

Shifting Freshwater Hydrology and Saltwater Intrusion Characterize Changing Dissolved Organic Matter Along Coastal Wetland Gradients



Photos: Evelyn Gaiser

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Photo: Mike Rugge



Florida Coastal Everglades Long Term Ecological Research Program





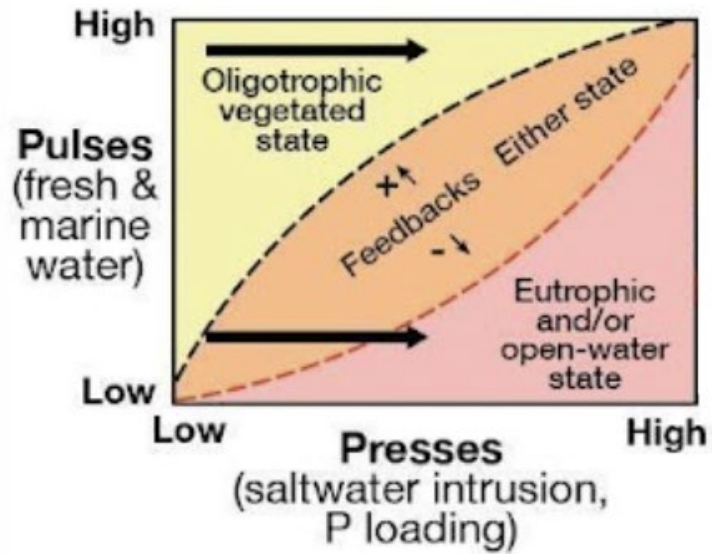
Seagrass die-offs

Photo: Steve Davis



Marsh peat collapse

Photo: Luke Lamb-Wotton



Marsh peat collapse

Photo: Steve Davis



Mangrove 'ghost forests'

Photo: B. Stackhouse

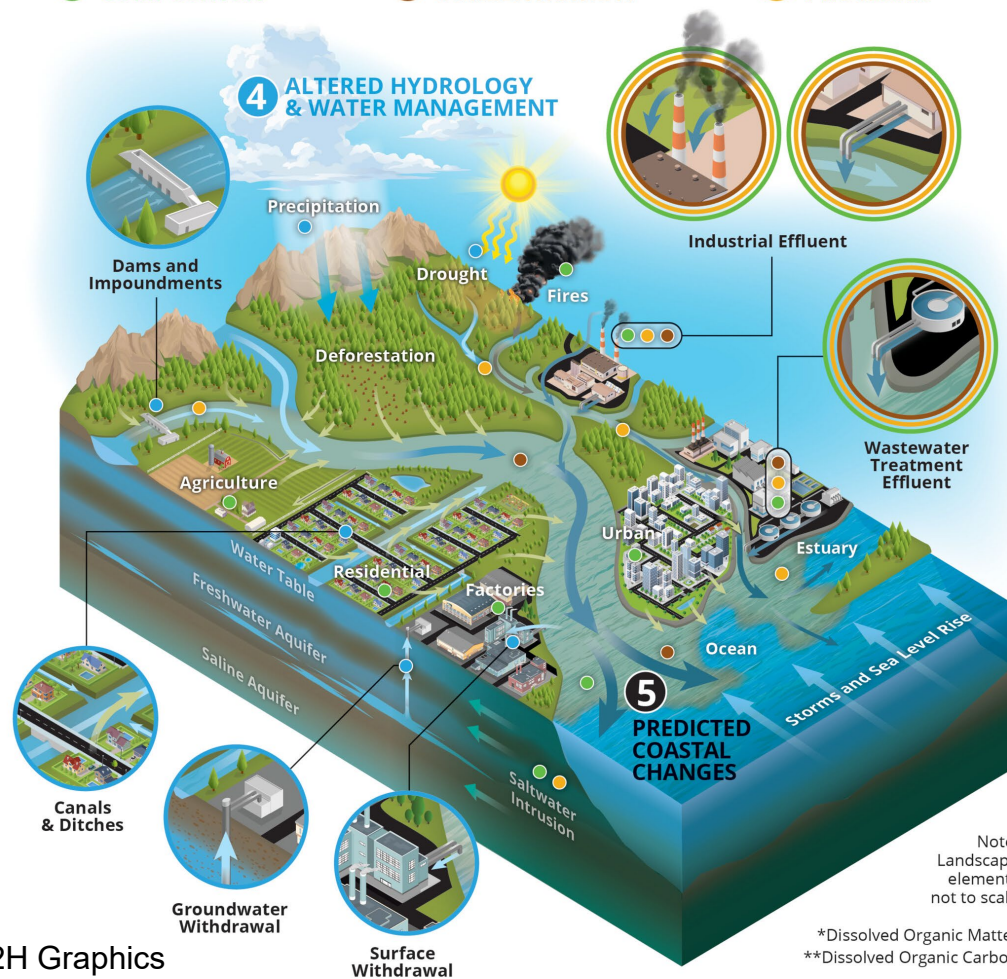
Adapted from Ratajczak et al. 2018 *TREE*



