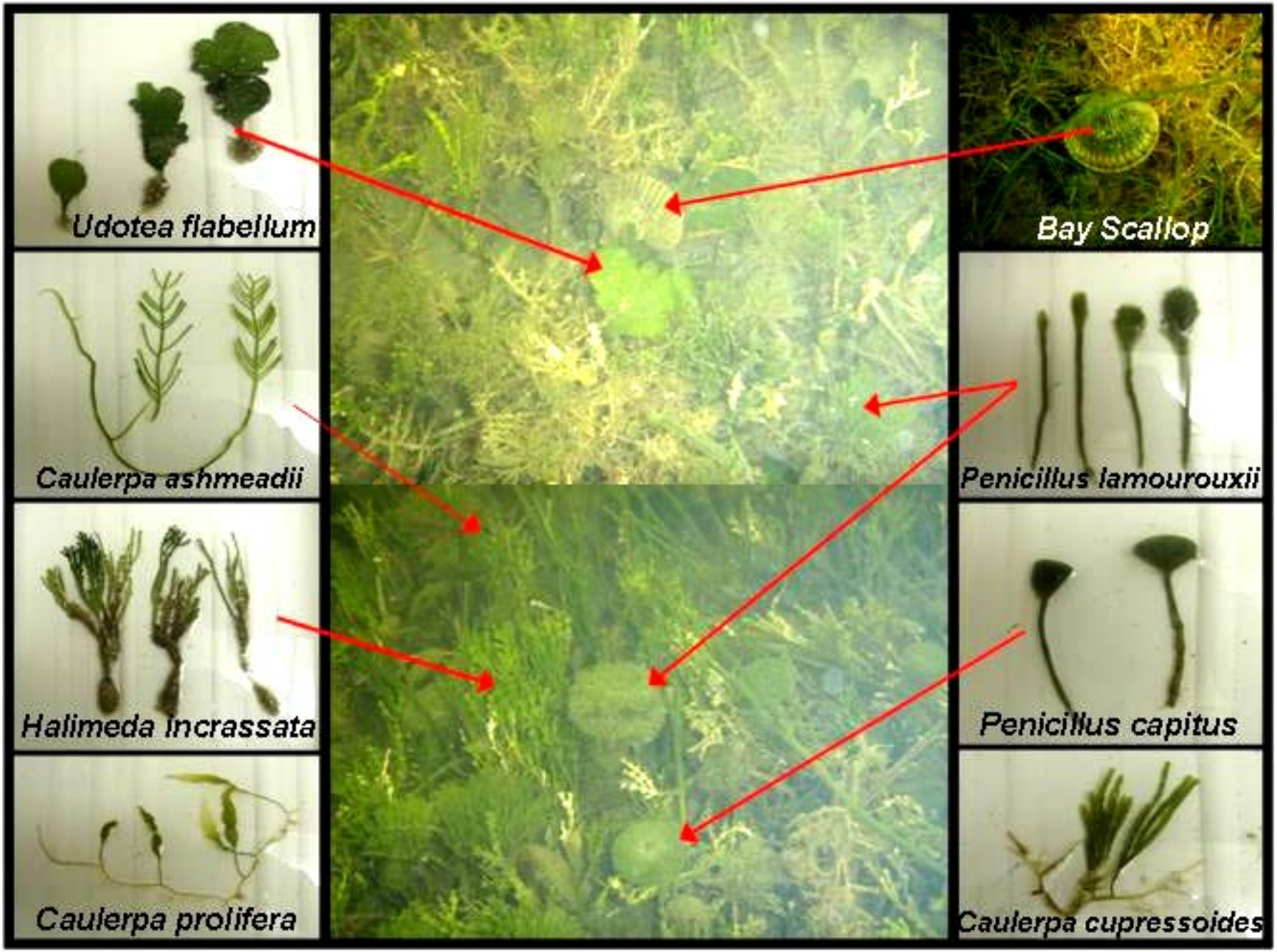

*Halodule*

**Mixed Seagrass Bed**

# Seagrass Species Distribution

- *Thalassia*
  - Low-energy
  - Shallow areas
- *Halodule*
  - Very shallow or very deep
  - Widely Distributed
- *Syringodium*
  - Mid to Deep
  - Mainly STJS

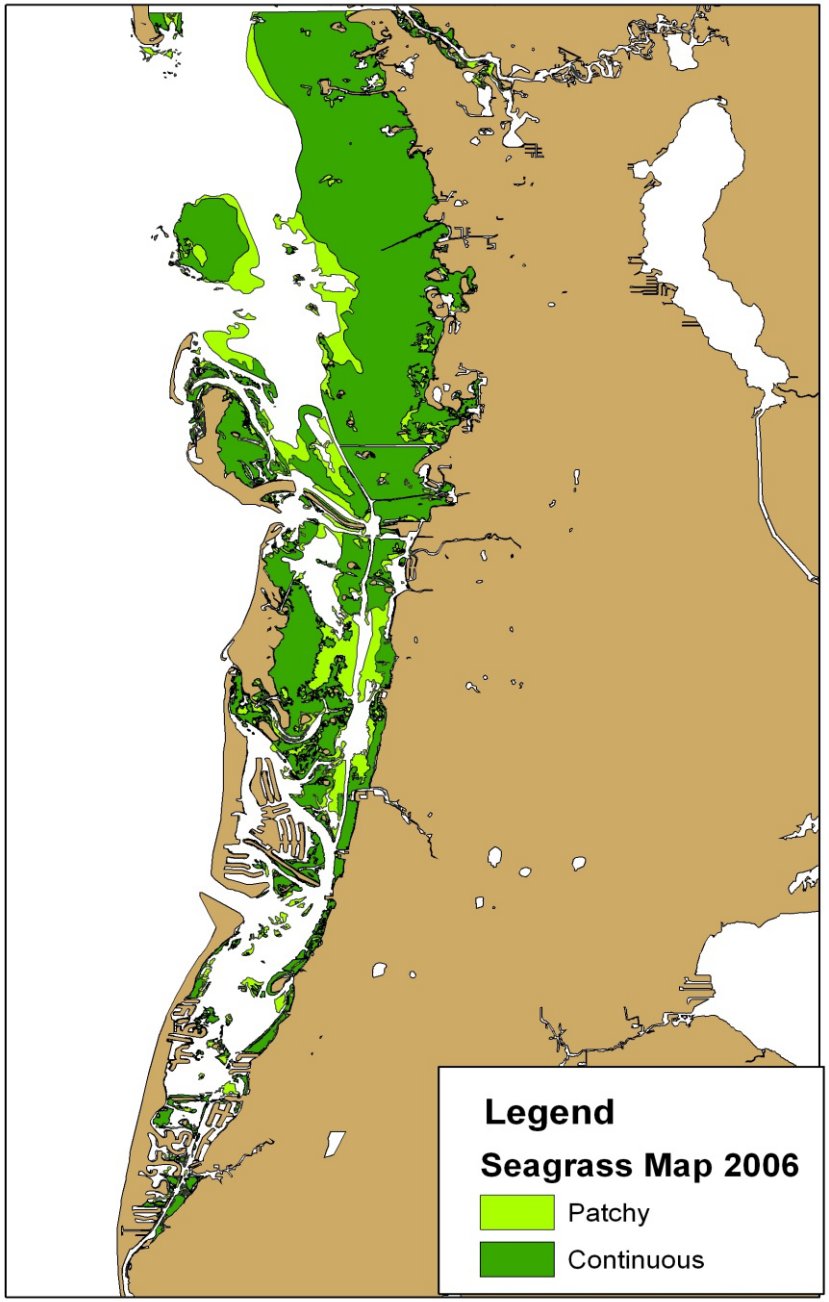



Udotea flabellum
Bay Scallop
Caulerpa ashmeadii
Penicillus lamourouxii
Halimeda incrassata
Penicillus capitus
Caulerpa prolifera
Caulerpa cupressoides

