Landscape-scale evaluation of vegetation cover and hydrologic conditions along the southwest coast of Everglades National Park

Lukas Lamb-Wotton[1,2]*, Tiffany G. Troxler*[3,4]*, Daniel Gann*[2]*, Khandker S. Ishtiaq*[5]*, and Stephen E. Davis*[6]

[1] Department of Earth and Environmental Sciences, Tulane University, New Orleans, LA, USA

[2]Department of Biological Sciences, Florida International University, Miami, FL USA

[3]Institute of Environment, Sea Level Solutions Center, Florida International University, Miami, FL USA

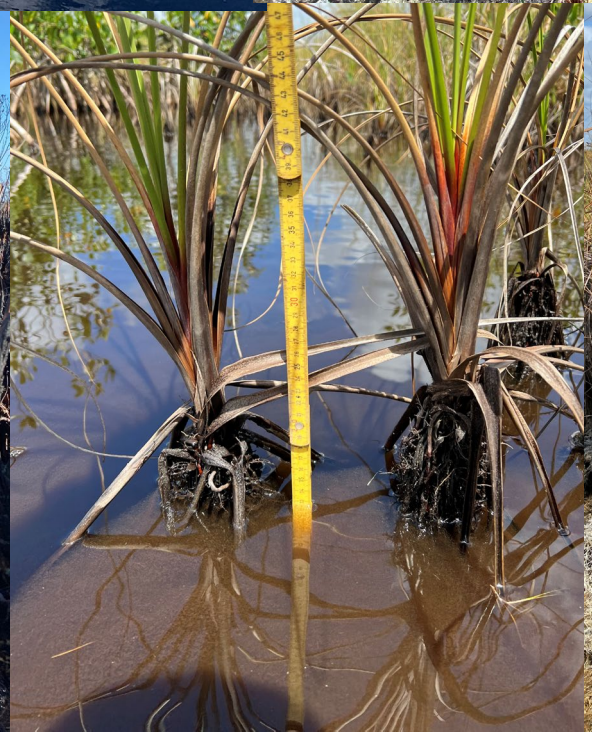
[4]Department of Earth and Environmental Sciences, Florida International University, Miami, FL USA

[5]Everglades Foundation, Palmetto Bay, FL USA

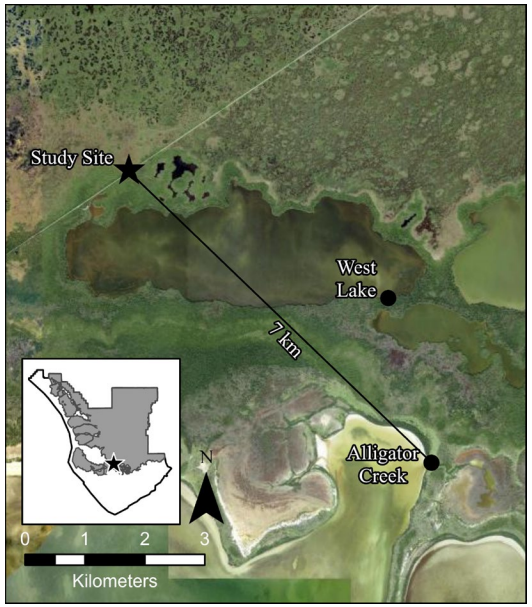
Greater Everglades Ecosystem Restoration Conference 2025

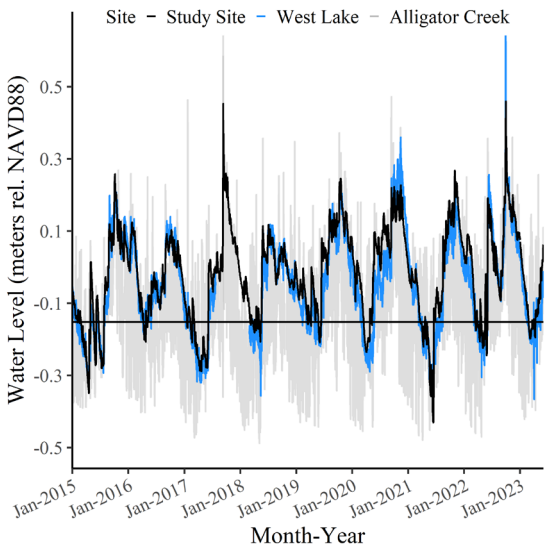





Characterizing hydrogeomorphic conditions of a non-tidal brackish peat marsh





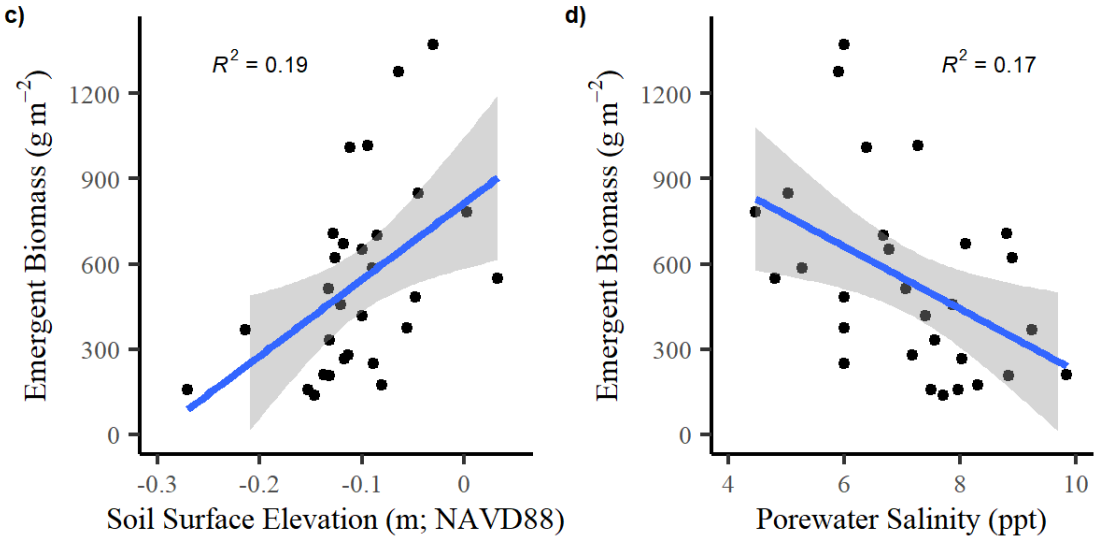


Figure 1. Linear relationships observed across geomorphic, hydrologic, and biologic variables across ecosystem states.