1 DOM* COMPOSITION

2 DOC** CONCENTRATION

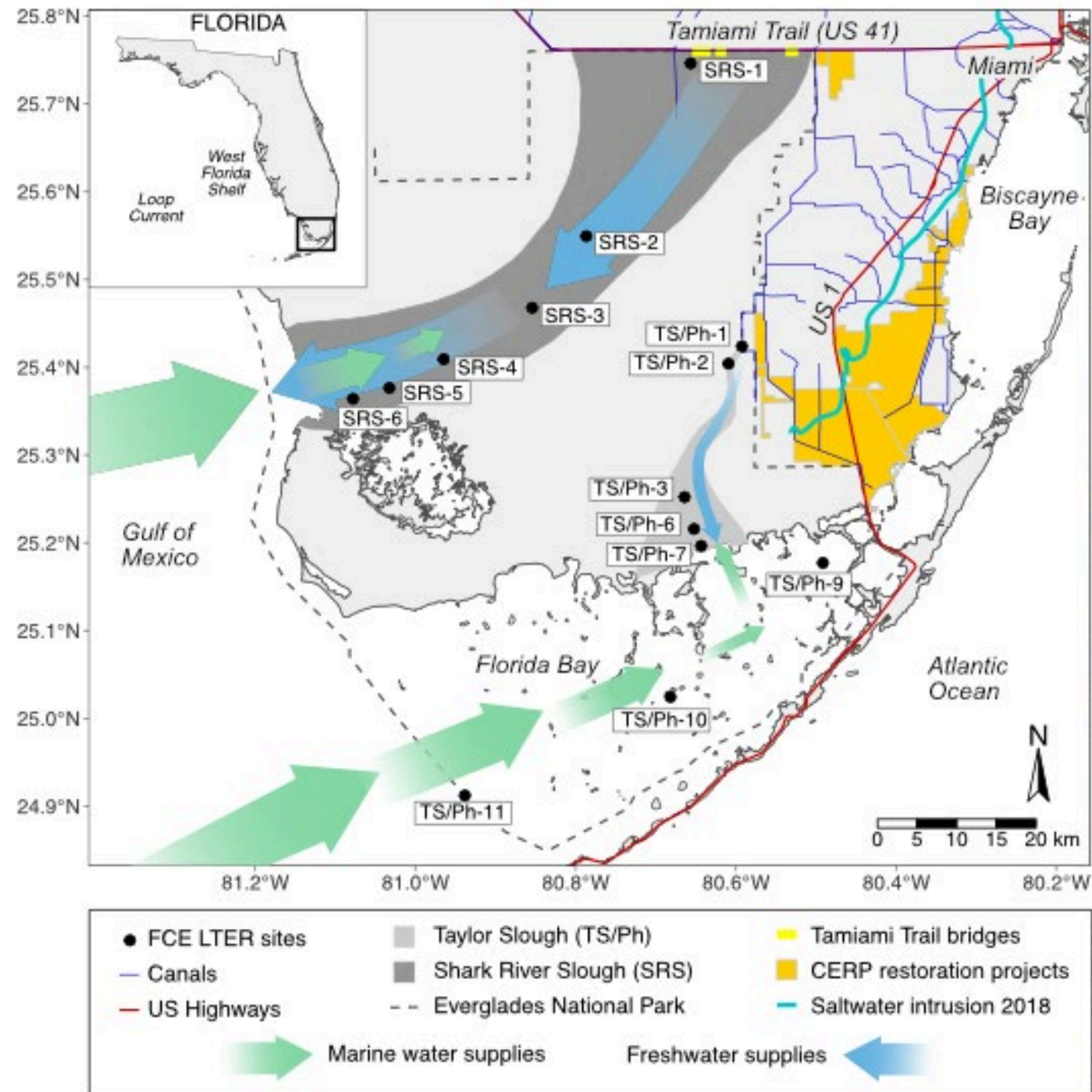
3 BIOGEOCHEMICAL PROCESSES



Note:
Landscape
elements
not to scale

*Dissolved Organic Matter
**Dissolved Organic Carbon

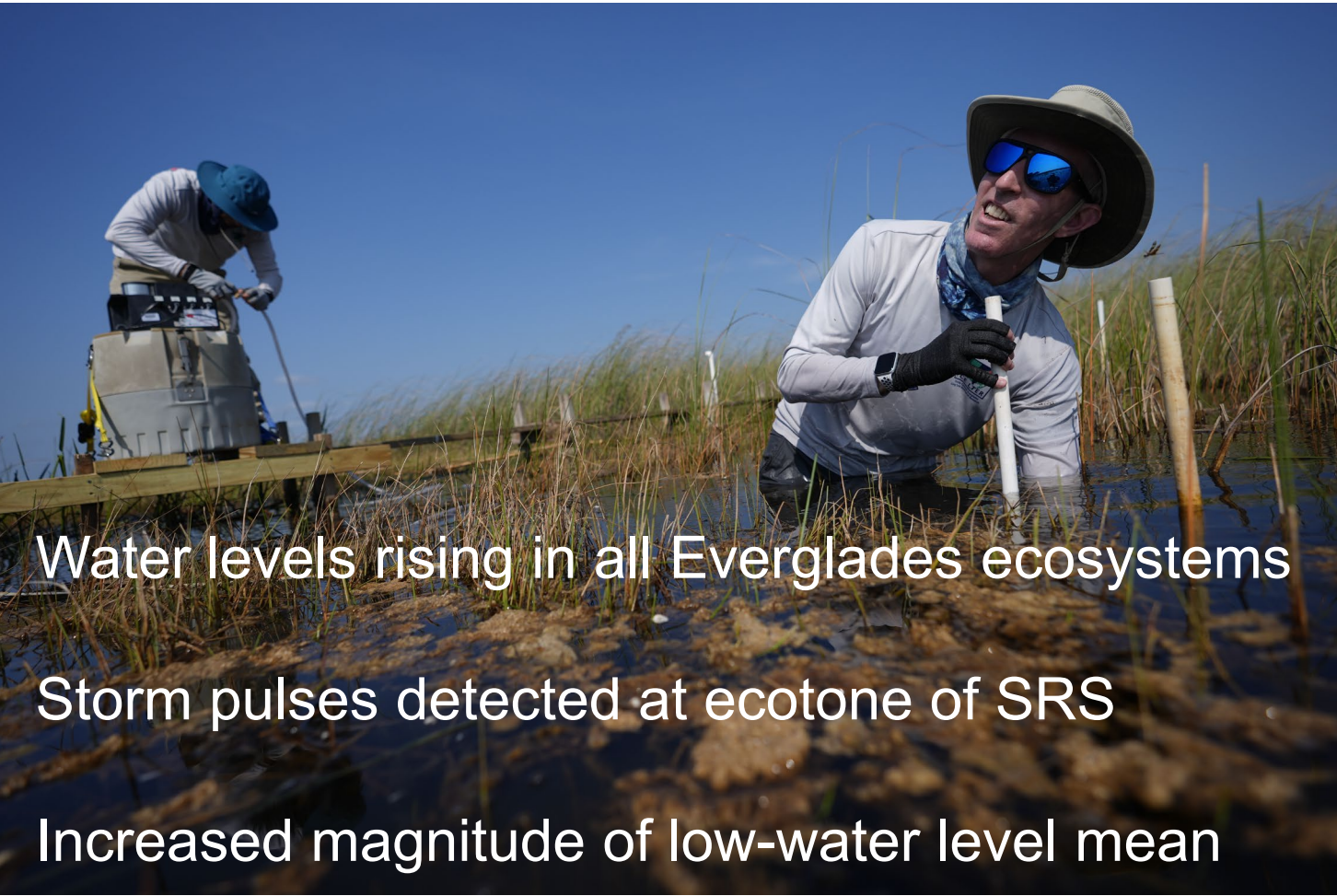
- 1 DOM COMPOSITION
- 2 DOC CONCENTRATION
- 3 BIOGEOCHEMICAL PROCESSES
- 4 ALTERED HYDROLOGY & WATER MANAGEMENT
- 5 PREDICTED COASTAL CHANGES





Seagrass Meadows & Marine Ecosystems





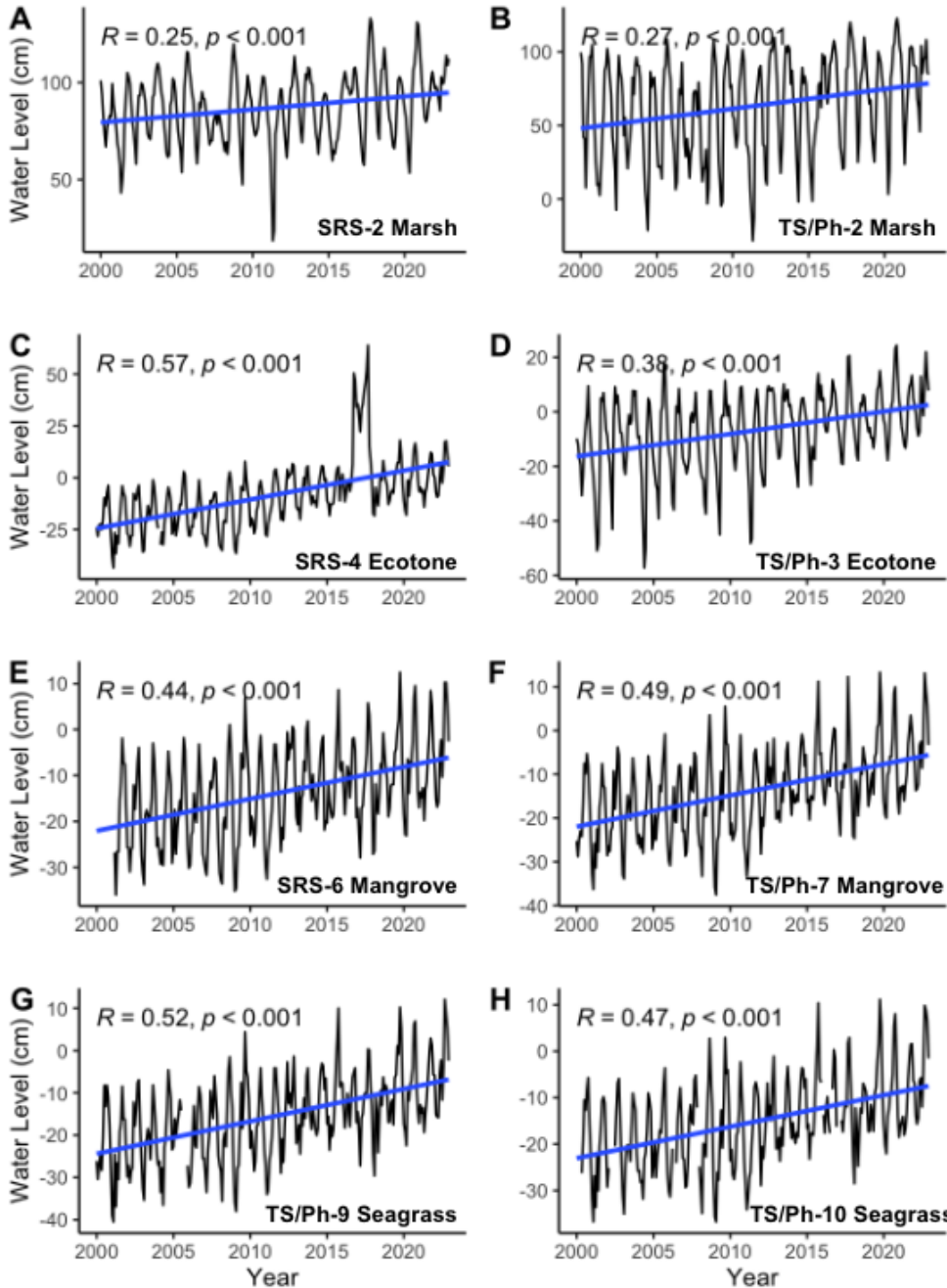
Water levels rising in all Everglades ecosystems
Storm pulses detected at ecotone of SRS
Increased magnitude of low-water level mean