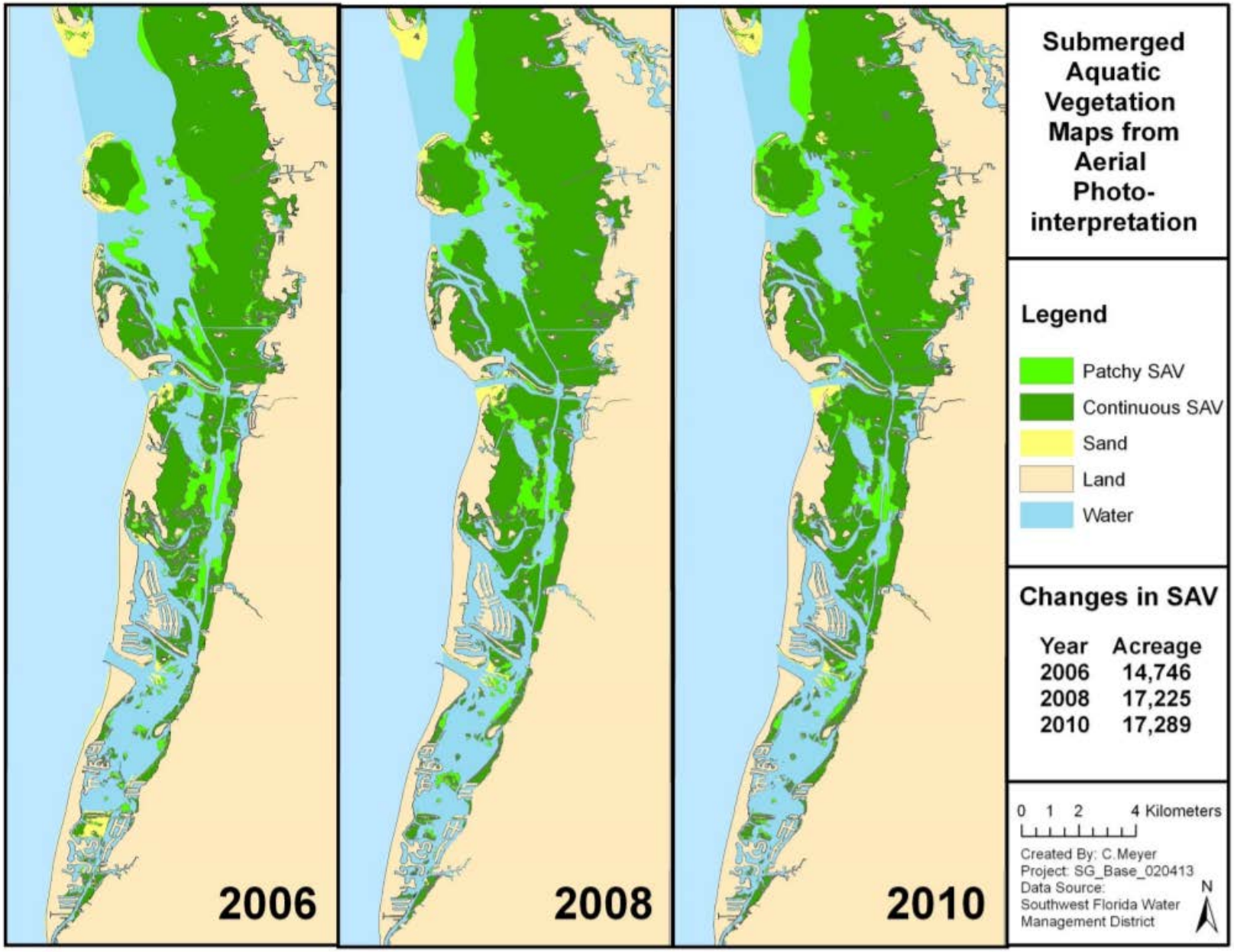
# Aerial PhotoInterpretation

- Image Acquisition
  - February 2006
  - January 2008
  - December 2010
- Classes:
  - Continuous SAV
  - Patchy SAV
- 1 meter resolution
- 0.5 acre mapping unit
- 90% Groundtruth Accuracy

(SWFWMD, 2007)



# Aerial PhotoInterpretation



# Imagery

- EO-1 Hyperion
  - 9/29/2010
- Landsat TM 5
  - 10/04/2010

# Preprocessing

- Preprocessing
  - Denoise*
  - Destripe*
  - Image Registration
  - Masking

* Zhoa et al. (2013)

# SAV Delineation

- Equalization of TM bands 3,2,1
- Spectral Differentiation of SAV
- Defining Regions of Interest (ROIs)

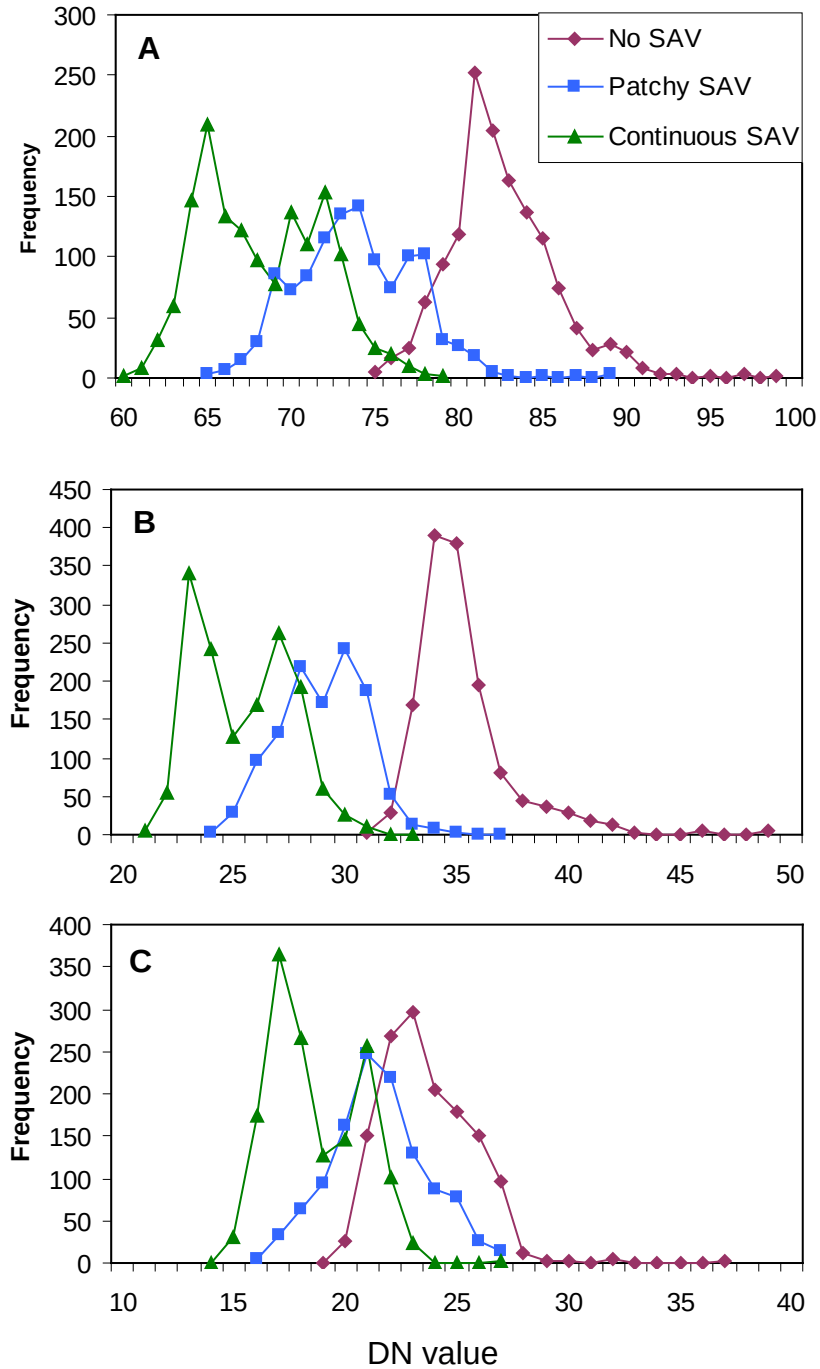
  Classes:
  - Presence = >25% SAV
  - Absence = <25% SAV

  - No SAV = 0% – 25% SAV
  - Patchy SAV = 25% – 75% SAV
  - Continuous SAV = >75% SAV