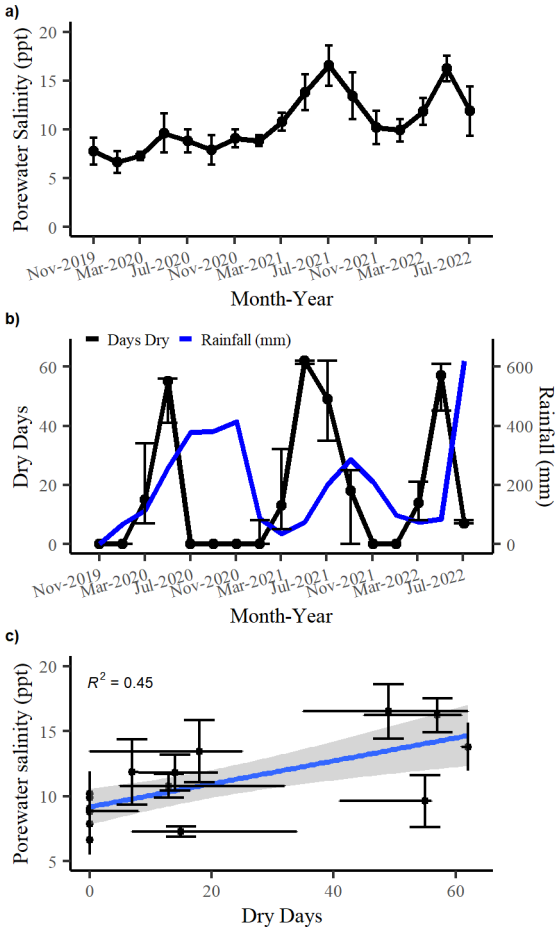


Figure 2. (a) Porewater salinity in the emergent (EMG) state from Jan 2020 – May 2022. (b) Dry days for the EMG state (black) and total rainfall (blue). (c) Bi-monthly dry days for EMG state.

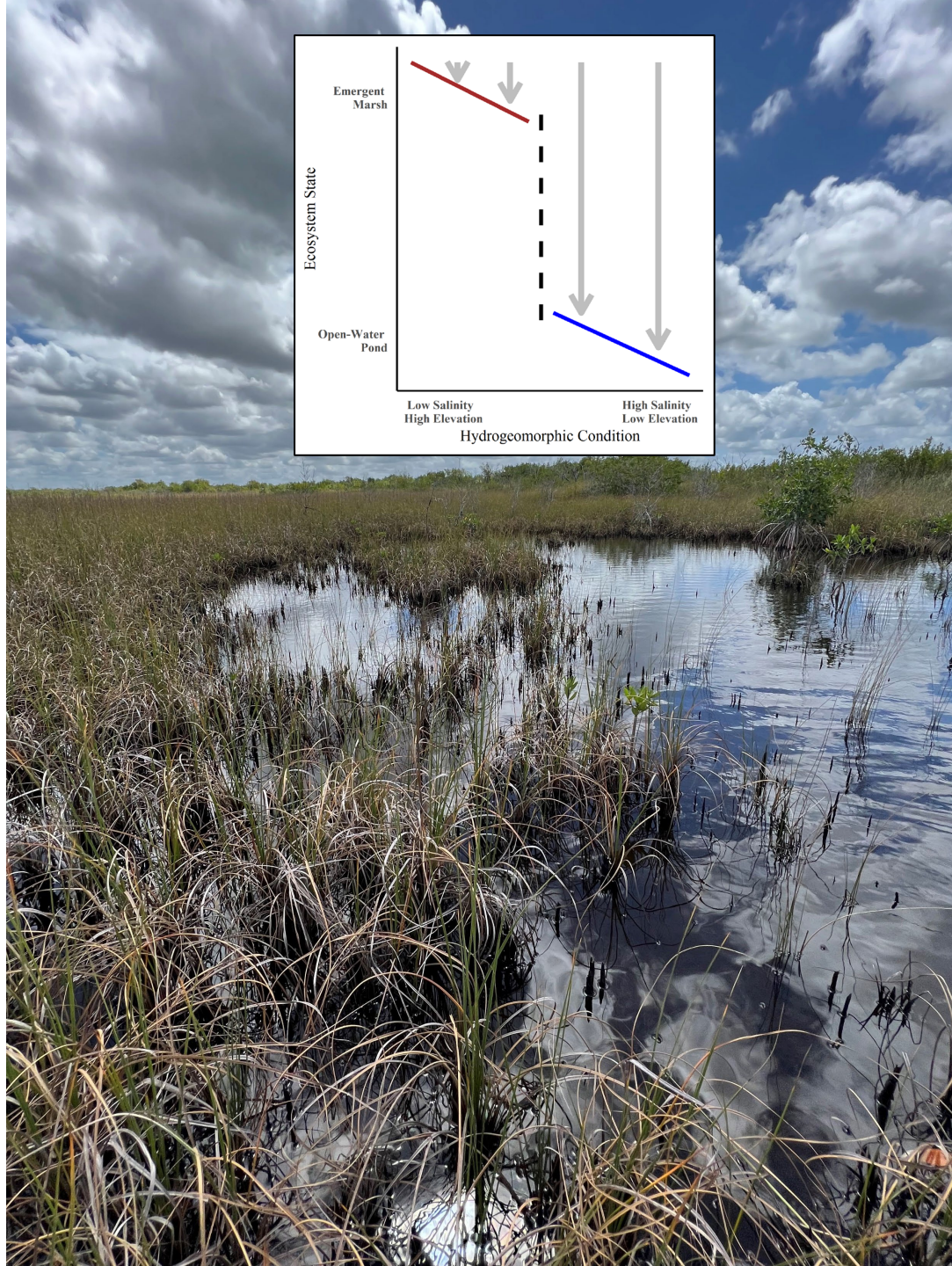
<u>Goal:</u> Better understand patterns of hydrologic conditions across coastal peat marshes and how they relate to vegetation cover.

Q1: How are water depth and porewater salinity related in sawgrass marsh across the southwest coastal region and does this relationship change seasonally?