Photo: Rebecca Blackwell, Associated Press

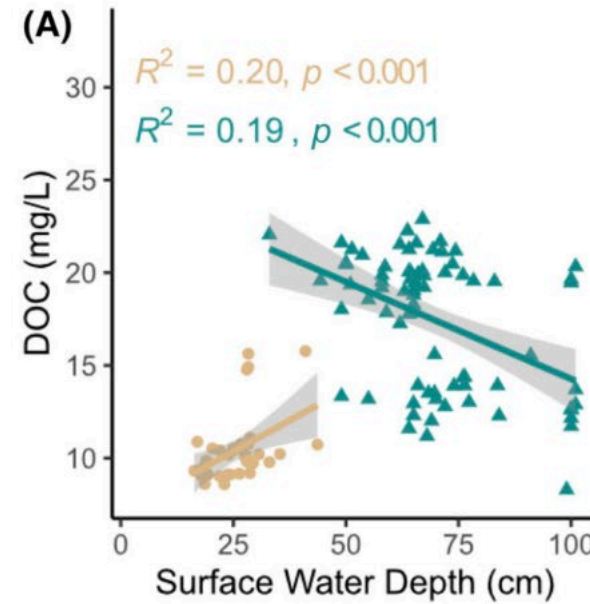
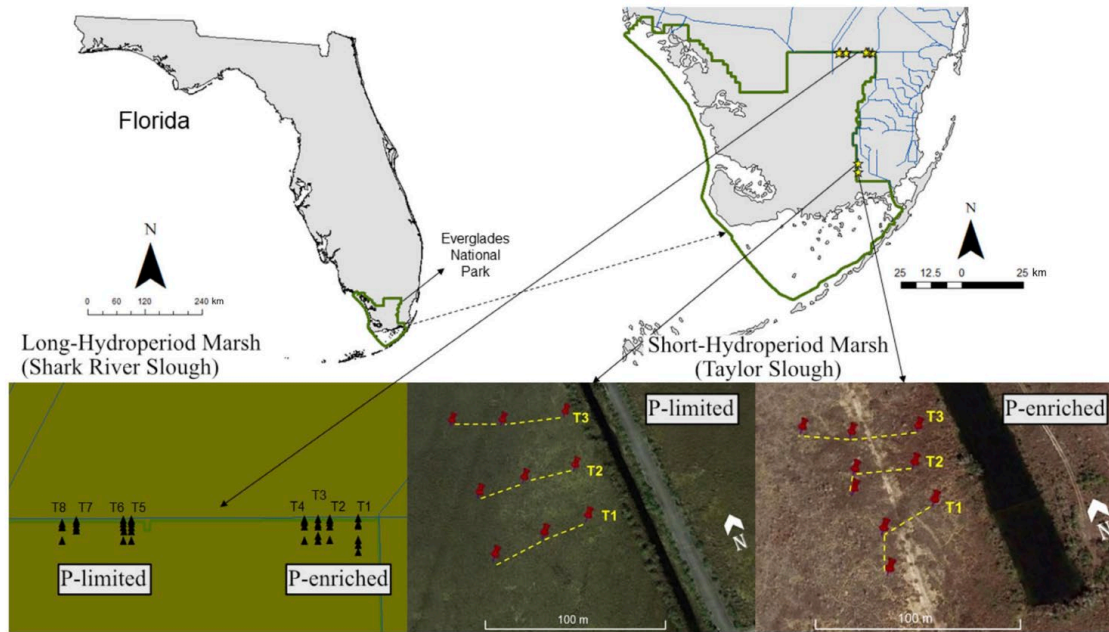
4 ALTERED HYDROLOGY & WATER MANAGEMENT



Anderson et al. 2024 *JGR Biogeosciences*



DOC/DOM shift with depth, vary in marl & peat



Wetland

● Marl

▲ Peat

1

DOM COMPOSITION

2

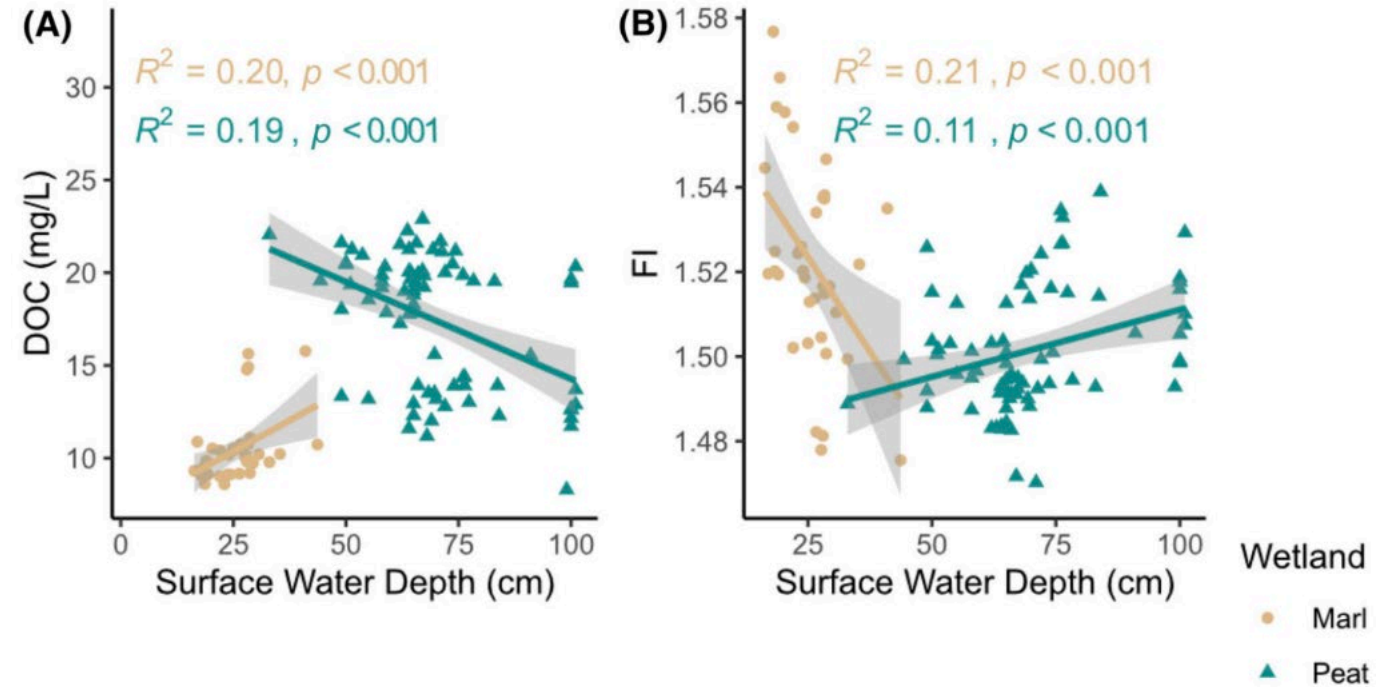
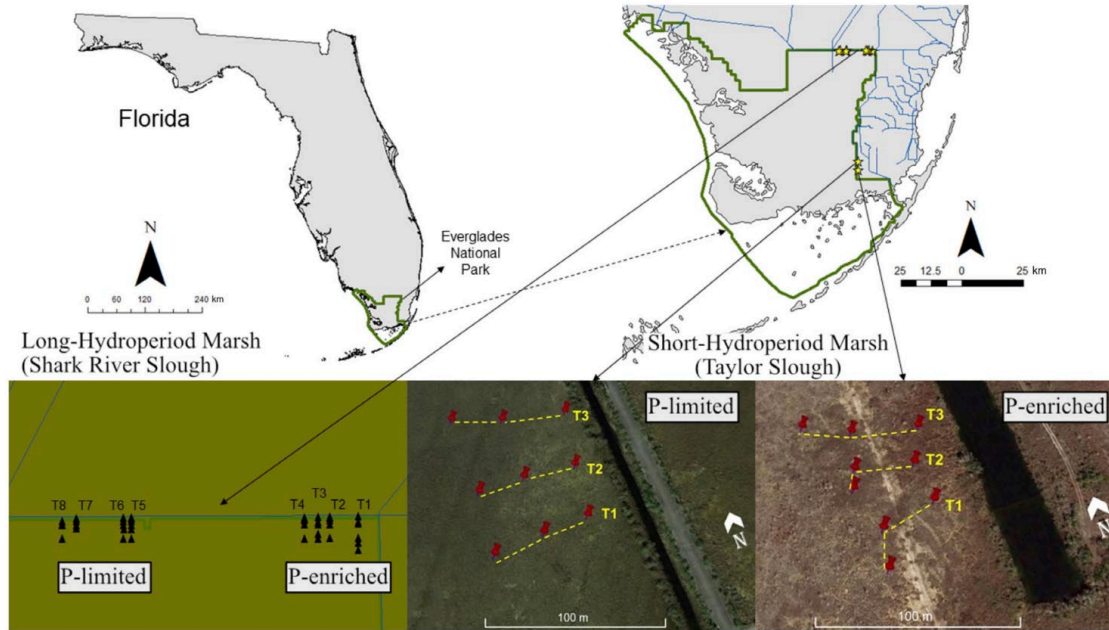
DOC CONCENTRATION