# Spectral Signatures

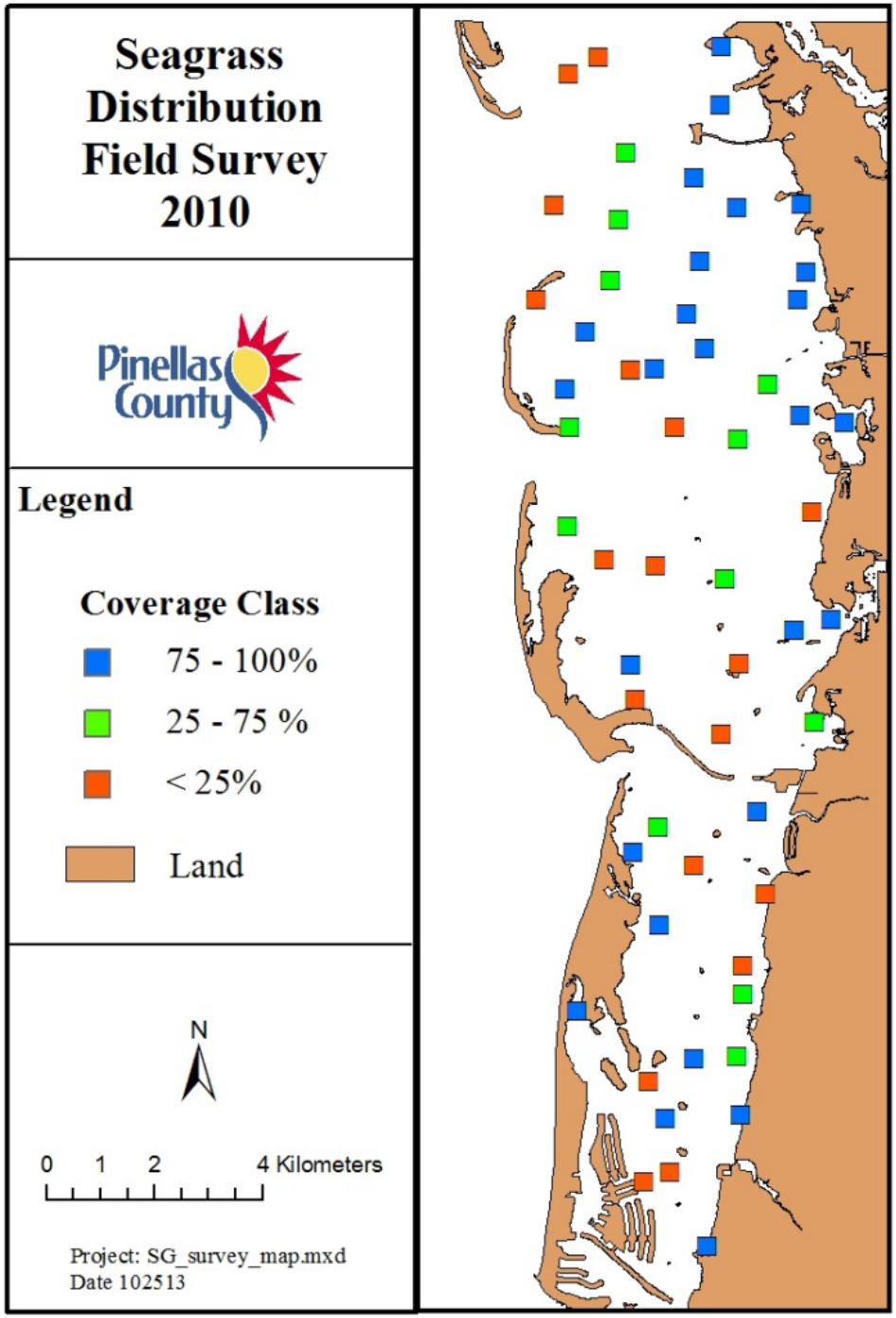
- Spectral Properties of ROIs
  - A: Band 1
  - B: Band 2
  - C: Band 3

| ROI | Pixels | Band | Mean DN | Standard Deviation |
|---|---|---|---|---|
| No SAV | 1401 | 1 | 82.51 | 3.12 |
| | | 2 | 35.22 | 2.17 |
| | | 3 | 23.68 | 2.09 |
| Patchy | 1154 | 1 | 73.85 | 3.51 |
| | | 2 | 29.00 | 1.89 |
| | | 3 | 21.48 | 2.15 |
| Continuous | 1493 | 1 | 68.25 | 3.65 |
| | | 2 | 25.40 | 2.15 |
| | | 3 | 18.62 | 2.04 |



# Classification

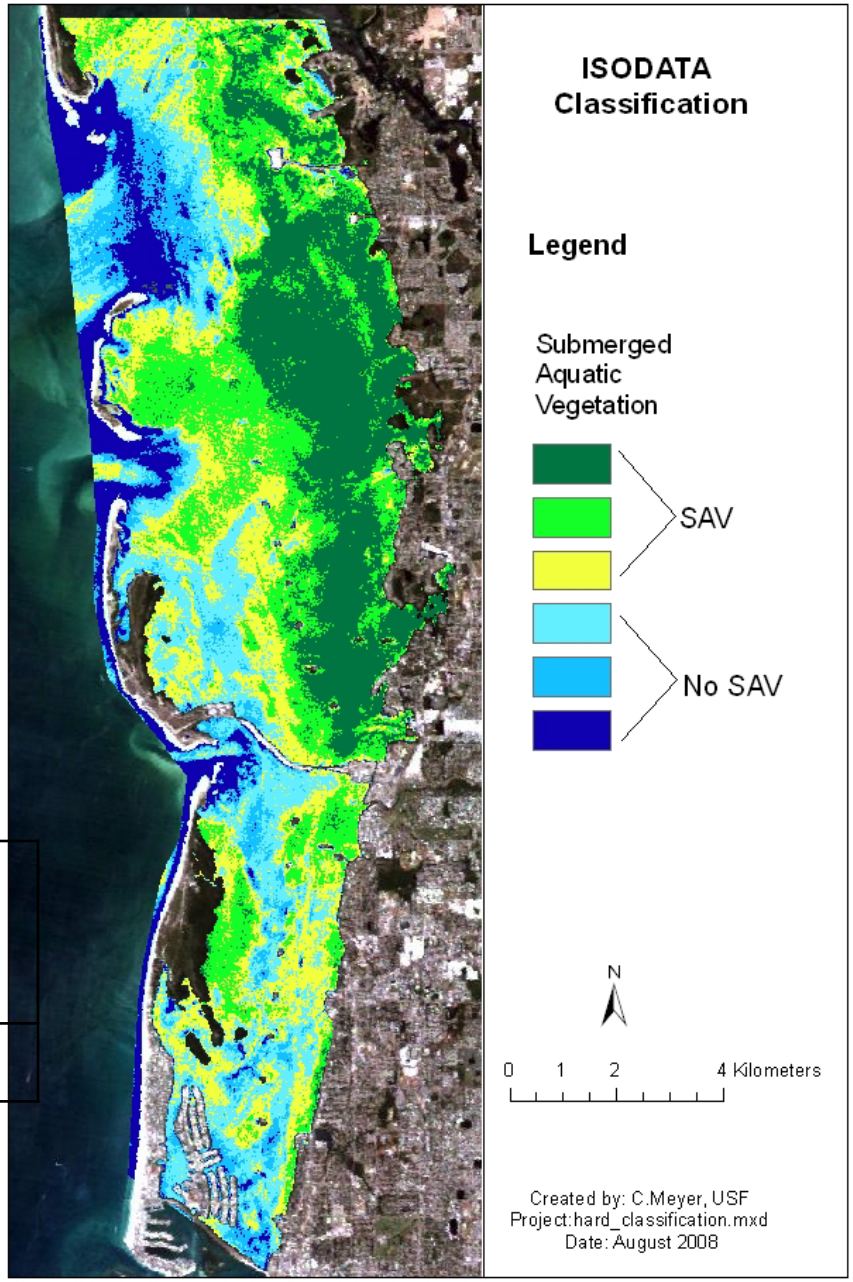
- Unsupervised ISODATA
- Training & Test ROIs
  - Seagrass 2010 Data
- Supervised MLC (Meyer and Pu, 2012)
  - HYP– 95% OA
  - TM– 91% OA
- Composite
  - Validation: 81%