> **HYP1:** Water depth and porewater salinity will be negatively related at annual timescales. This relationship will be exacerbated at seasonal scales, due to dry season salinization.

Q2: At broad scales, is there a relationship between hydrologic conditions and the percentage of herbaceous vegetation, woody vegetation, or open-water?

> **HYP2:** Water depth and porewater salinity will be negatively related with percent herbaceous marsh and positively related with percent woody vegetation and percent open water.



Methods

1. BISECT: Biscayne and Southern Estuaries Coastal Transport Model (Swain et al. 2019)
    1. Simulates surface water and groundwater (including porewater) conditions in rectangular 500 x 500 m grid cells at a daily time-step from 2005 – 2017.
    2. Calculated 4-year mean water depth and porewater salinity for 2013-2016, at seasonal and annual (water year) scales for southwest coast.

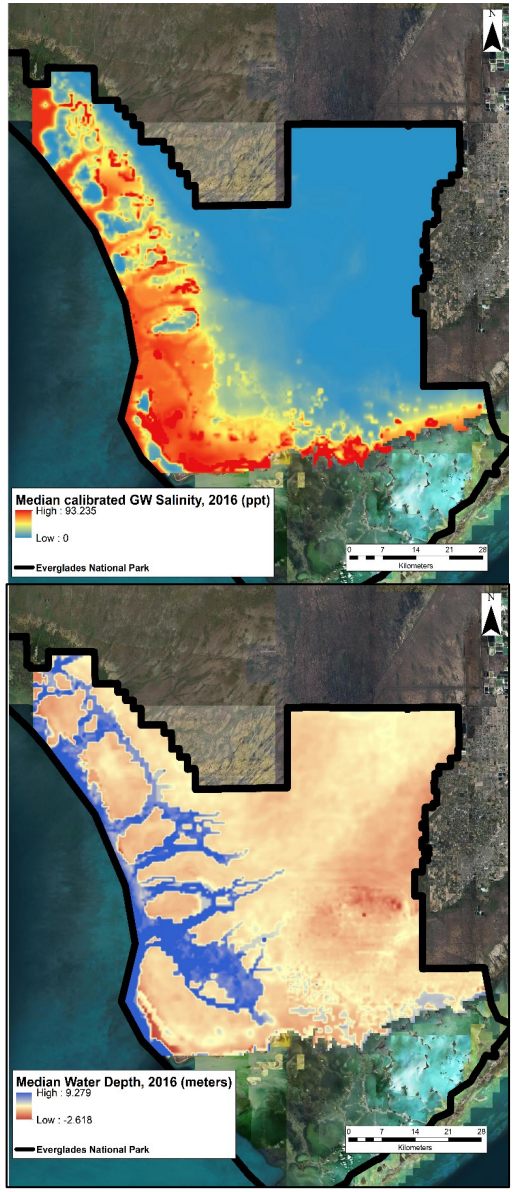


Figure 3. BISECT simulated water depth (left) and porewater salinity (right) across Everglades National Park.

Methods

1. BISECT: Biscayne and Southern Estuaries Coastal Transport Model (Swain et al. 2019)
    1. Simulates surface water and groundwater (including porewater) conditions in rectangular 500 x 500 m grid cells at a daily time-step from 2005 – 2017.
    2. Calculated 4-year mean water depth and porewater salinity for 2013-2016, at seasonal and annual (water year) scales for southwest coast.
2. Model and map vegetation types using WorldView-3 satellite images from May 2021.
    - Random forest classifier; training dataset = 15,641 points; MMU = 12 m^2
    - Coarse class labels: herbaceous marsh, woody vegetation, open-water (unvegetated).
3. Calculated percent of each vegetation class for each BISECT grid cell (500 x 500 m) across the study domain.
4. Compare relationships between 4-year hydrologic metrics and class percent metrics across grid cells.

