Saltwater intrusion causes peat collapse.

Principal researchers:
- S. Charles, S. Servais, B. Wilson,
- J. Kominoski, S. Davis, T. Troxler,
- E. Gaiser

Technical researchers:
- M. Kline, M. Robinson, L. Bauman

Added salt (10 PPT) and phosphorus (P, \(\times 2\) ambient load)
- ... Freshwater (FW)
- ... Freshwater with P (FWP)
- ... Saltwater (SW)
- ... Saltwater with P (SWP)
Saltwater intrusion causes peat collapse.

Tukey’s HSD post-hoc test compared to the control (FW)

… n.c. when no change

… ⤷ or ⤵ when $P < 0.05$

… ⇓ or ⇑ when insignificant

Geoderma Servais et al. (2019), Est. and Coa. Wilson et al. (2018), Charles et al. (in review)
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<th>Bulk Density</th>
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<td>Root growth</td>
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<td>Aboveground biomass</td>
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Geoderma Servais et al. (2019), Est. and Coa. Wilson et al. (2018), Charles et al. (in review)
Can restored freshwater recover soil elevation?

Dong Yoon Lee¹,², John Kominoski²

¹ South Florida Water Management District
² Florida International University
Freshwater recovery experiment

- **Hypothesis**: The legacy of saltwater intrusion would continue; P legacy would last longer than salt legacy
- **Methods**:
  - Add only **FRESHWATER**
  - CO$_2$ flux was measured monthly

CO$_2$ flux measured under different light and temperature
Porewater

Salinity (ppt)

Soluble reactive P (µmol L⁻¹)

Dissolved organic carbon (µmol L⁻¹)

Recovery

Salt effect ($P < 0.001$)

Salt effect ($P < 0.001$)
Phosphorus content (µg g⁻¹) for different parts of the ecosystem:

- **Leaf**:
  - FW
  - FWP
  - SW
  - SWP

- **Litter**:
  - FW
  - FWP
  - SW
  - SWP

- **Root**:
  - (not measured)

- **Soil**:
  - FW
  - FWP
  - SW
  - SWP

(pre-recovery)
Phosphorus

P legacy ($P < 0.01$)
Salt legacy ($P < 0.01$)

Post-recovery

(pre-recovery)

Phosphorus content ($\mu g \ g^{-1}$)

- Leaf
- Litter
- Root
- Soil

FW
FWP
SW
SWP
Aboveground biomass

Aboveground biomass (g dw m$^{-2}$)

Pre-recovery … … P effect ($P < 0.001$)

Recovery … … P legacy ($P < 0.001$)

… salt legacy ($P < 0.01$)
Metabolism during freshwater recovery

Gross primary production at maximum light

- no salt legacy
- P legacy ($P < 0.001$)

Ecosystem respiration

- salt legacy ($P < 0.05$)
- P legacy ($P < 0.001$)
Ecosystem carbon balance

Net ecosystem metabolism

\[ \text{Net ecosystem metabolism} = [\text{CO}_2]_{\text{uptake}} - [\text{CO}_2]_{\text{release}} \]

\[ = \text{GPP} - \text{ER} \]

For example,

… when NEM > 0

: net carbon gain

… when NEM < 0

: net carbon loss

(Error bars are 25th and 75th percentiles of 1000 model outputs)
Ecosystem carbon balance

Net ecosystem metabolism (g C m$^{-2}$ month$^{-1}$)

FW...
... +17 g d.w. m$^{-2}$ mon$^{-1}$
... +1.5 mm yr$^{-1}$

FWP...
... -6.3 mm yr$^{-1}$

SW...
... -7.1 mm yr$^{-1}$

SWP...
... -12.5 mm yr$^{-1}$

(Error bars are 25$^{th}$ and 75$^{th}$ percentiles of 1000 model outputs)
Summary

Effect of legacy

a) FWP

b) SW

c) SWP

Lag time for recovery
• Although P legacy was effective, its effect can be short-term
• Salt legacy led to long-term changes in the rate and pathway of carbon and nutrient dynamics (likely due to geochemical and community changes)
• When salt and P legacies coexisted, organisms that adapted to high salinity and P enhanced net carbon loss ADDITIVELY
• Short-term exposure to saltwater disproportionally enhanced carbon loss pathways and will delay ecosystem recovery
Phosphorus

Aboveground P concentration (mg P m⁻²)

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<td>300</td>
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Phosphorus content (µg g⁻¹)

- Leaf
- Litter
- Root
- Soil

**Post-recovery**

(pre-recovery)