# Classification

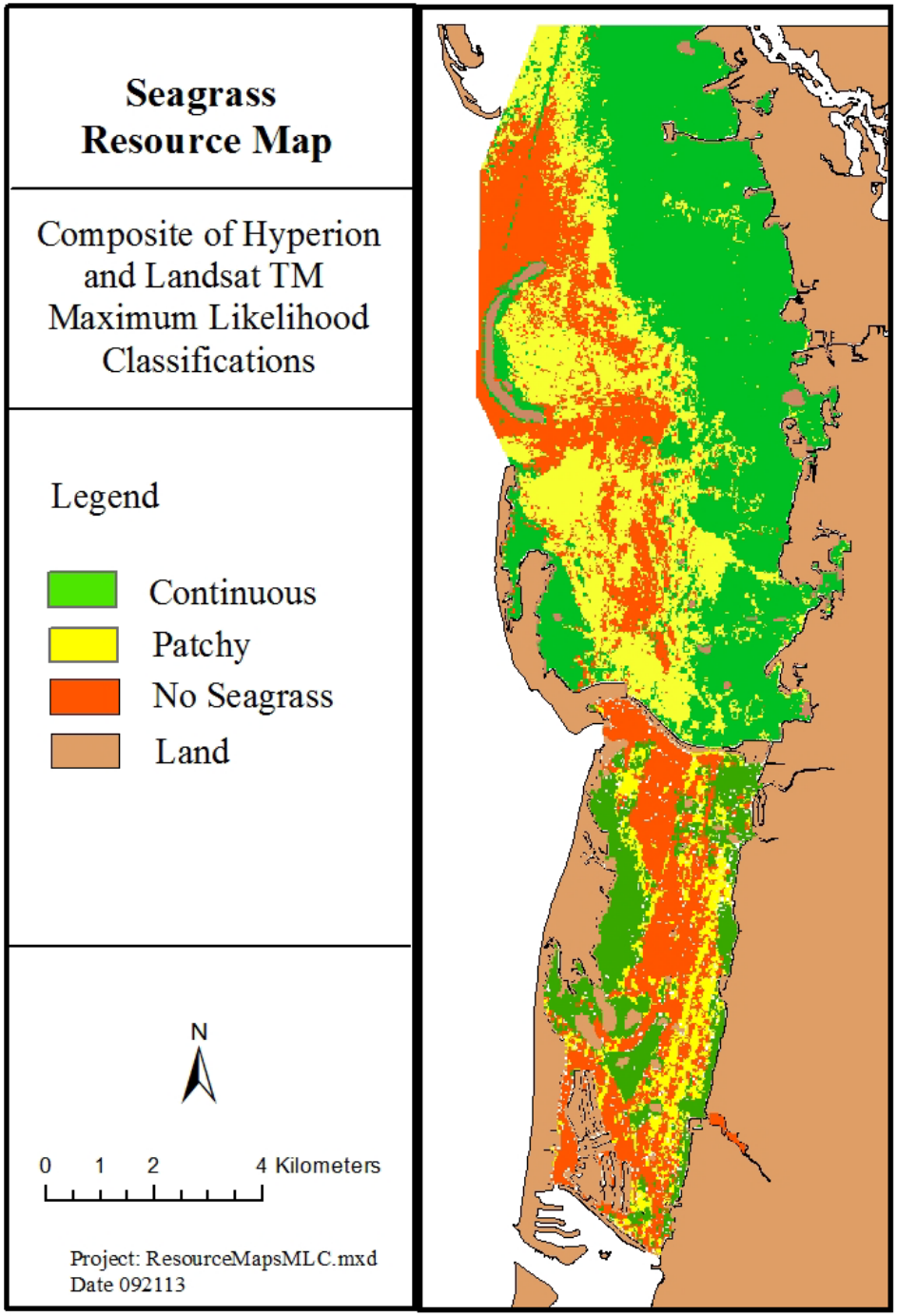
- Unsupervised ISODATA
- Validation Accuracy

| | SAV Accuracy % | No SAV Accuracy % | Overall Accuracy % |
|---|---|---|---|
| **ISODATA** | **76.6** | **51.8** | **68.4** |



# Seagrass Resource Map

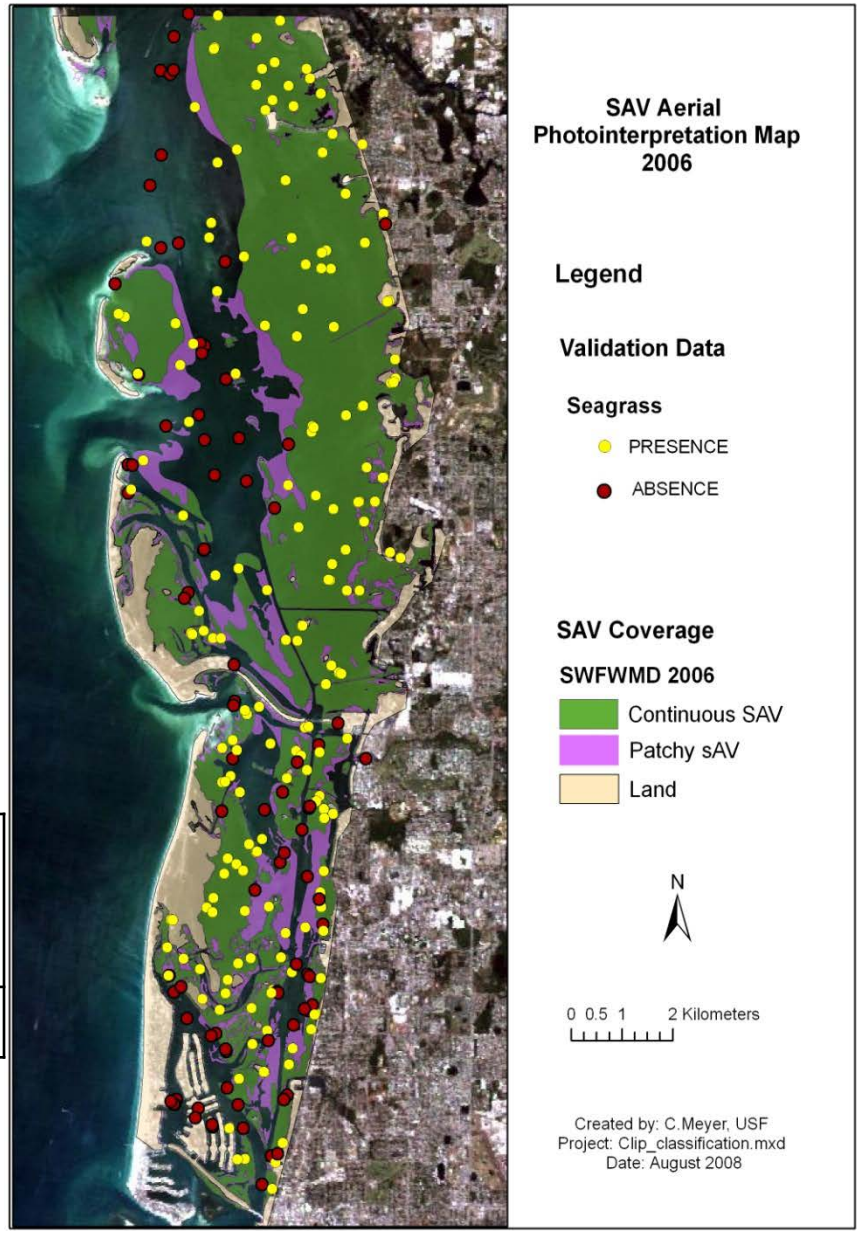
| | Area (Km) |
|---|---|
| Continuous | 40 |
| Patchy | 23 |
| No SAV | 21 |
| Unclassified | 5 |



