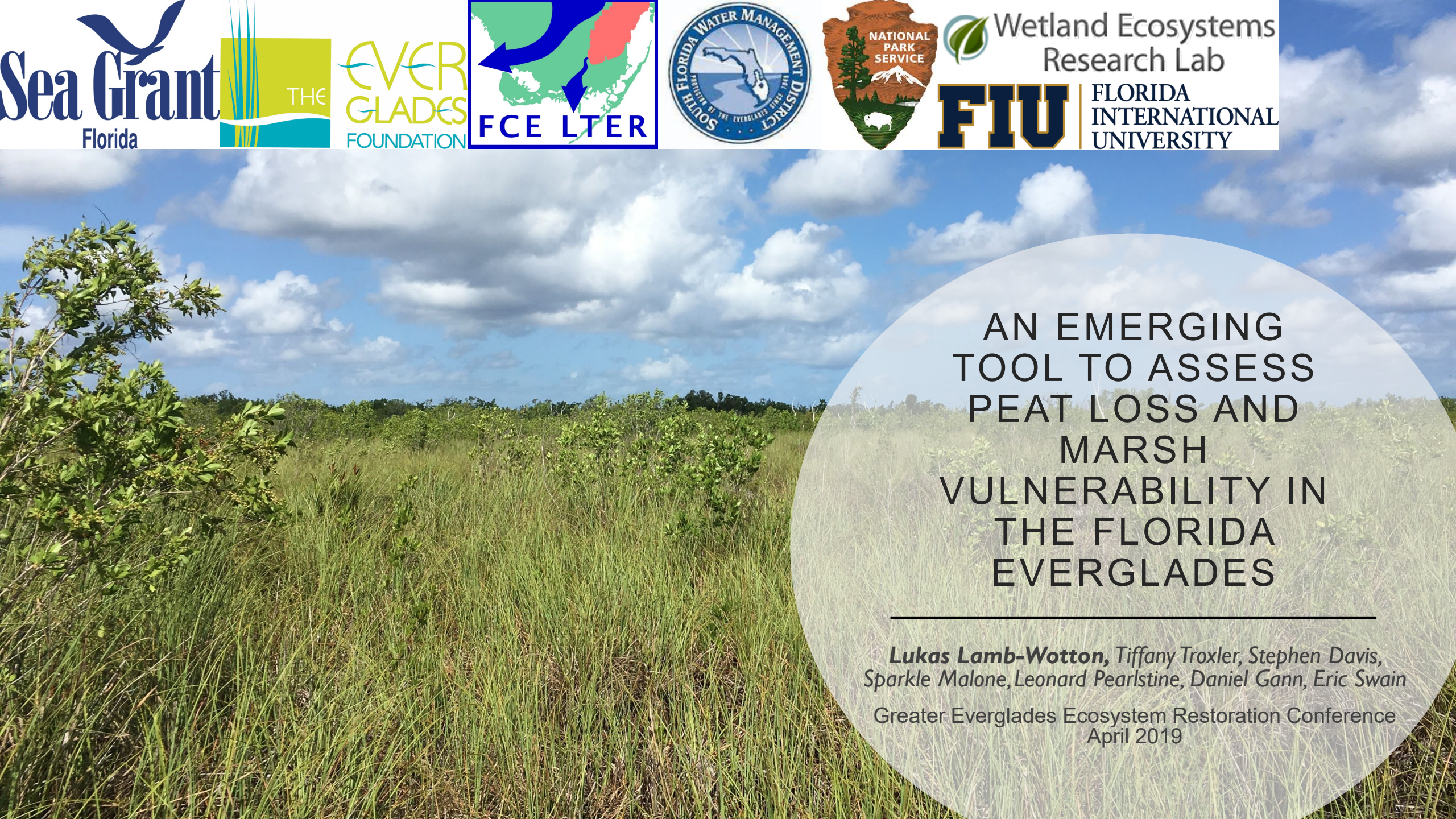

AN EMERGING TOOL TO ASSESS PEAT LOSS AND MARSH VULNERABILITY IN THE FLORIDA EVERGLADES

Lukas Lamb-Wotton, *Tiffany Troxler, Stephen Davis, Sparkle Malone, Leonard Pearlstine, Daniel Gann, Eric Swain*

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Peat Collapse!

- Peat collapse causes rapid declines in soil surface elevation and a net loss in organic carbon.
  - **Marsh → Open water**

- Loss of coastal marshes has the potential to hinder inland transgression of mangrove forests with sea level rise and saltwater intrusion.