4

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WATER MANAGEMENT

Anderson et al. 2023
Restoration Ecology

DOC/DOM shift with depth, vary in marl & peat



1

DOM COMPOSITION

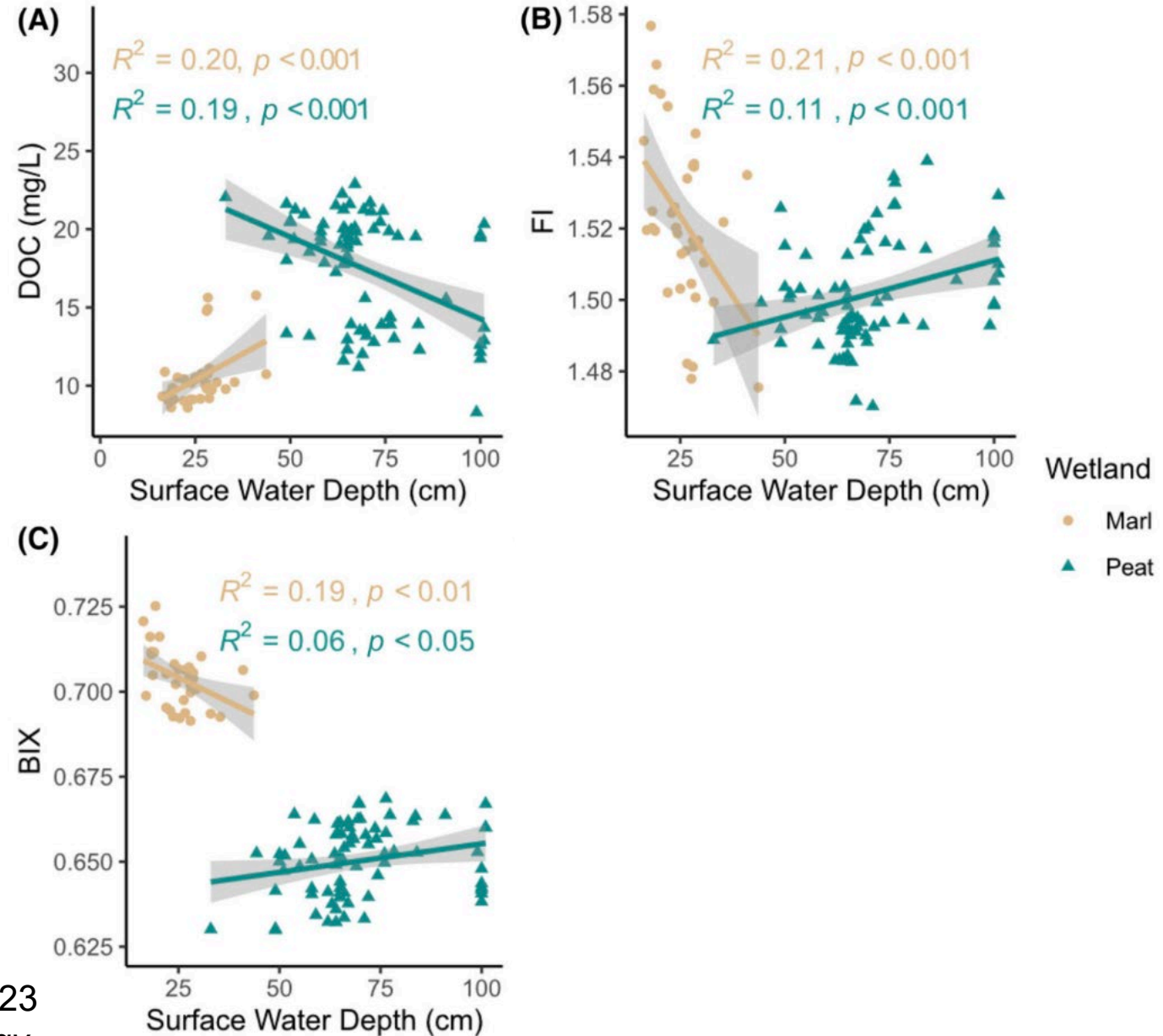
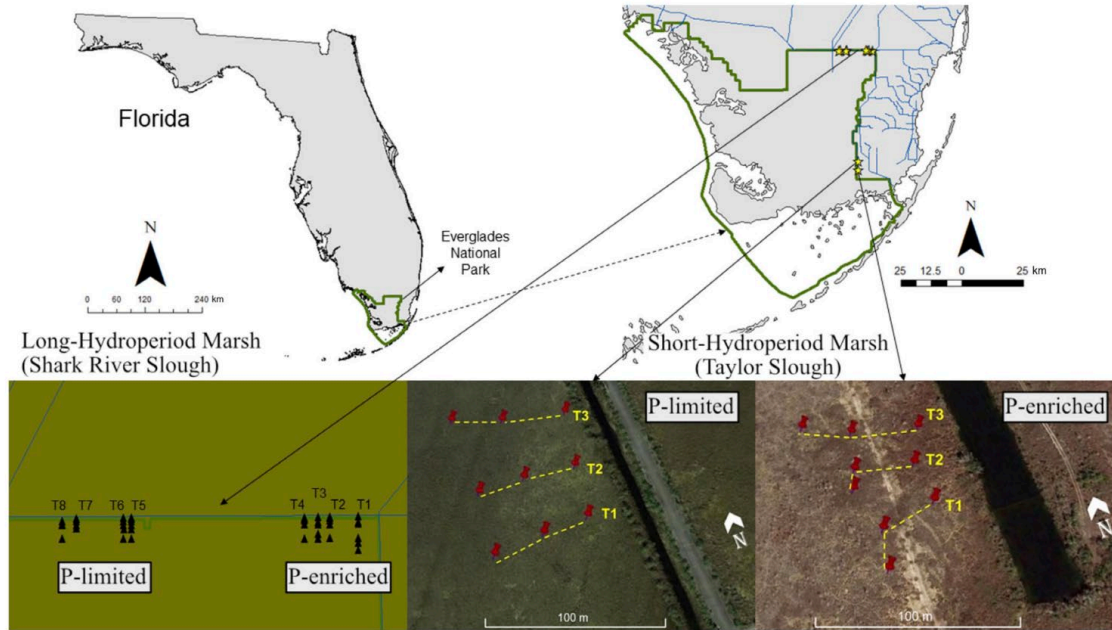
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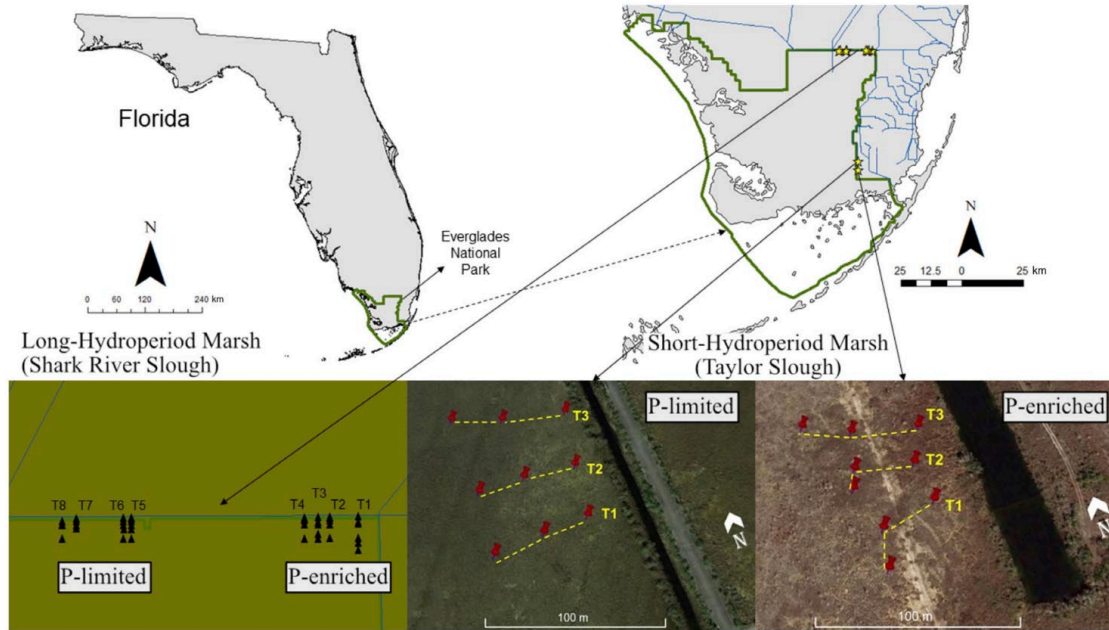
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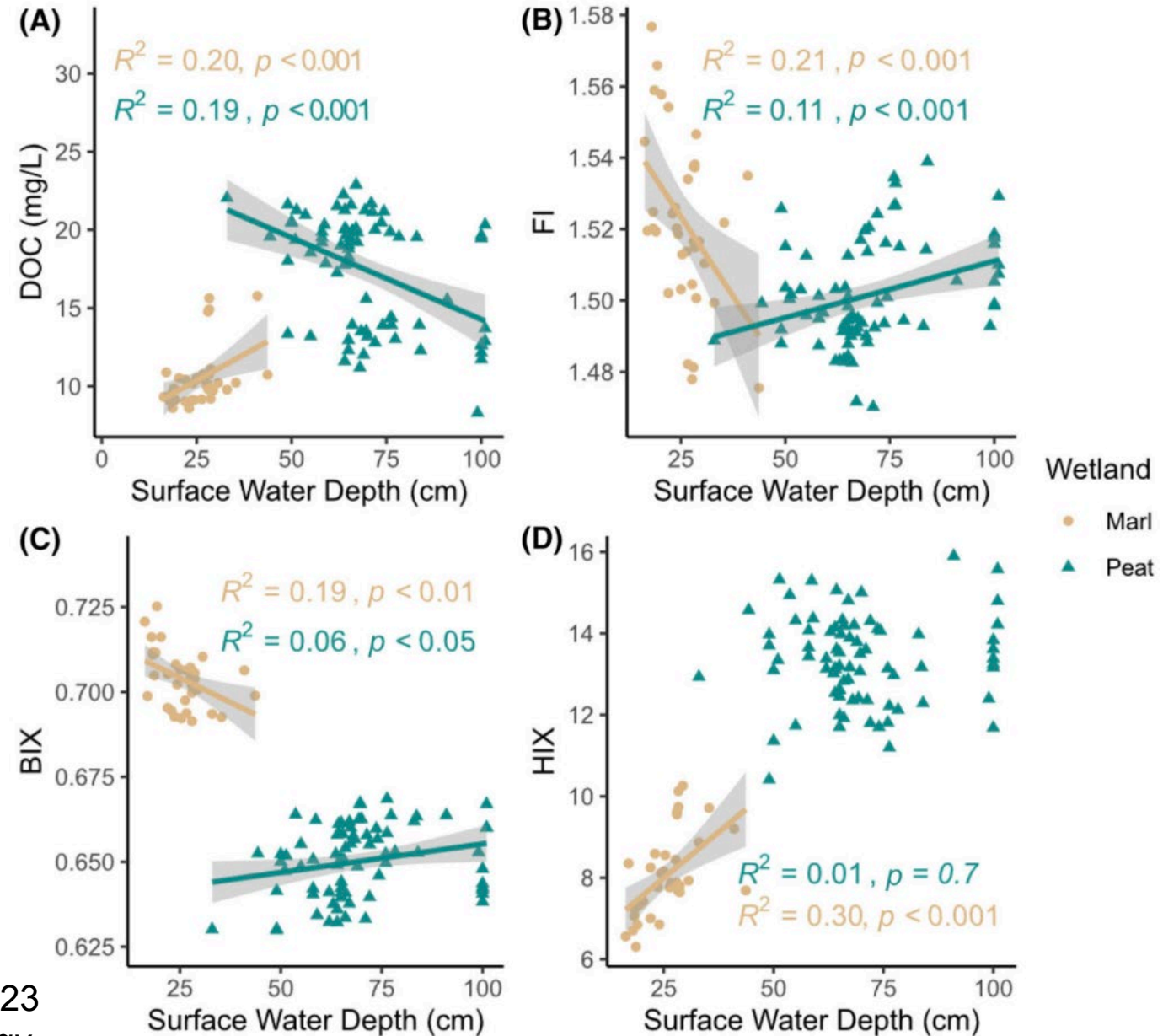
1 DOM COMPOSITION