# Results: Comparison

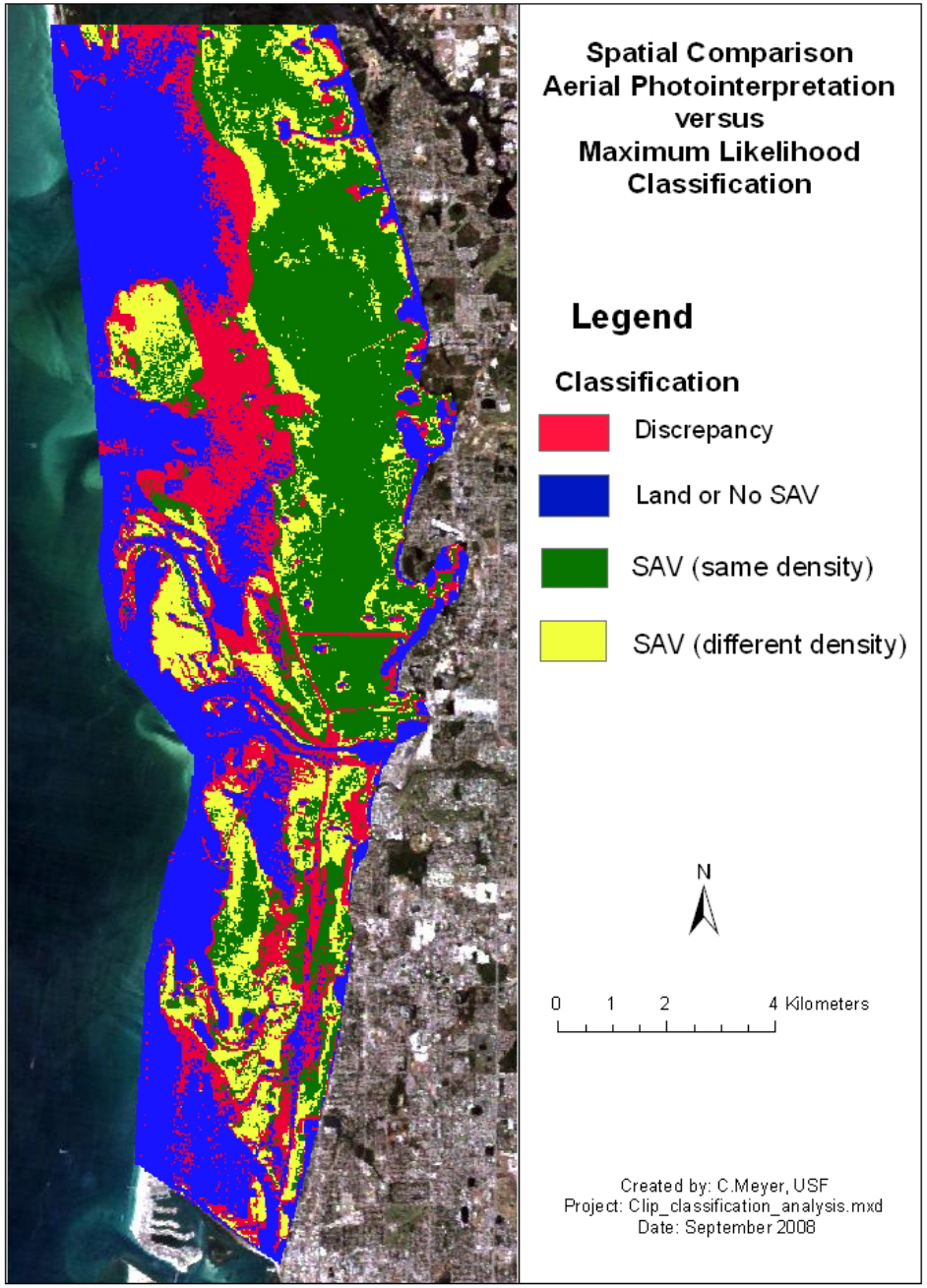
- 90% Ground-truth Accuracy
- AP Validation Accuracy

| | SAV Accuracy % | No SAV Accuracy % | Overall Accuracy % |
|---|---|---|---|
| AP | 81.1 | 51.2 | 71.4 |