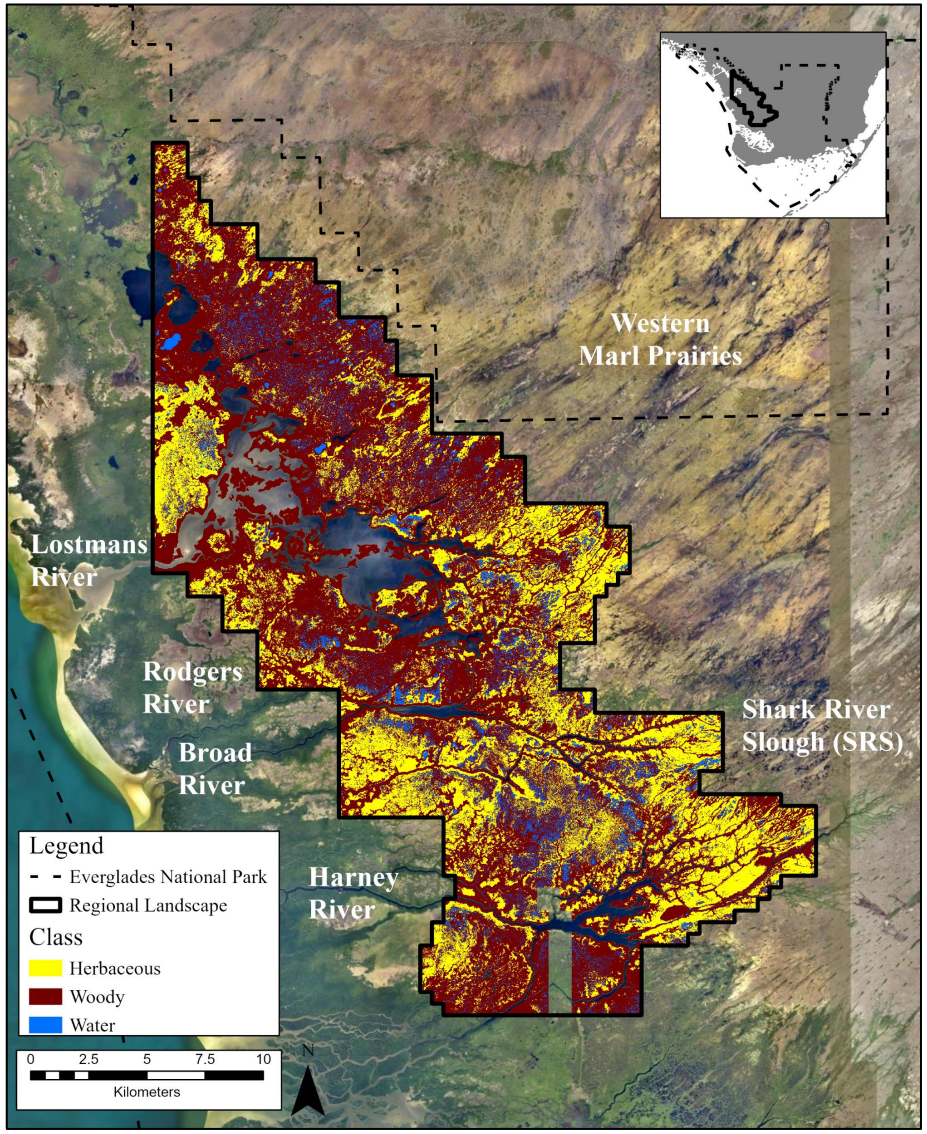


Figure 4. High-resolution vegetation map for southwest coast of Everglades National Park. Yellow is herbaceous vegetation, brown is woody vegetation, and blue is open-water. Overall classification accuracy was 92%. Herbaceous vegetation had user's accuracy of 86%.

Results: BISECT simulated hydrology, 2013-2016

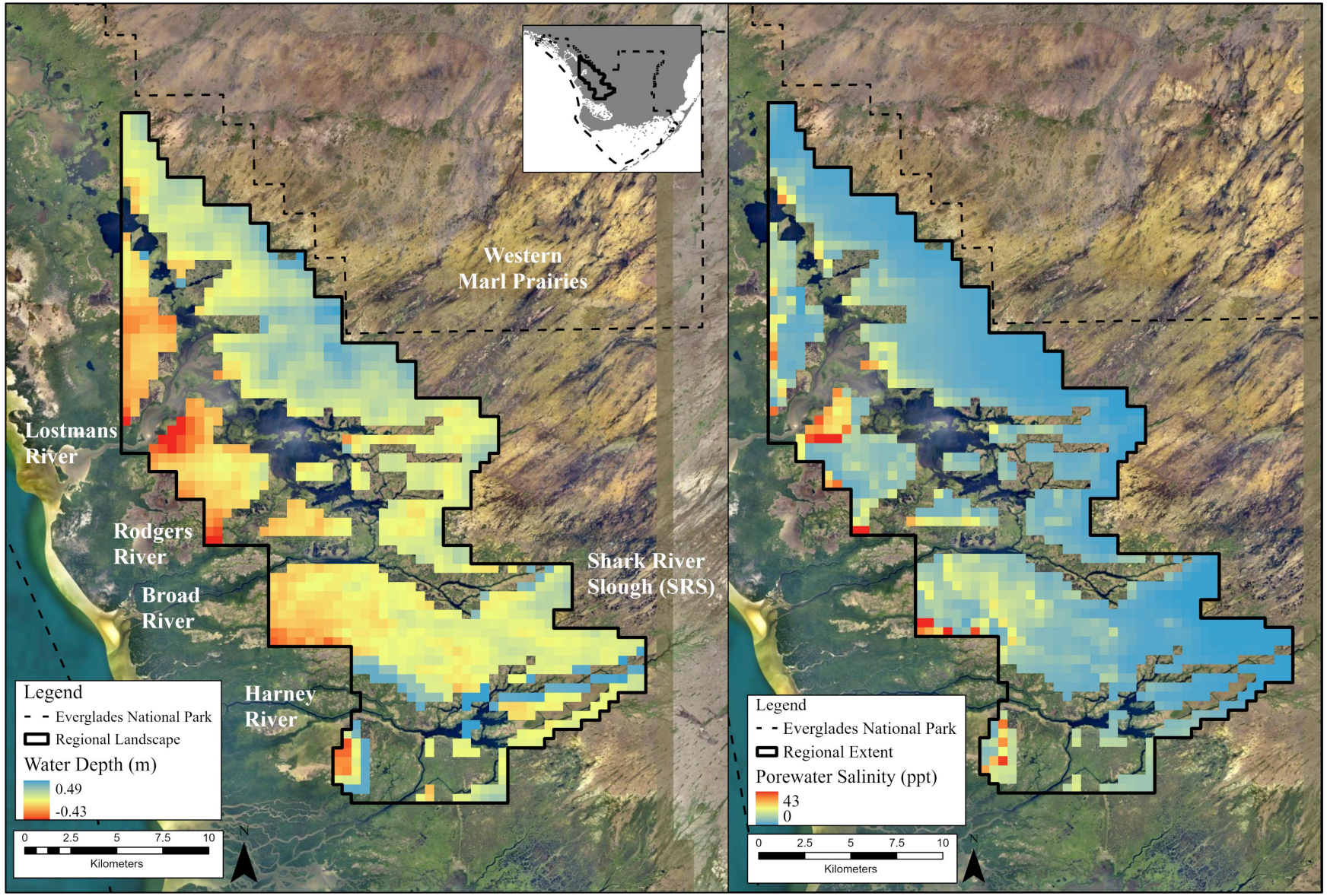


Figure 5. (left) 2013 - 2016 BISECT simulated mean water depth across the study area. **(right)** 2013 - 2016 BISECT simulated mean porewater salinity across the study area.

Q1: How are water depth and porewater salinity related across the southwest coastal region and does this relationship change seasonally?