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Restoration Ecology



Shifting hydrology & DOC/DOM

FI (microbial) DOM increases after floods and a hurricane

SR (marine) DOM increases with sea-level rise and storms

SUVA₂₅₄ (aromatic) DOM increases with droughts, decreases when DOC increases

1

DOM COMPOSITION

2

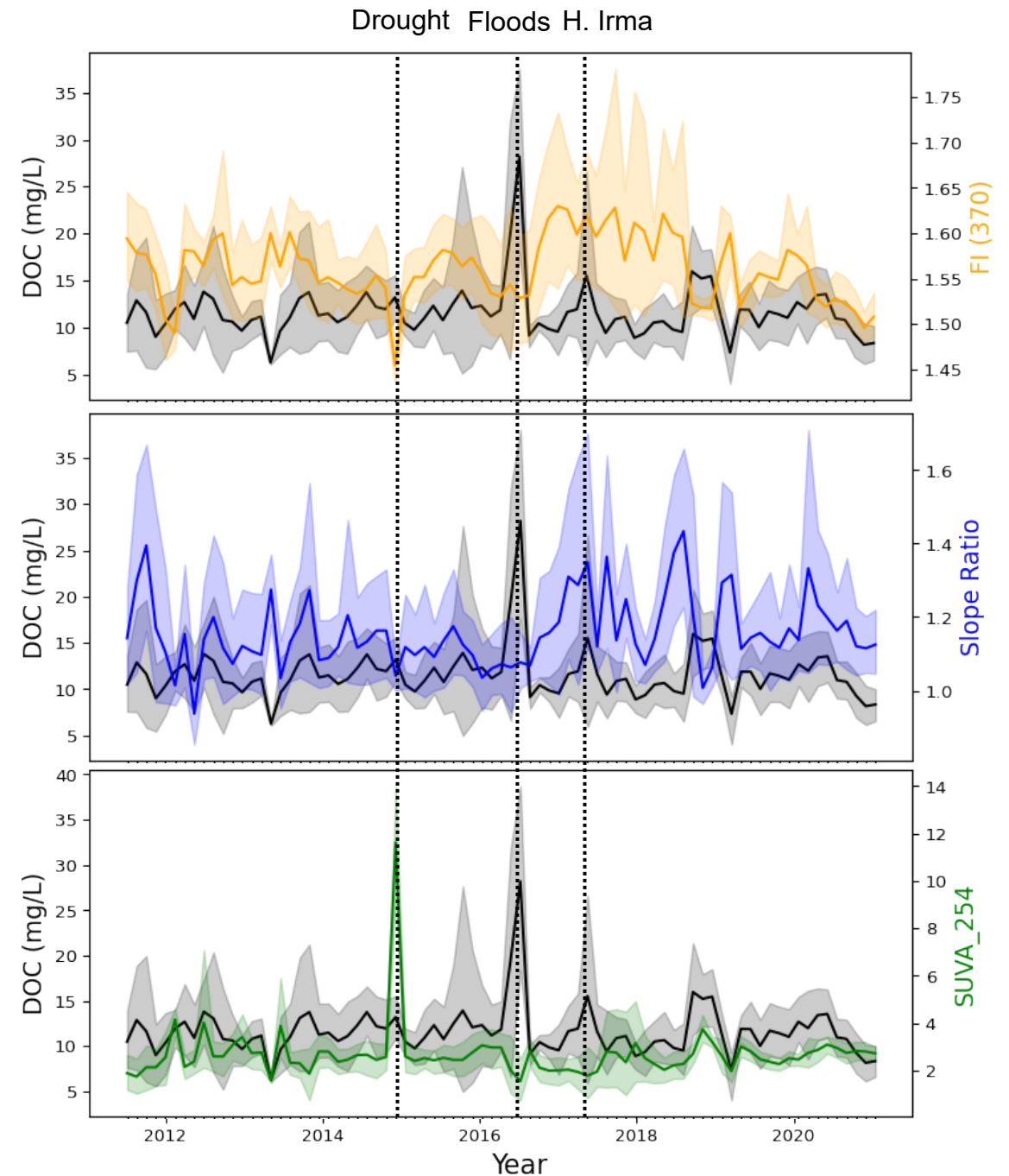
DOC CONCENTRATION

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ALTERED HYDROLOGY &
WATER MANAGEMENT