- **While our mechanistic understanding of peat collapse in coastal marshes has grown strong, we still lack an integrated method to evaluate occurrence, extent, and severity of collapse at the landscape scale.**

Translating experimentally determined relationships to the landscape!

QUESTION & OBJECTIVE

- ***Q:*** *What sawgrass-dominated areas across the coastal landscape are **indicated** as **vulnerable** to peat collapse, based on our understanding of the **drivers** of collapse?*

- ***OBJ:*** *Develop a **product** that visualizes areas indicated to be most **vulnerable** to peat collapse.*

  - **Indicators**
    - *Using components of an ecosystem that are selected in order to characterize the system and the process of interest.*

  - **Ecological Vulnerability**
    - *"The potential to which an ecosystem is likely to experience **harm** due to **exposure** to a **hazard**, either a perturbation or a stress/stressor, where the potential is determined by **characteristics of the ecosystem** that span multiple levels of organization."*
      - *Soils, vegetation, environmental parameters (hydrology, disturbance, etc.).*

  - **Experimentally determined Drivers**
    1. **Driver:** Saltwater intrusion
       Mechanism: Threshold ~10-15 ppt where sawgrass productivity declines and initiates peat collapse.
    2. **Driver:** Drought/length of drawdown
       Mechanism: Soil exposure 5-6 months or more increases mineralization and CO_2 loss, increasing elevation loss.

  - **Product**
    - *GIS-based map that portrays vulnerability based on a set of standardized indicators, aggregated into a single value **(index),** that takes into account the relative influence of each indicator on peat collapse.*

THE COASTAL MARSH VULNERABILITY INDEX (CMVI)

- **CMVI** indexes coastal marshes using a classic rank classification system:

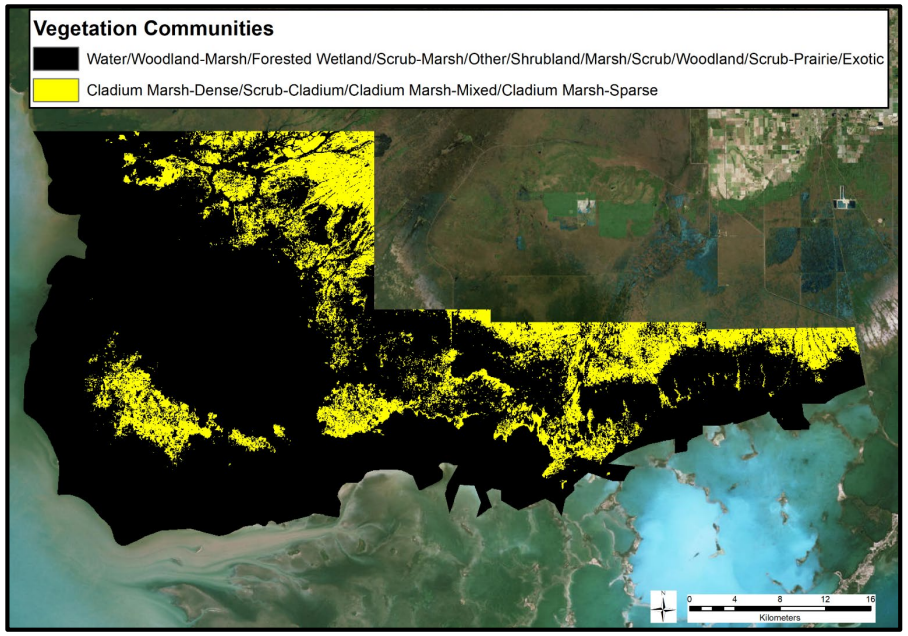
$$\textbf{CMVI} = \Sigma(X_i * X_w)$$

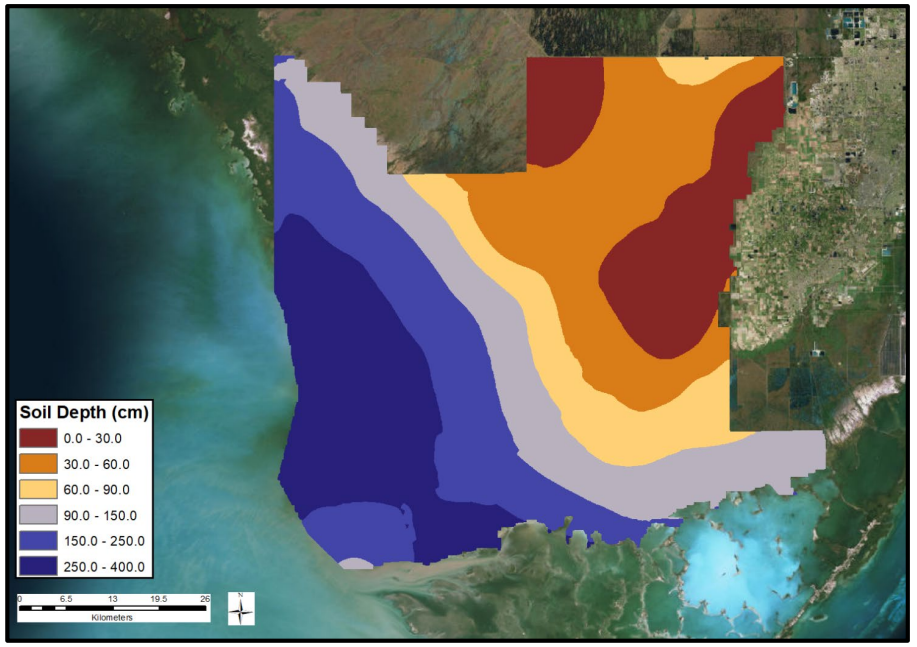
- **Method**
  - Standardize a set of **indicators** to a common numeric scale.
  - **Weight** each indicators based on it's relative influence to peat collapse.
    - Weights equal one (1) between all indictors and selected to emphasize the drivers of peat collapse.
  - Aggregate indicators to single value (**index**).

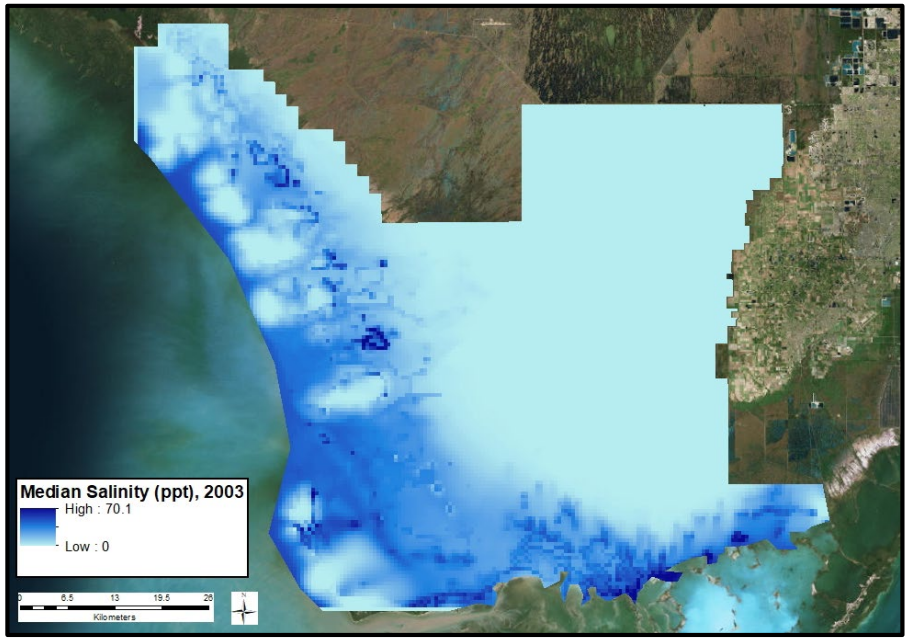
Indicators, ranks, and weights, for the CMVI.