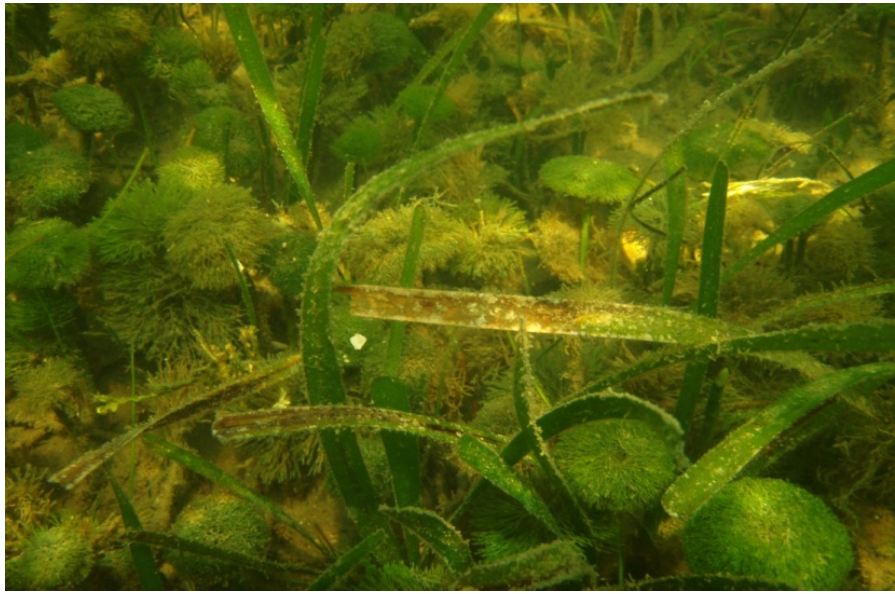


# Results: Comparison

- Boat Channels
- Deep Water
- Shoreline
- Tidal Flats



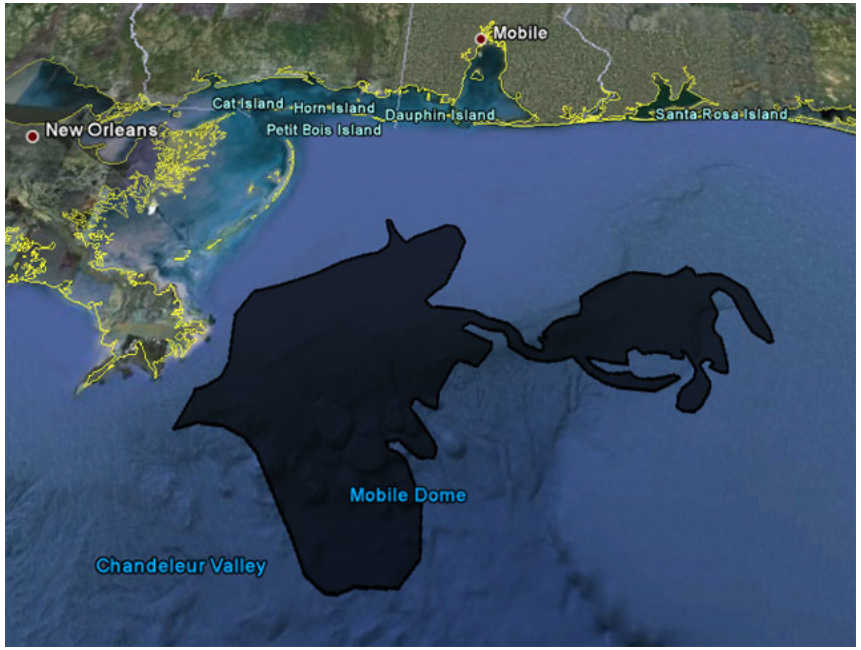
# Potential Limitations



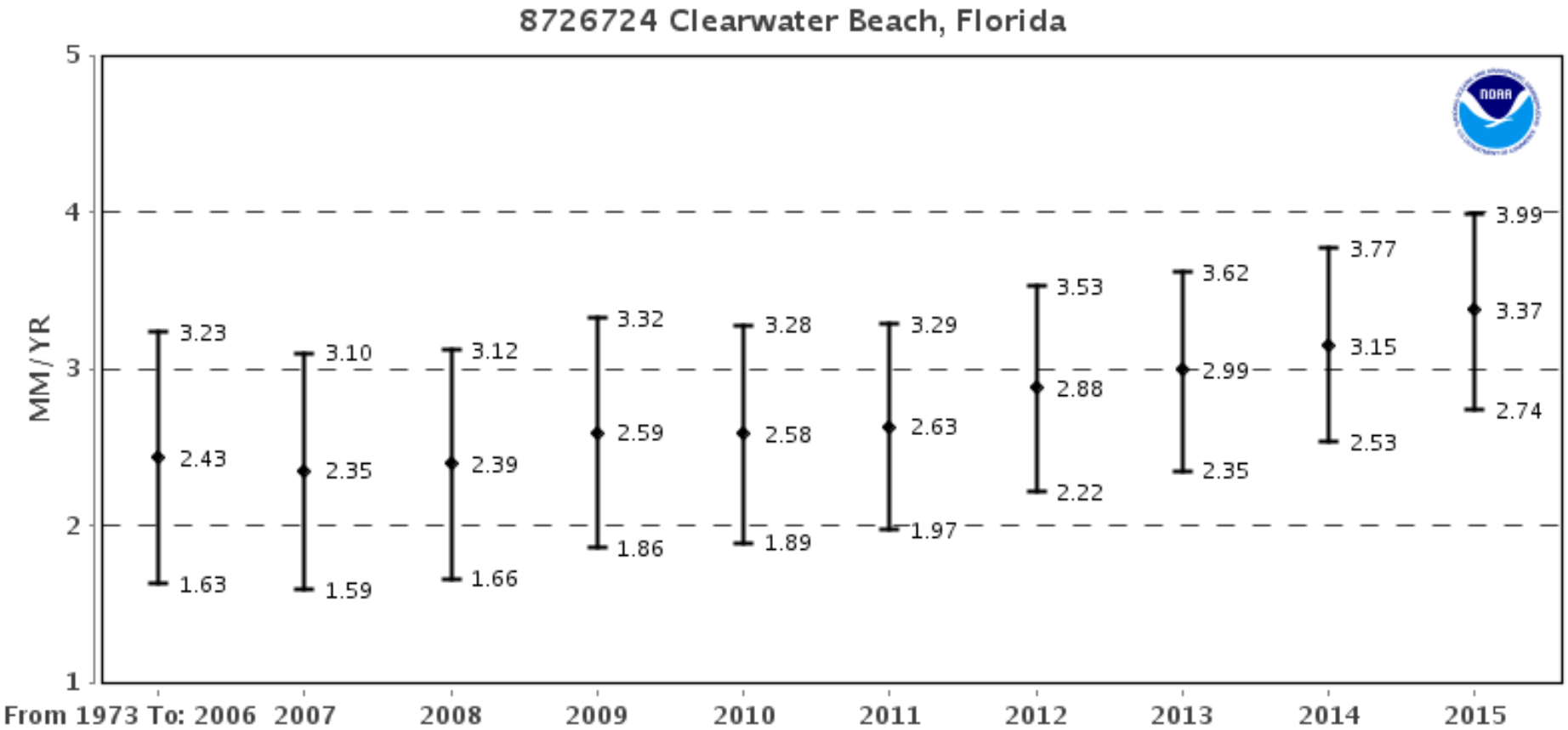
- Spectral Variations
  - Water Clarity
  - Seasonal Change
  - Epibionts
- Other Considerations
  - Bottom type
  - SAV other than Seagrass
  - Mixed Species Composition

# Conclusion:
# Why bother?

- Ability to assess natural and anthropogenic events
- Develop strategies for response and mitigation of impacts



# Sea Level Rise: Observed



# Conclusion

- Classification of spectral signatures from EO-1 HYP and Landsat 7 TM Imagery is comparable to the aerial photointerpretation
- Additional corrections for the water column greatly increased the overall accuracy of the classification

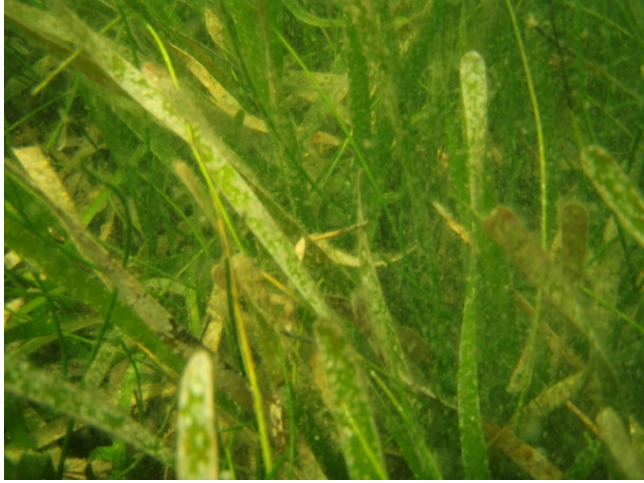
# Acknowledgements


- Dr. Ruiliang Pu, University of South Florida
- Pinellas County Watershed Management
- Southwest Florida Water Management District
- Fish & Wildlife Research Institute
- F&AM Lodge #9
- NASA-ROSES GOMA grant
- NOAA Fisheries: Advanced Studies Program

# Questions


Contact: Cynthia.Meyer@noaa.gov

# Introduction: Remote Sensing Studies

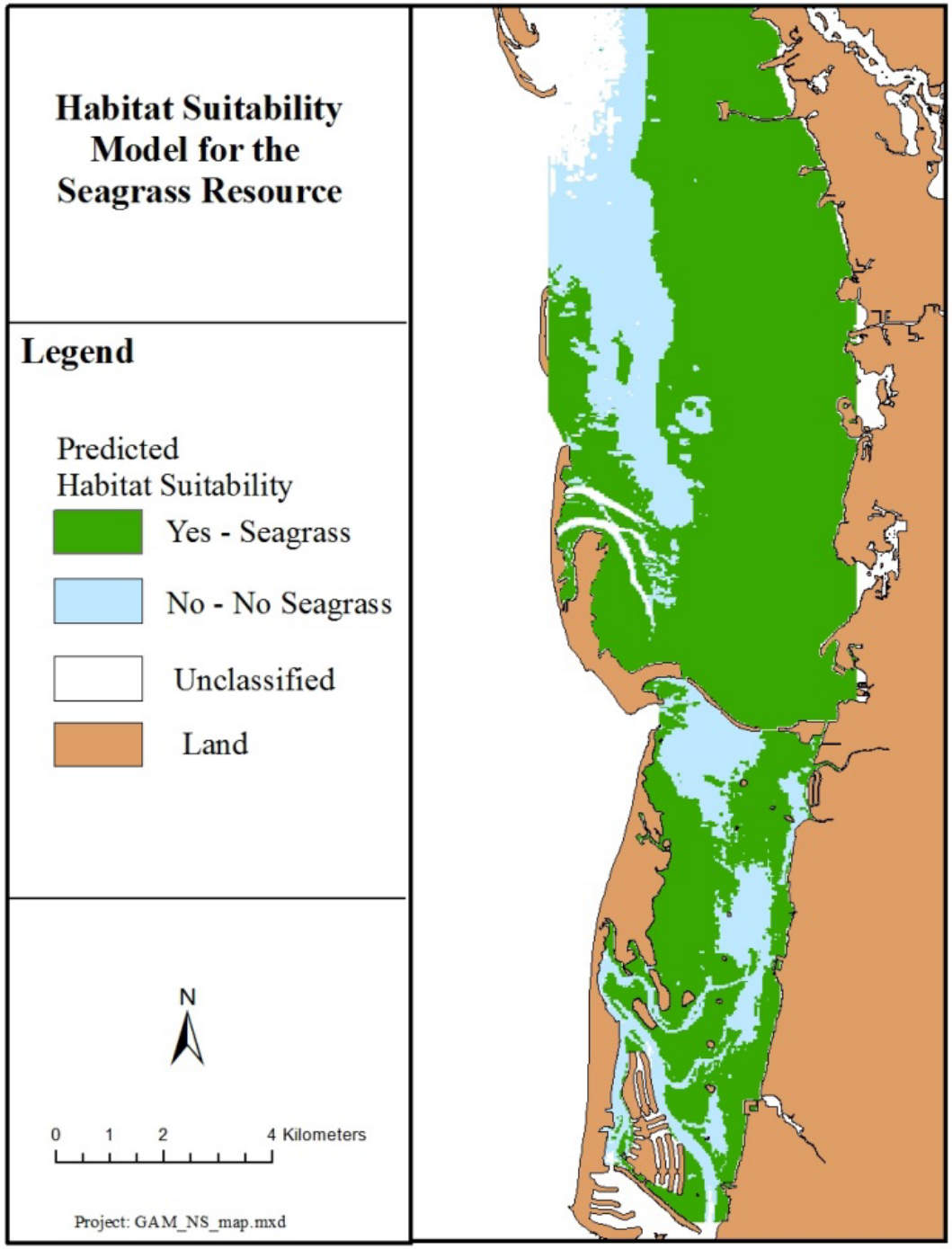


- Seagrass Spectral Signatures
  - Fyfe 2003 Australia
  - Thorhaug et al 2007 Florida