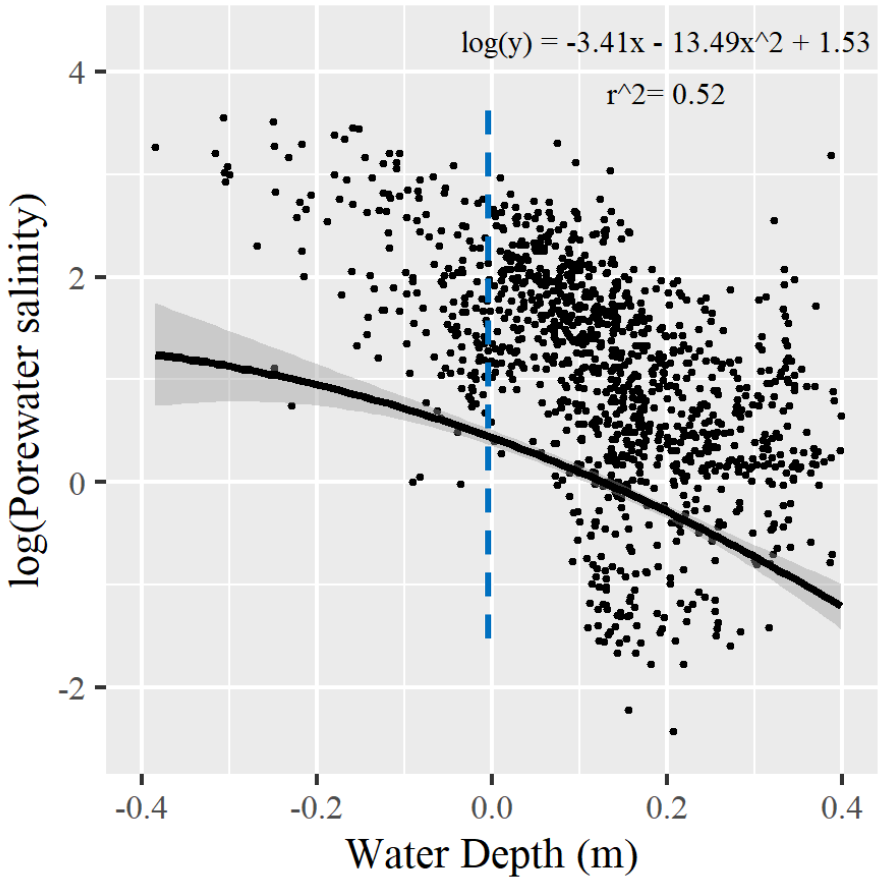


Figure 6. Relationship between porewater salinity (ppt) and water depth across region of interest. Y-axis is log-transformed.

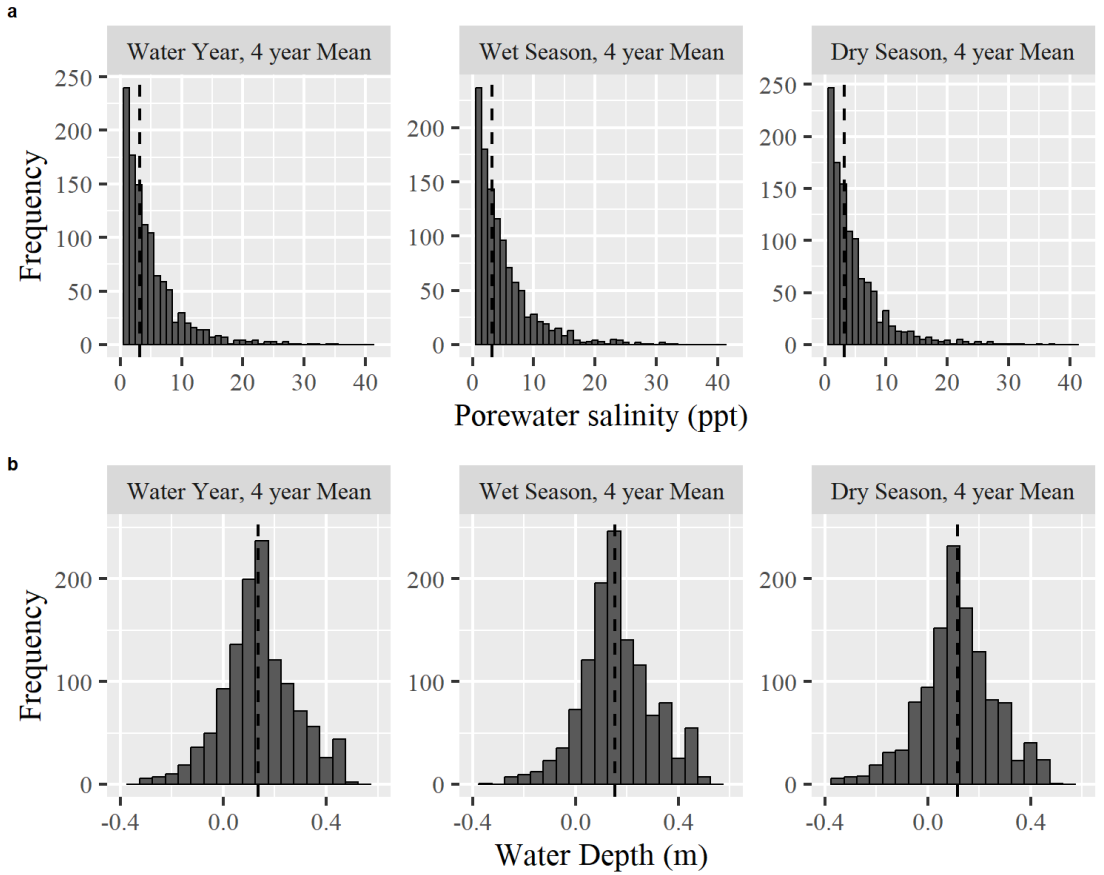
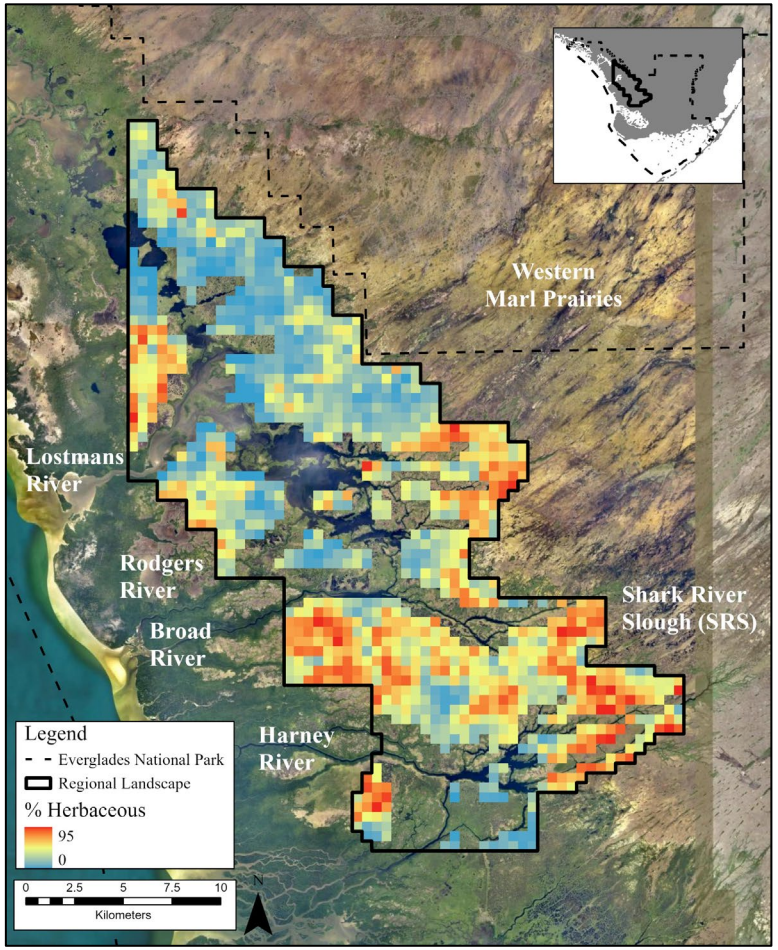
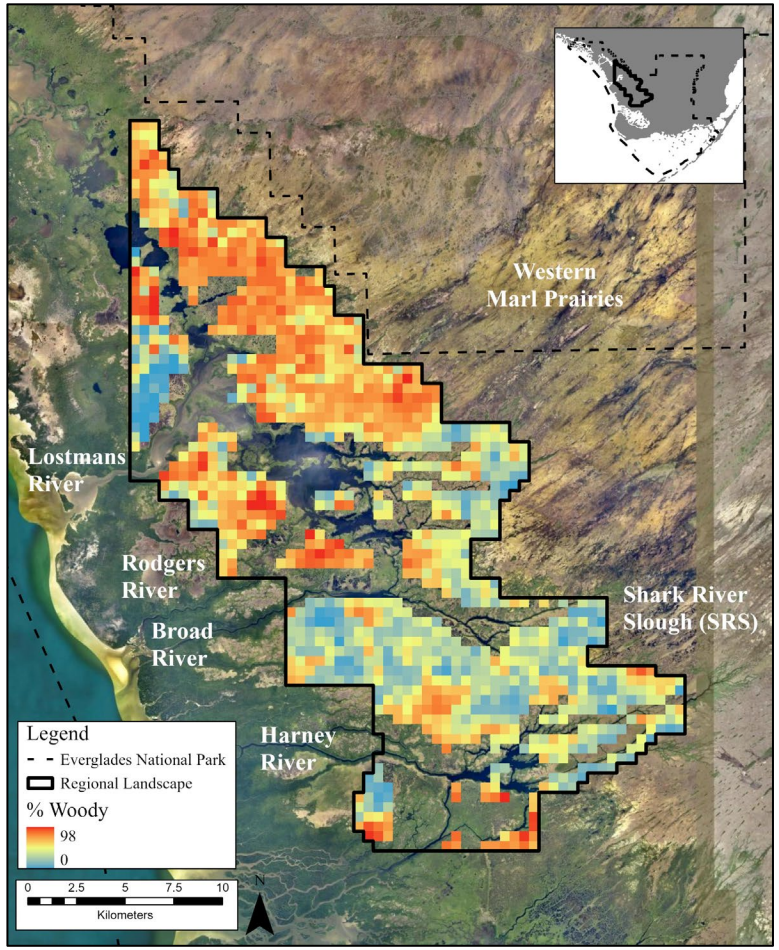