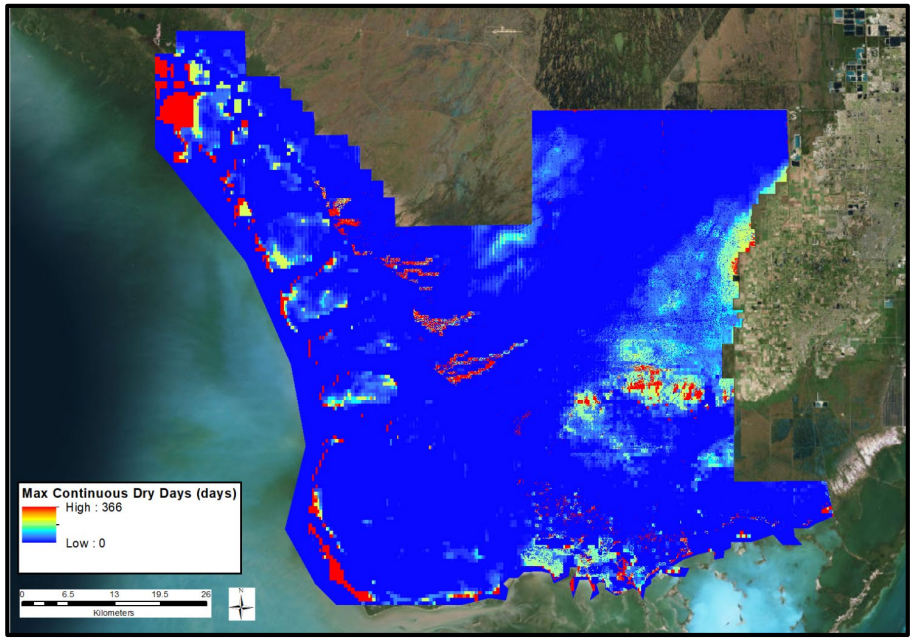
Indicator	Class	Rank	Weight	Data Source
Vegetation Type	Communities dominated or co-dominated by *Cladium jamaicense*	1	0.2	Everglades National Park Service (Ruiz et al. 2017)
	Other	0		
Soil Depth (m)	250-400	6	0.1	EPA; USGS; unpublished, Troxler lab data; literature
	150-250	5		
	90-150	4		
	60-90	3		
	30-60	2		
	0 - 30	1		
Groundwater Salinity (top 2 m; ppt)	20 +	5	0.4	E. Swain; USGS BISECT Model
	15 - 20	4		
	10 - 15	3		
	5 - 10	2		
	0 - 5	1		
Length of dry-down (days)	180-365	5	0.3	E. Swain; USGS BISECT Model
	150-180	4		
	120-150	3		
	90-120	2		
	0-90	1		

INDICATORS









*All inputs at 50 x 50 m spatial scale

Top-left:
Vegetation Community
(Source: NPS, Ruiz et al. 2017)

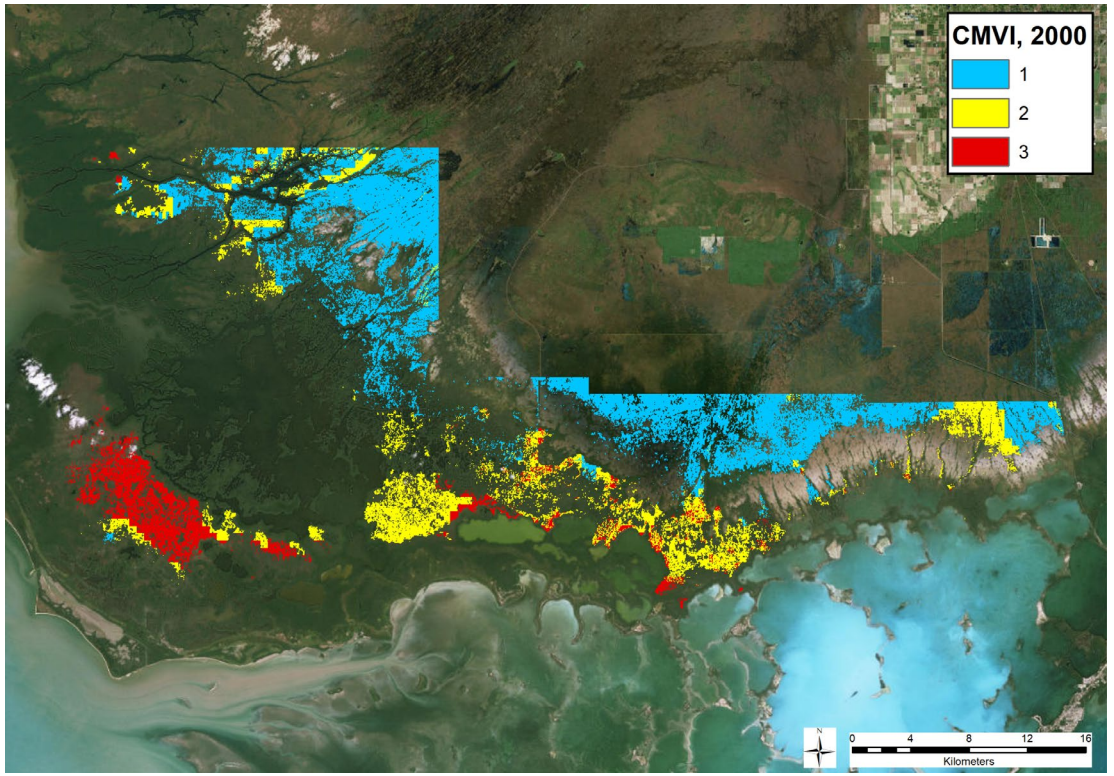
Top-right:
Soil Depth (cm)
(Source:Various).