Smith et al., in revision
Limnology and Oceanography



Shifting hydrology & DOC/DOM

Exponential relationship algal vs humic

- Marsh and mangrove BIX < HIX
- Marine BIX > HIX

BIX and HIX varies across DOC range

1

DOM COMPOSITION

2

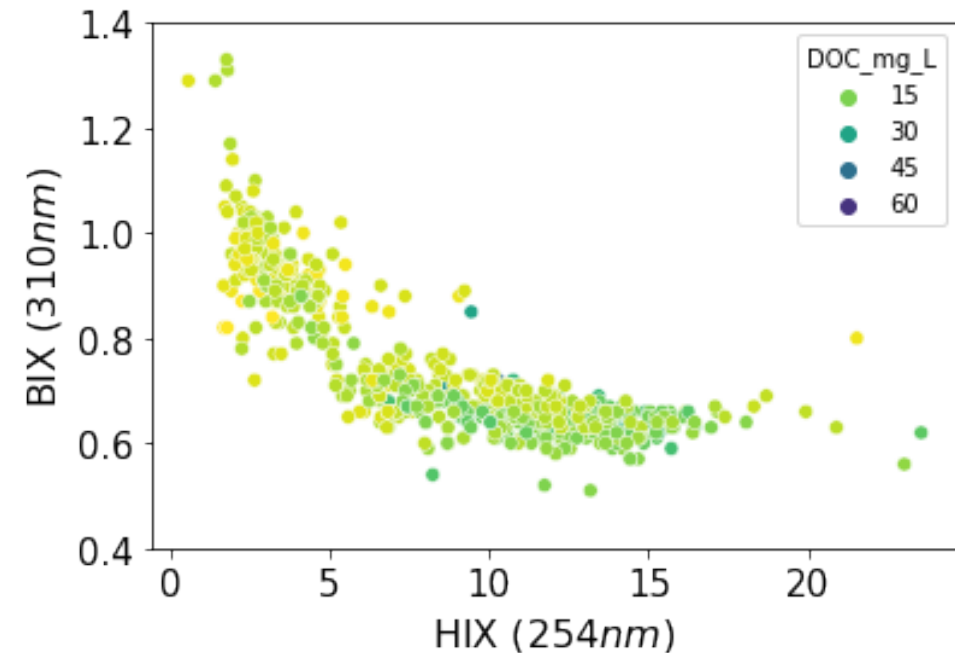
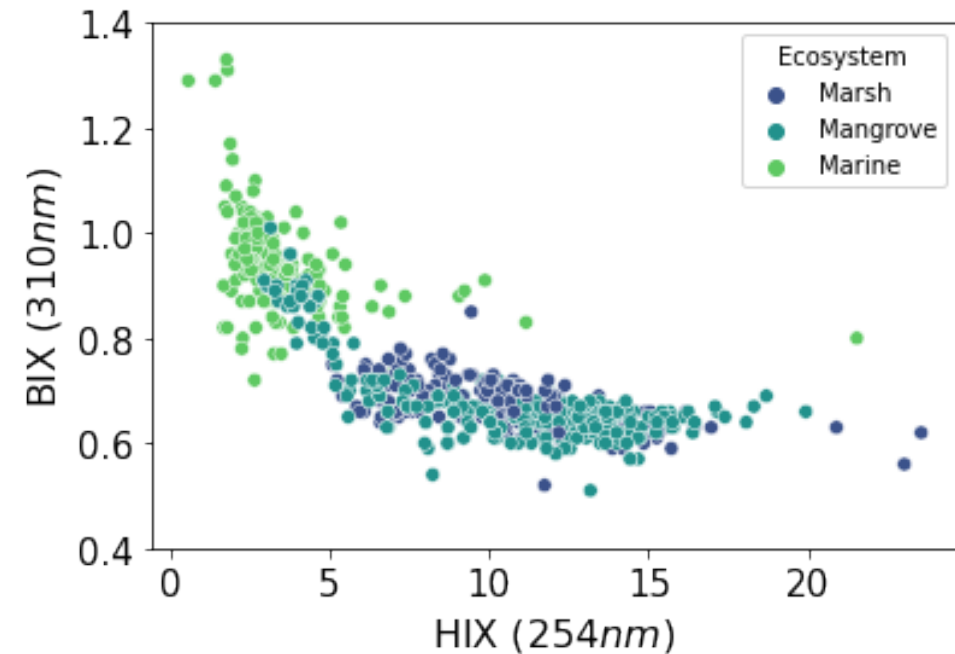
DOC CONCENTRATION

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Smith et al., in
revision
*Limnology and
Oceanography*



Shifting hydrology & DOC/DOM

Ecosystem-specific shifts

- Marsh and mangrove DOM cluster
 - driven by changing humic & aromatic components
- Marine DOM expands
 - driven microbial/algal components

1

DOM COMPOSITION

2

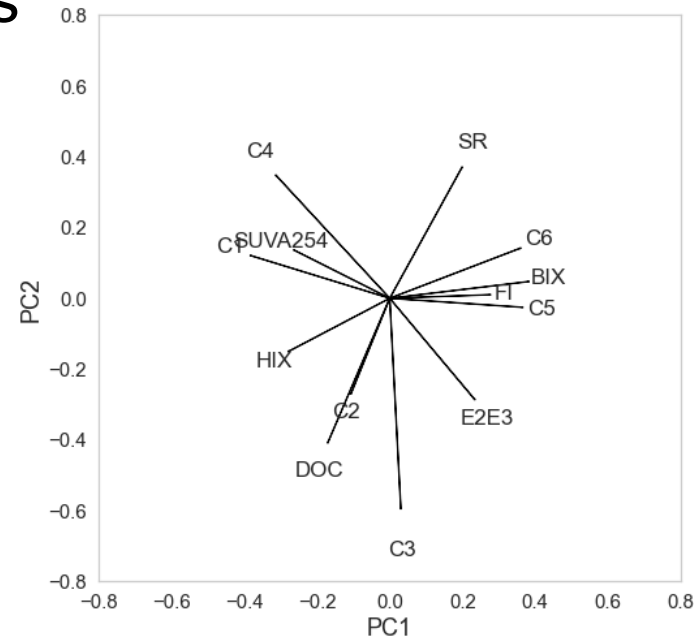
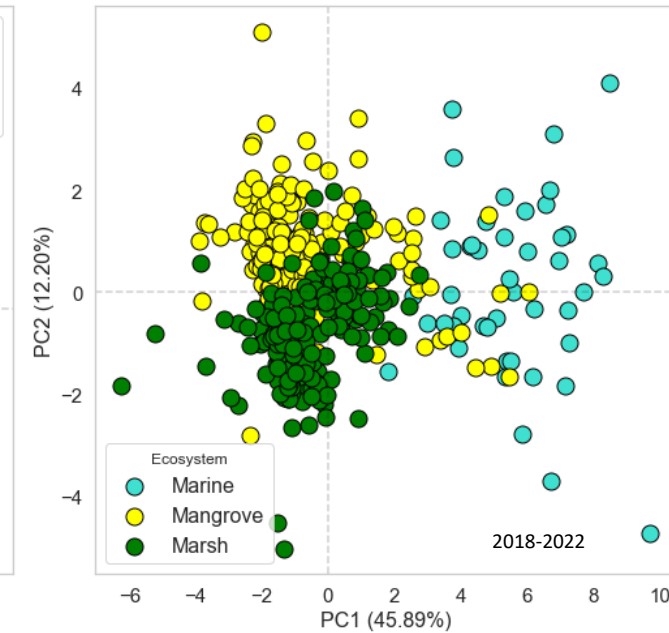
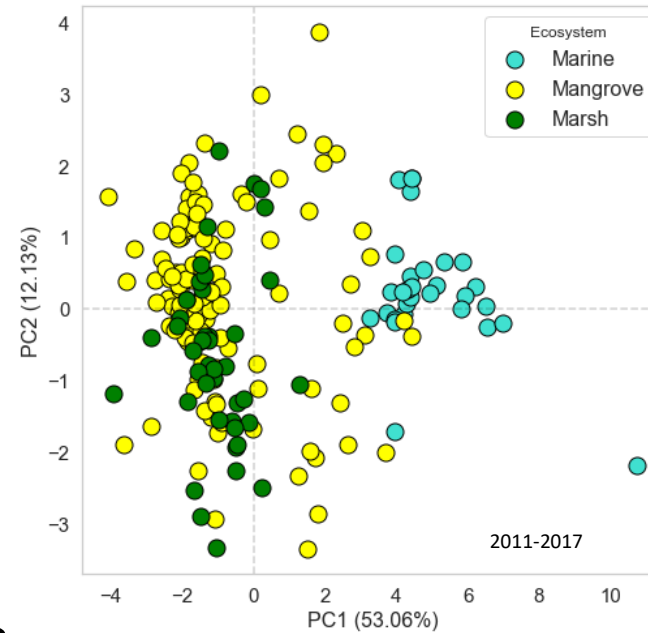
DOC CONCENTRATION

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Smith et al., in
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Shifting hydrology & DOC/DOM

Saltwater intrusion changes DOM in peat and marl mangroves

- BIX increases at downstream mangrove sites
- HIX increases at upstream mangrove sites