Figure 7. (**a**) Range of values for 2013-2016 mean BISECT simulated (a) porewater salinity and (b) water depth. Panels from left to right show water year wet season, and dry season. Water year is May 1 – April 30.

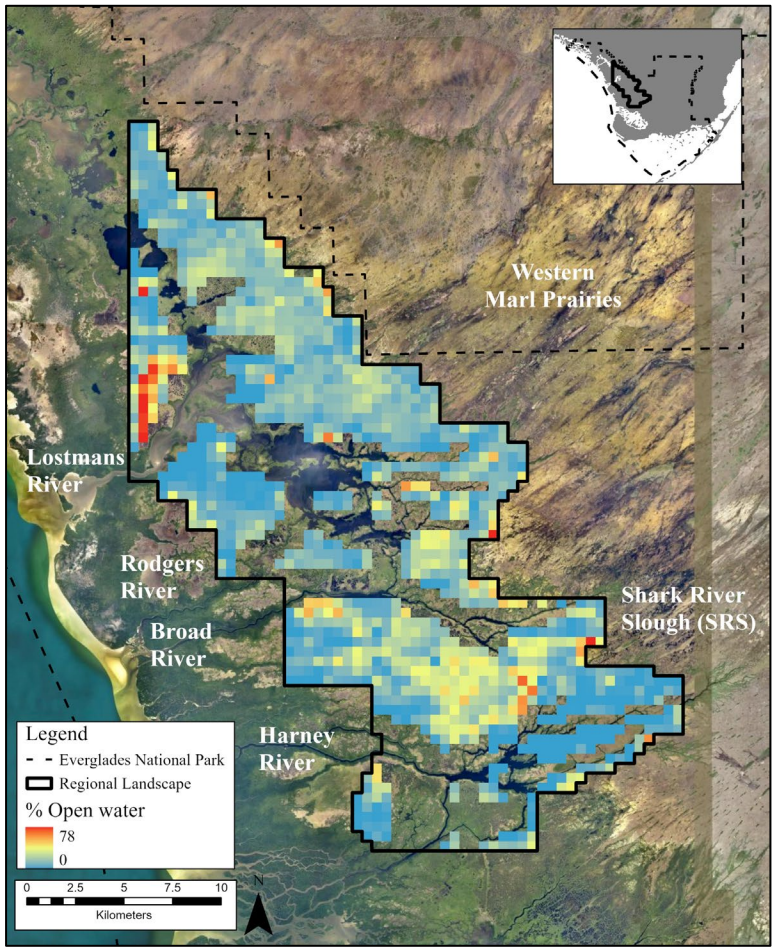
Q2: At a coarse spatial resolution, is there a relationship between hydrologic conditions and the percentage of herbaceous vegetation, woody vegetation, or open-water?



% Herbaceous



% Woody



% Open water

% vegetation metrics at 500 x 500 m spatial resolution

Q2: At a coarse spatial resolution, is there a relationship between hydrologic conditions and the percentage of herbaceous vegetation, woody vegetation, or open-water?