- Multispectral Seagrass Mapping
  - Dekker et al 2005 Landsat TM Australia
  - Andrefouet et al 2003 IKONOS World-wide
  - Schweizer et al 2005 Landsat TM Venezuela
  - Pasqualini et al 2005 SPOT 5 Mediterranean
  - Gullstrom et al 2006 Landsat TM Tanzania

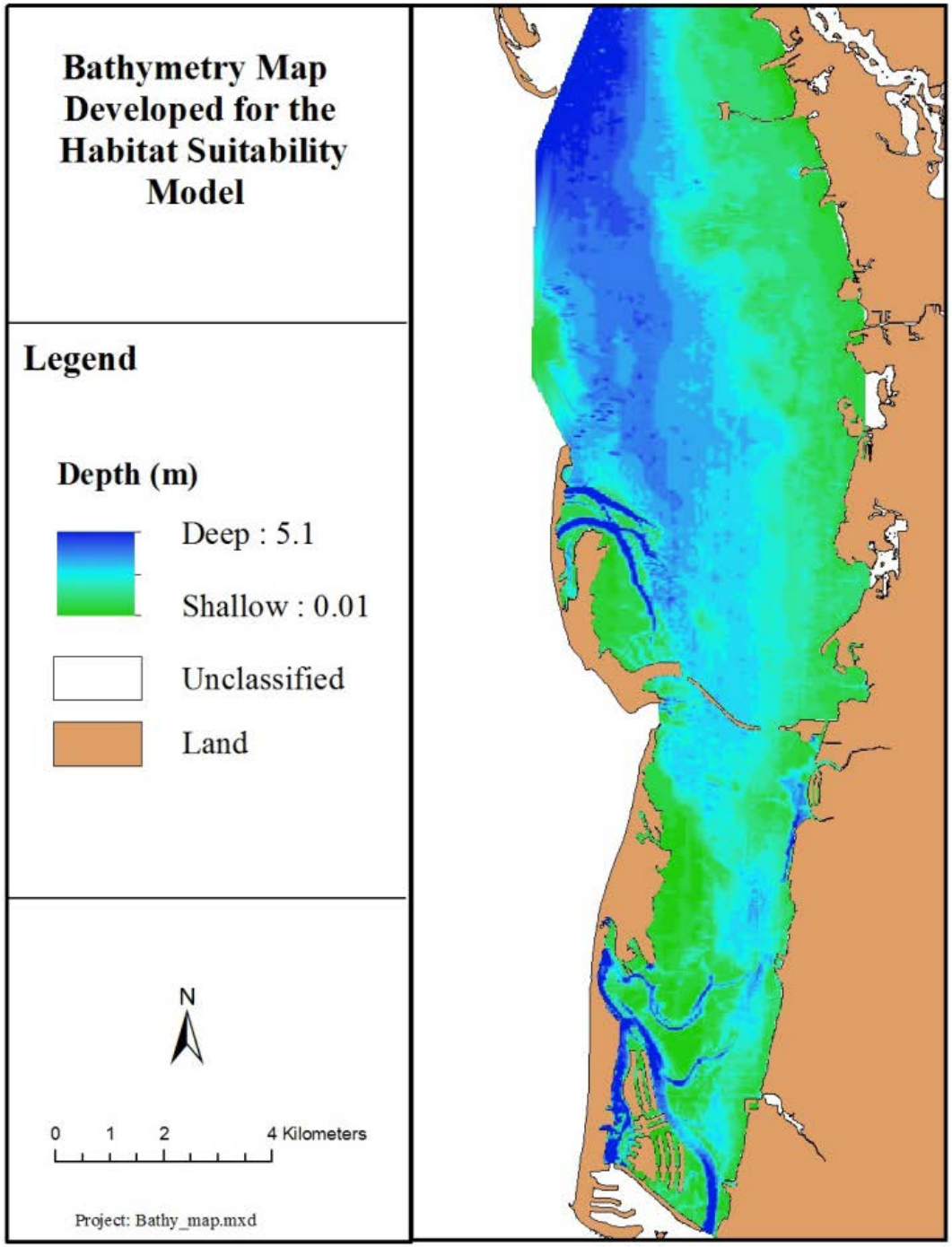
# HSM Predicted Raster

- Estimated Thresholds (C660)
  - STJS = 0.3
  - CLWN = 0.4
- Suitable Habitat
  - STJS = 43 $km^2$
  - CLWN = 17 $km^2$
- Validation Accuracy
  - STJS 82%
  - CLWN 95%



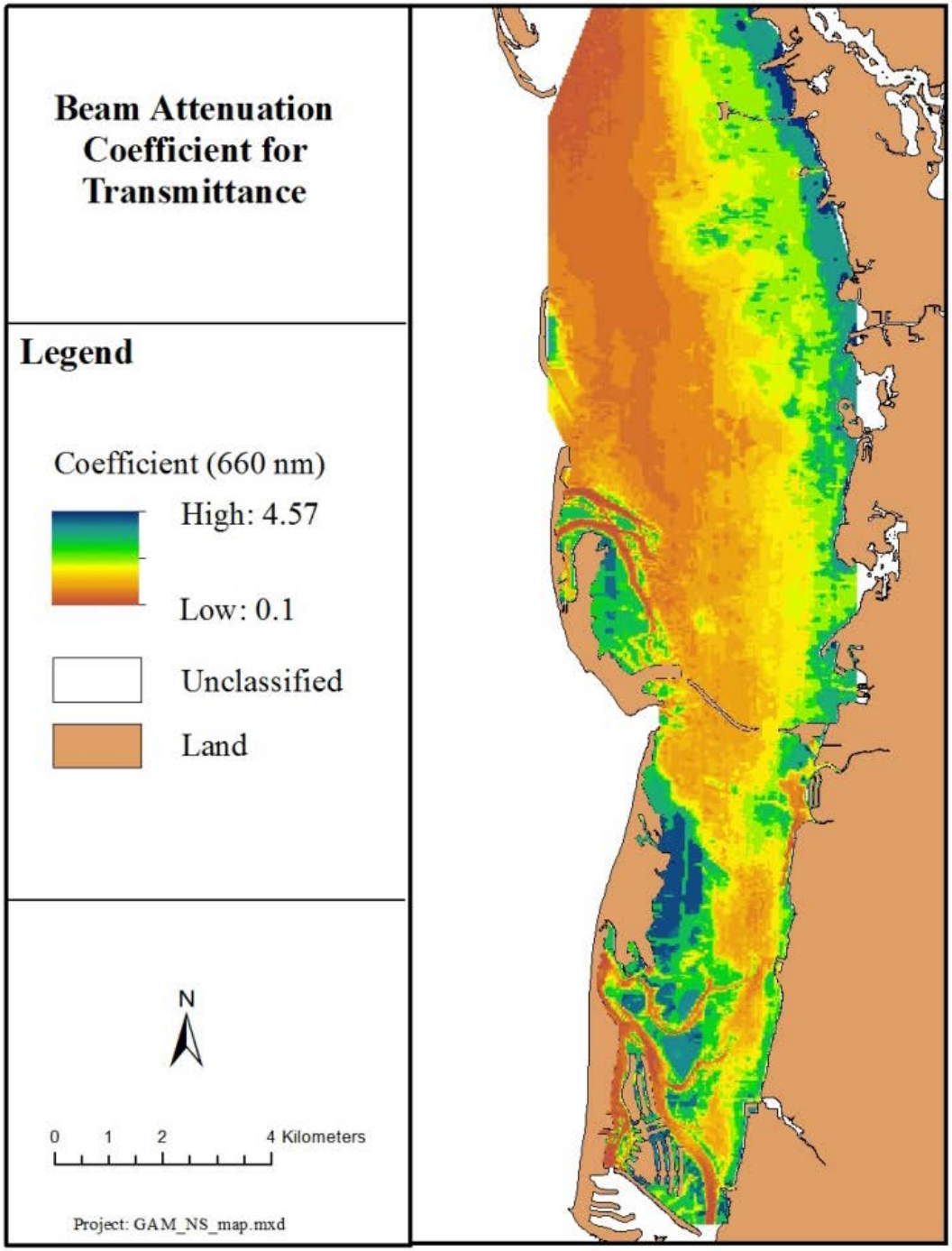
# Bathymetry

- Florida Shelf Habitat Map Project (FLaSH)
- TIN & DEM
  - N=30,185
- Validation (n=85)
  - Paired T-test (p=0.12)
  - Pearson Correlation (0.97)