1

DOM COMPOSITION

2

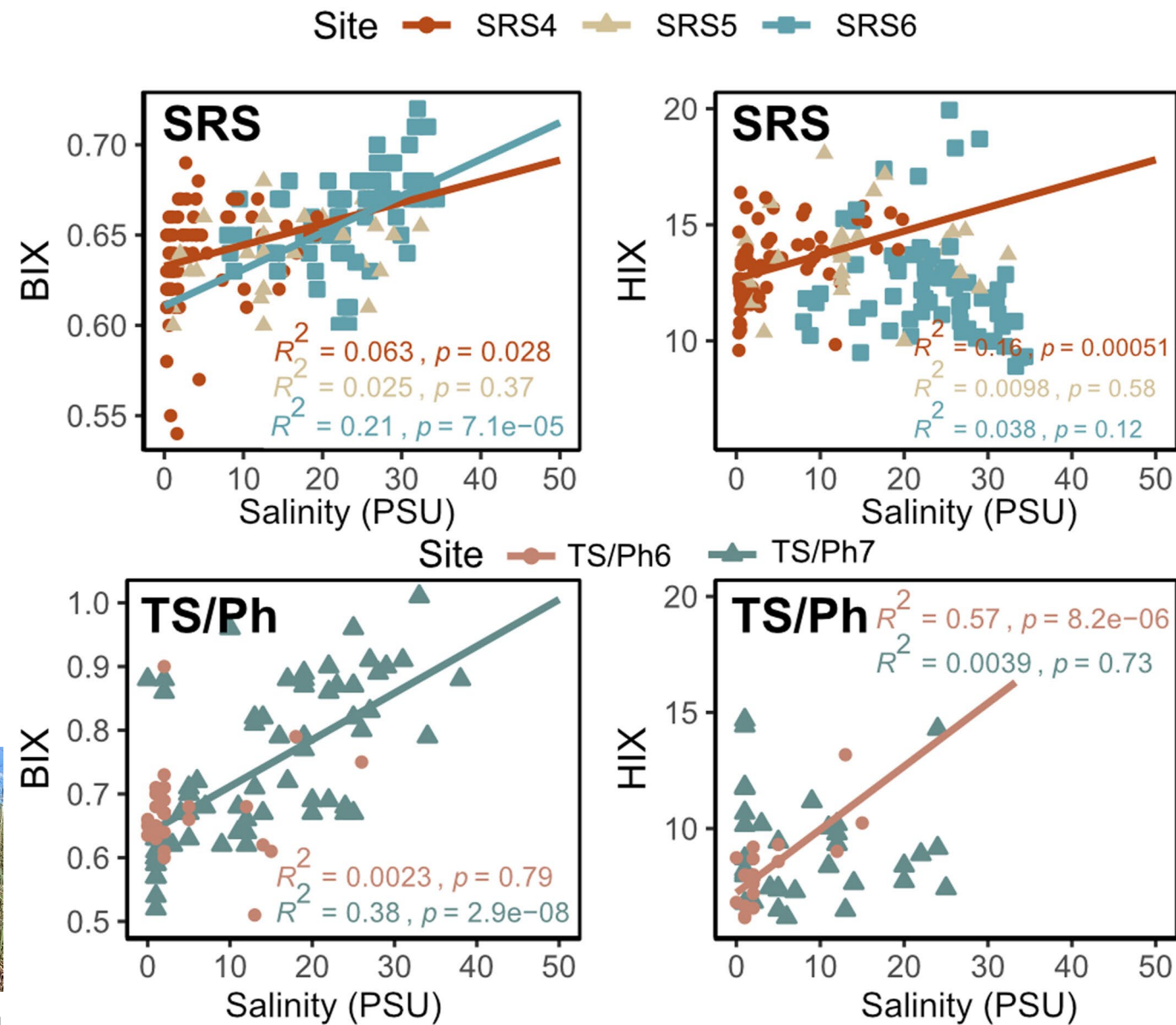
DOC CONCENTRATION

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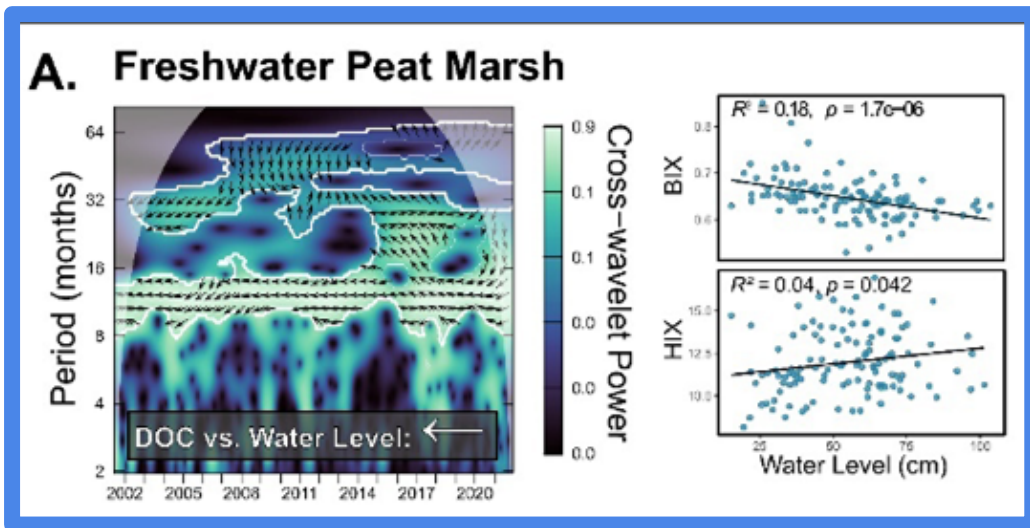
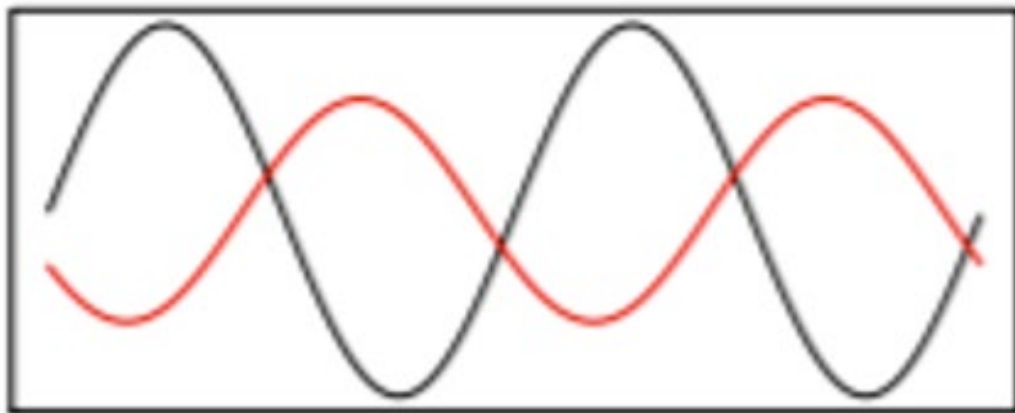


Photo: Evelyn Gaiser



DOC lags water level & both are out of phase

1

DOM COMPOSITION

2

DOC CONCENTRATION

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DOC and humic DOM increase from restoration water originating in peatlands

Photo: Kenny Anderson

1

DOM COMPOSITION

2

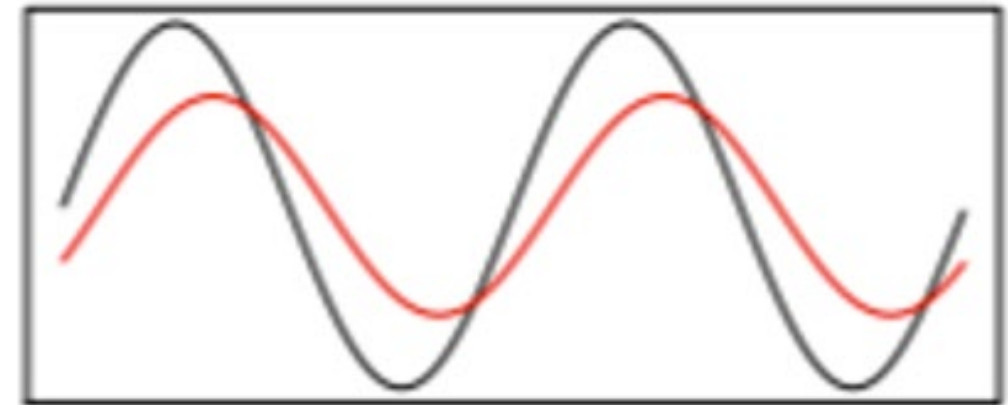
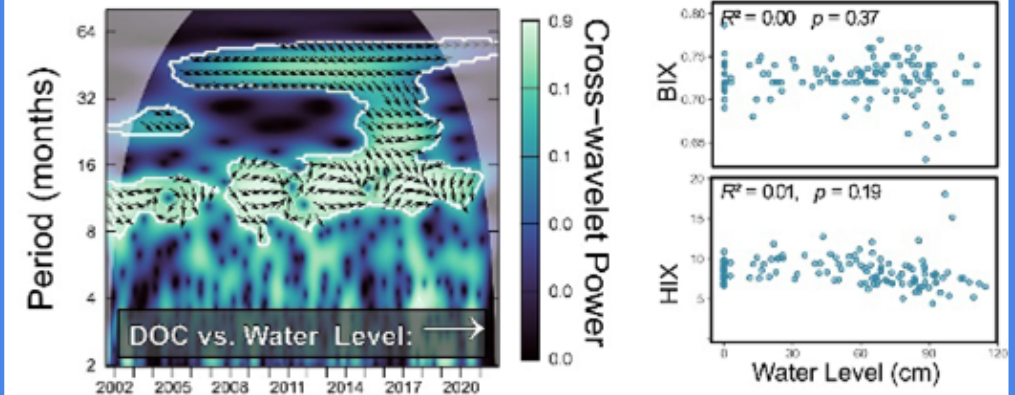
DOC CONCENTRATION