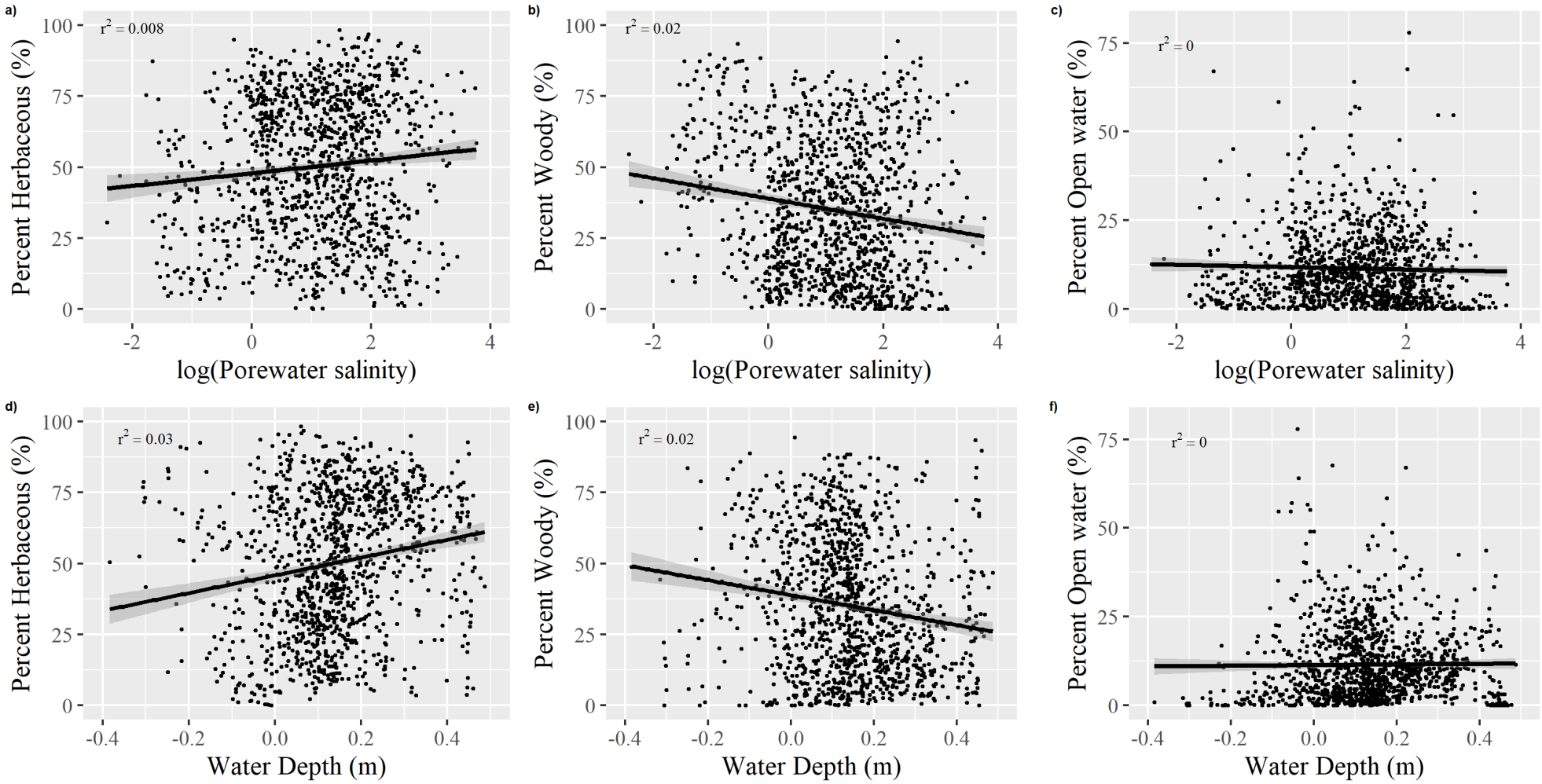


Figure 8. Relationships between percent of each class and BISECT simulated hydrology: (left) % Herbaceous, (center) % Woody, and (right) % Open water). Top panels are porewater salinity and bottom panels are water depth.

Q2: At a coarse spatial resolution, is there a relationship between hydrologic conditions and the percentage of herbaceous vegetation, woody vegetation, or open-water?