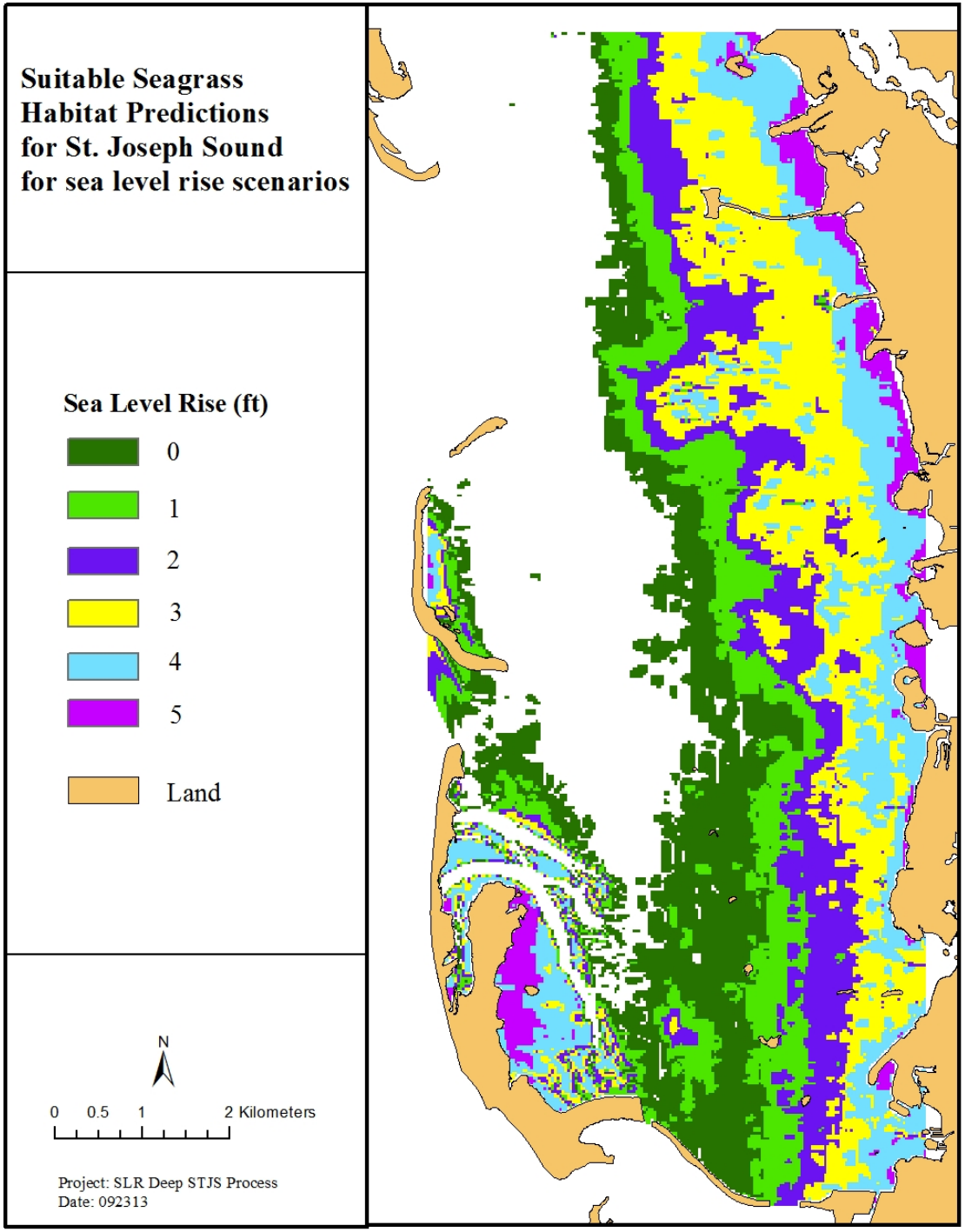
# Light Metric

- C660: Logarithmic light irradiance at the benthos
- $-\frac{\ln(\%\ \text{trans})}{\text{Depth (m)}}$
- Range= 0.1-4.57



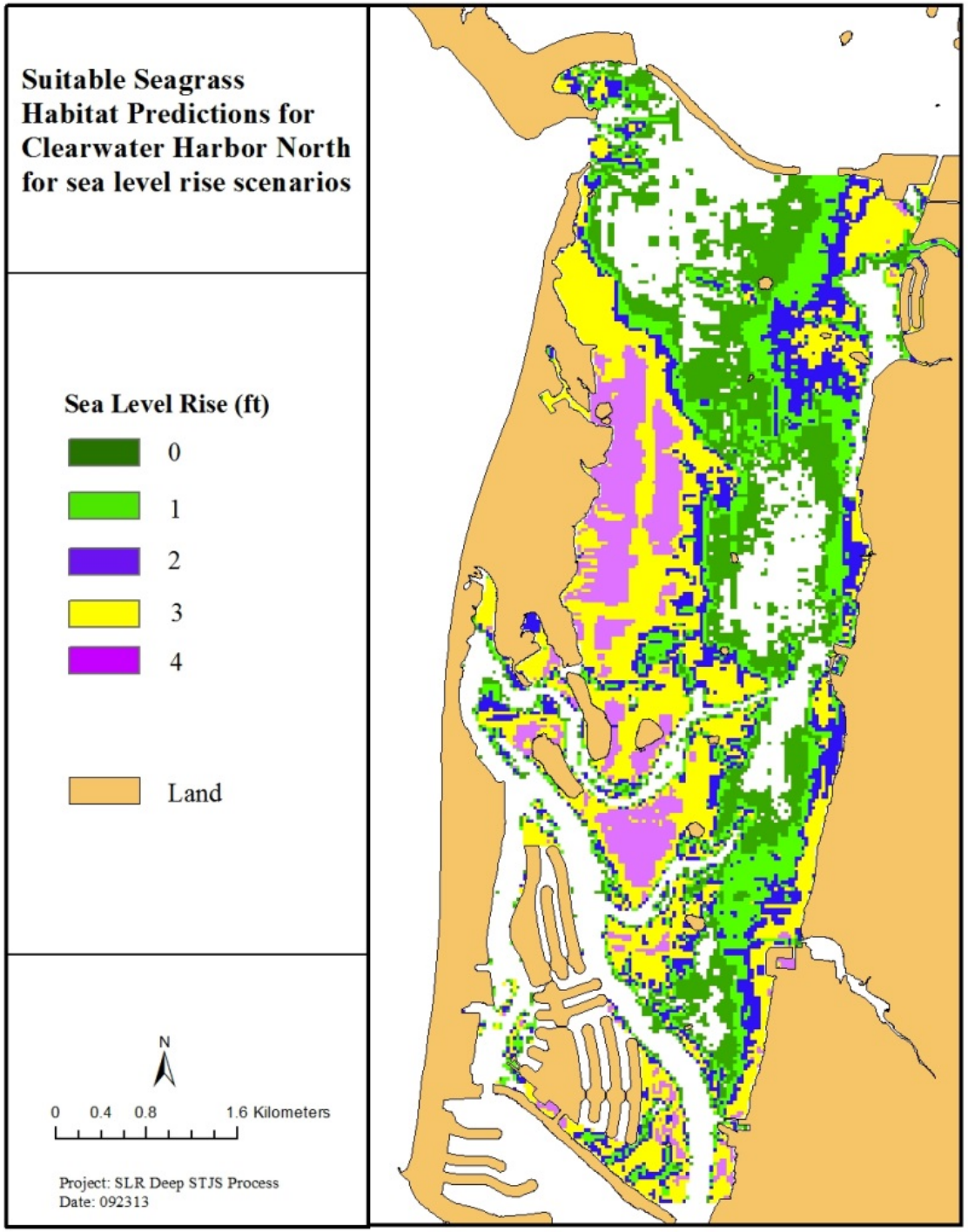
# Results: Habitat Loss

- Receding from Deep Edge
- SLR 6 ft = No Suitable Habitat



# Results: Habitat Loss

- Receding from Deep Edges
- SLR 5ft & 6ft = No Suitable Habitat



# Results: Loss vs. Gain