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B. Freshwater Marl Marsh



DOC leads water level & both are in phase

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DOC leads water level & both are in phase

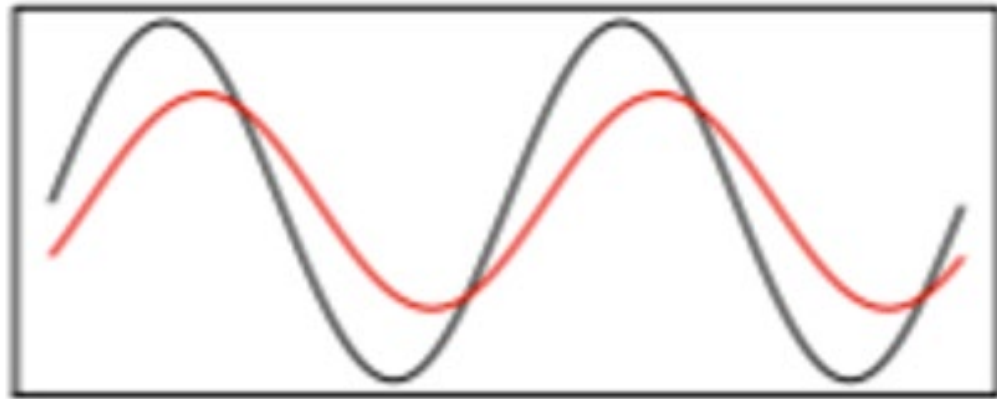
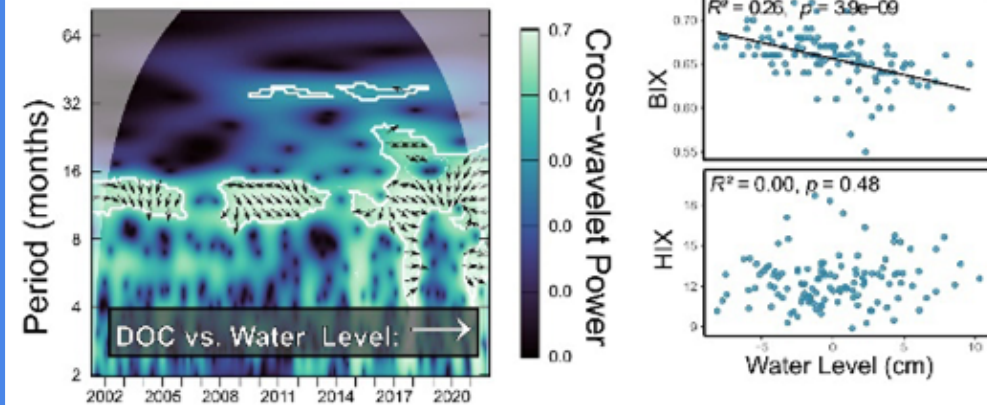


Photo: Rafael Travieso

C. Riverine Mangrove



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DOM COMPOSITION

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ALTERED HYDROLOGY &
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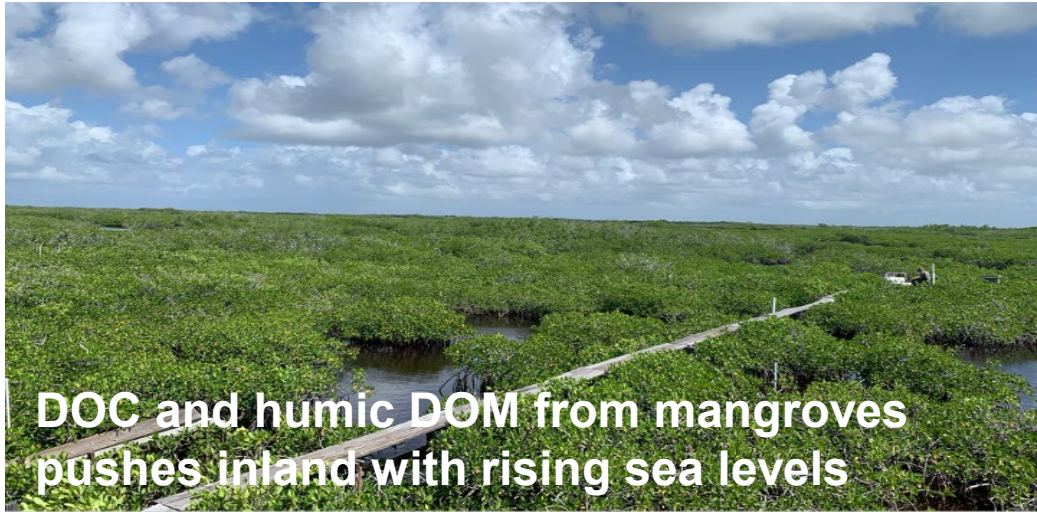
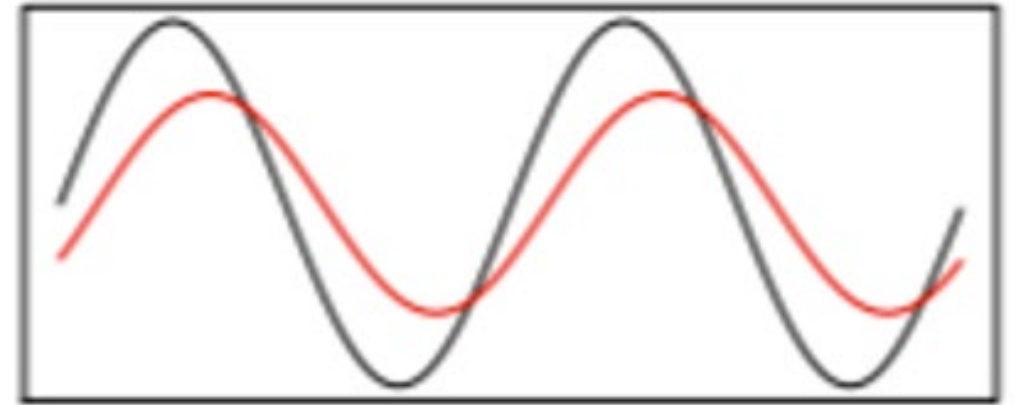
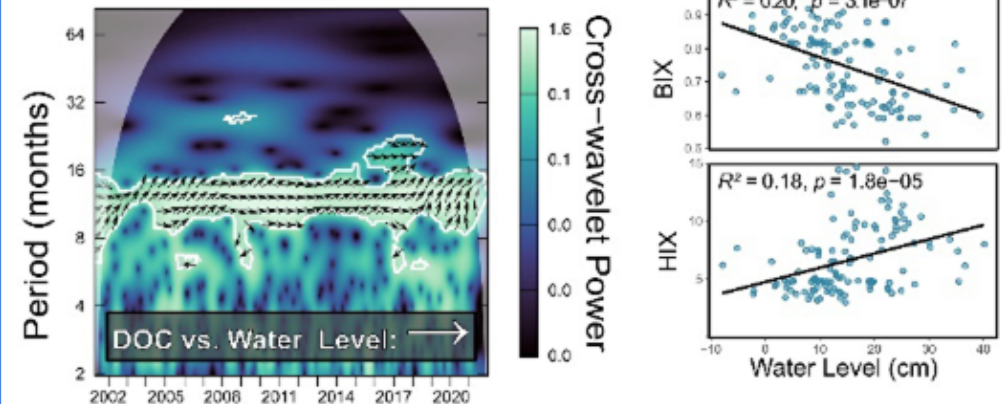


Photo: Edward Castañeda

DOC leads water level & both are in phase



D. Shrub Mangrove



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1 DOM COMPOSITION

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Tamiami Trail (US-41) in Northeast Shark River Slough, Everglades National Park.

Photo: John Kominoski

- Fresh and marine water presses & pulses are **shifting landscape DOC/DOM**
- Higher water depths **mobilize humic DOM** from marshes & mangroves
- **Algal & microbial DOM increase** with saltwater intrusion and sea-level rise
- Need to constrain and **quantify lateral fluxes of DOC & DIC**

Acknowledgements

NSF [DEB-2025954](#), [DEB-1832229](#), [DEB-1237517](#), [DBI-0620409](#), [DEB-9910514](#)

NPS Task Agreement [P21AC10854](#)

Tamiami Trail (US-41) in Northeast Shark River Slough, Everglades National Park.

ASLO 2025



Meilian
Chen

Rudolf
Jaffè

Nagamitsu
Maie

Soy
yo

Chris
Osburn

Photo: John Kominoski