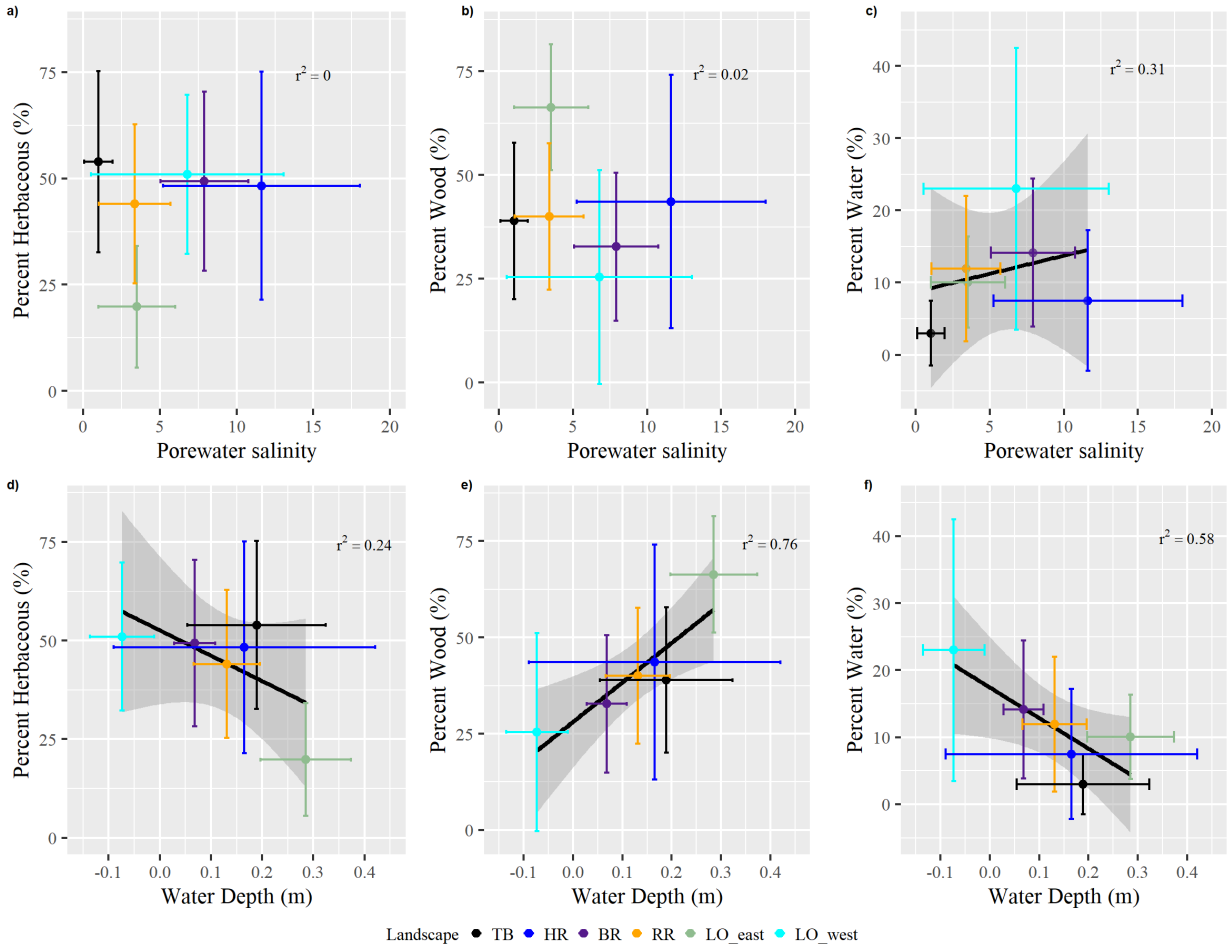


Figure 9. Relationships between percent of each class and BISECT simulated hydrology: (left) % Herbaceous, (center) % Woody, and (right) % Open water). Top panels are porewater salinity and bottom panels are water depth.

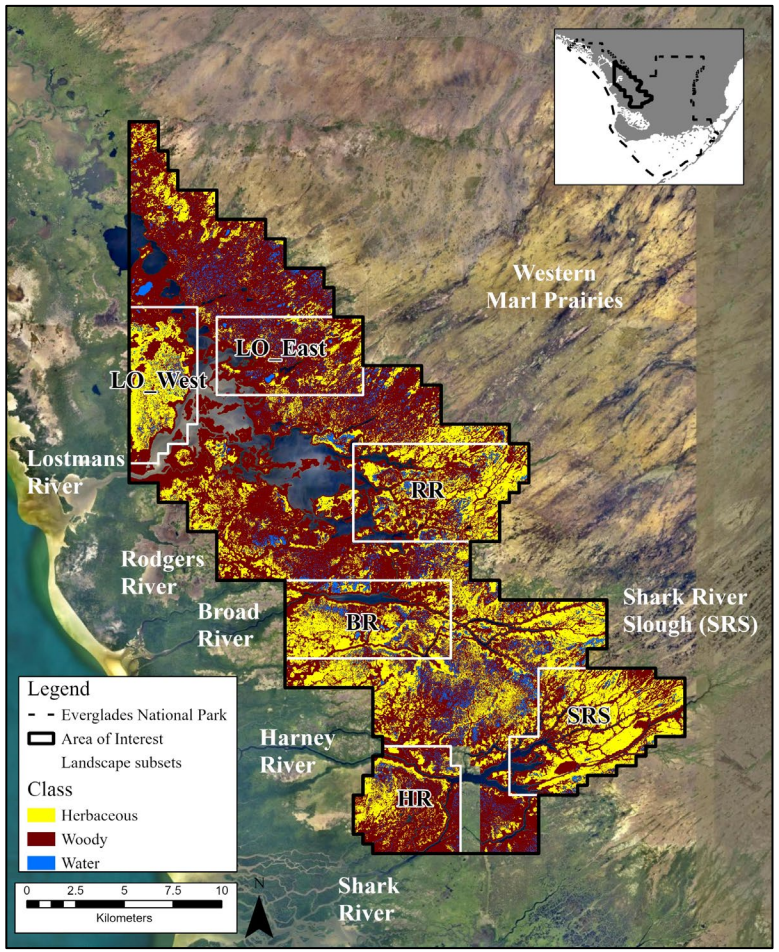
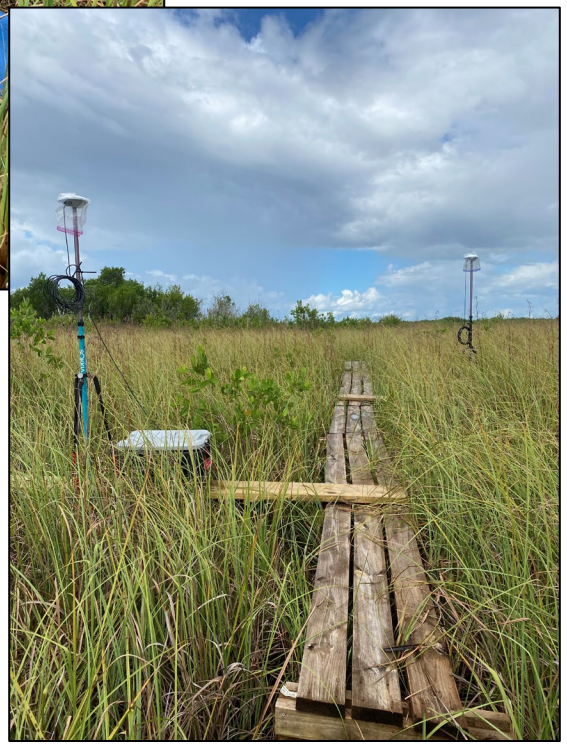


Figure 10. Landscape “bins” used to reduce noise. Bins identified based on assumed landscape connectivity.

Take-aways

1. BISECT needs calibration from vegetated locations along southwest coast of Everglades National Park.
   - Two sawgrass peat marsh hydrogeomorphic monitoring sites were established in 2021 along Harney River and upstream Rodgers River (photos on right).
2. Opposing pattern of percent woody and herbaceous vegetation along north-south axis. Related to legacy of 20th century drainage?
3. Focusing on elevation trends across the landscape (e.g. LiDAR) is key to understanding current vulnerabilities.



QUESTIONS?