Bottom-left:
Median Groundwater salinity to max depth of 2m
(Source: USGS).

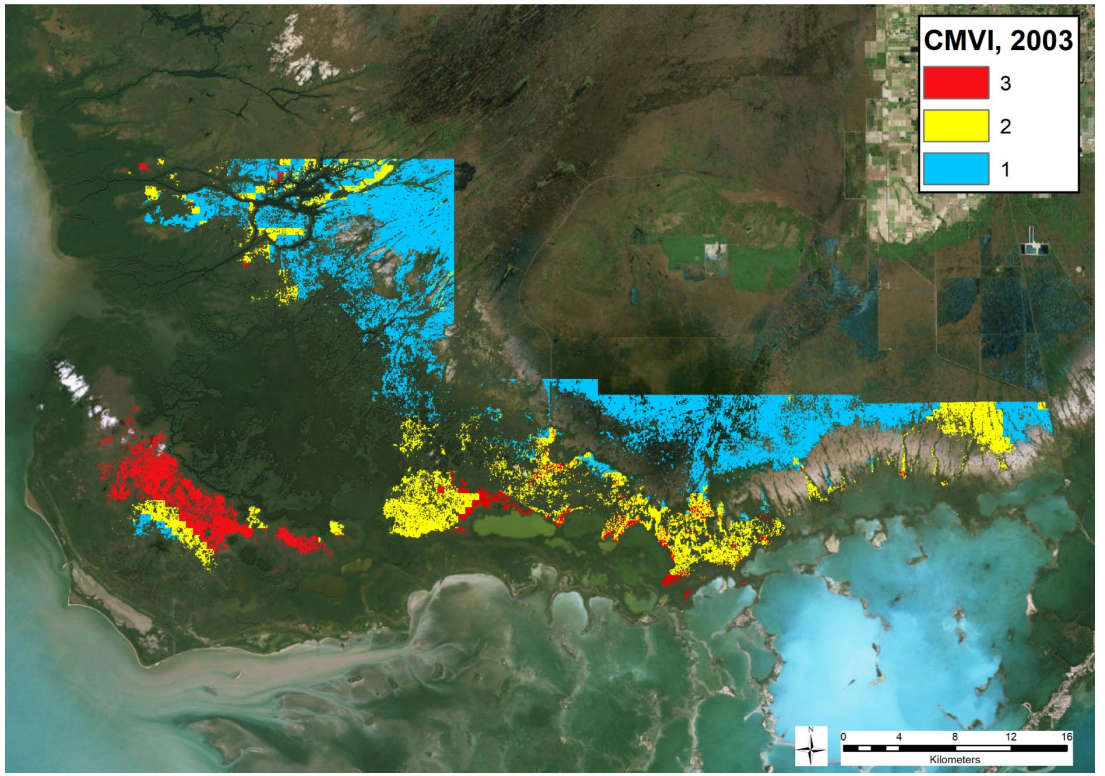
Bottom-right:
 # Days Dry
Source: USGS)

CMVI OUTPUT

CMVI, 2000



CMVI, 2003



CMVI, hectares			
Rank	2000	2003	Change
1	16,333	16,659	326
2	7,464	7,477	-13
3	3,793	3,454	-339

RECAP/FUTURE DIRECTIONS

- CMVI uses a ranked classification system that visualizes and indexes sawgrass dominated/co-dominated marshes vulnerable to peat collapse, based on mechanistically determined relationships.
  - Increase number of inputs → Soil type
  - Move away from classic rank-classification approach towards a more mechanistic approach → decision-tree
- Develop composite index that takes into account multiple years to arrive at an overall composite index value that can be used to select field sites.

Predicting Soil Types in Everglades Marshes

Can we probabilistically model the occurrence of peat soil at coarse scales (50x50m) based on soil depth and hydrology?

Goal?

- Feed into broader Coastal & Greater Everglades Landscape Vulnerability Analysis and serve as input to CMVI
- Be available to the broader research community

Limitations

- Soil is heterogenous in reality.
- Mismatch of spatial scale between response and predictors.
- Can only focus on individual community types due to inability to capture biotic forces within model.

Modeling Approach

- Predict probability of soil along a gradient of organic content.
  - Mineral: <40%
  - Intermediate 40-70%
  - Organic: <70%
- Preliminary analysis using logistic regression

IDENTIFY A FIELD APPROACH THAT CAN BE USED TO INDICATE IF PEAT COLLAPSE IS OCCURRING AND ITS SEVERITY.


THANKS!
QUESTIONS?