Coastal wetlands respond differently to increasing salinity. Why?

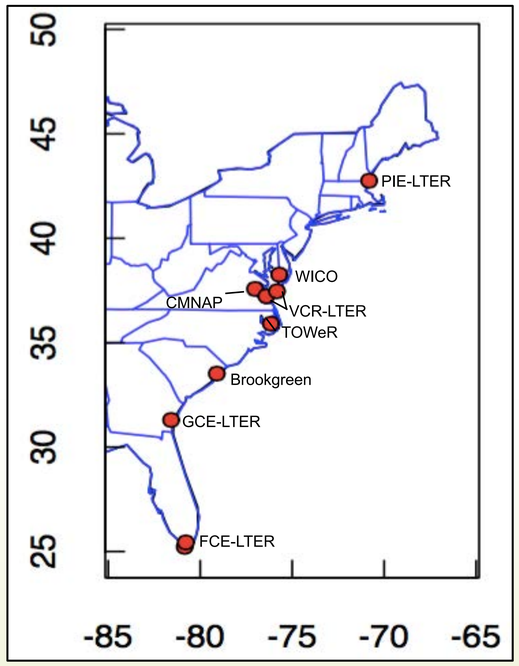
John Kominoski[1], Evelyn Gaiser[1], Tiffany Troxler[1], Shelby Servais[1], Ben Wilson[1], Viviana Mazzei[1], Sean Charles[1], Laura Bauman[1], Michael Kline[1], Michelle Robinson[1], Kristina Morales[1], Marco Fernandez[1], Carlos Coronado[2], Steve Kelly[2], Fred Sklar[2], Joe Stachelek[2], Steve Davis[3], David Rudnick[4], Dong Yoon Lee[5], Scott Neubauer[5], Chris Craft[6], Sarah Widney[6], Ellen Herbert[6], Dontrece Smith[7], Merryl Alber[7], Steve Pennings[8]

[1]Florida International University & FCE-LTER, [2]South Florida Water Management District, [3]Everglades Foundation, [4]Everglades National Park, [5]Virginia Commonwealth University, [6]Indiana University, [7]University of Georgia & GCE-LTER, [8]University of Houston

Research Questions

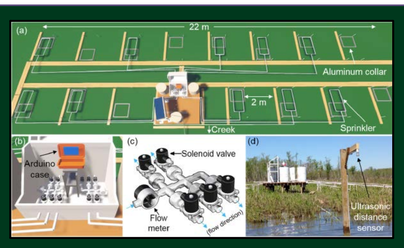
Reduced freshwater flows and sea level rise are increasing salinity in many coastal marshes, which can affect the balance between plant growth and plant and soil decomposition. As growth declines, relative to decomposition, marshes become vulnerable to overwash and destruction. *Many long-term research sites along the Atlantic Coast are experiencing and experimenting with changes in salinity*.

- How does increasing salinity due to sea-level rise and drought differentially affect net ecosystem productivity [NEP = gross primary productivity (GPP) – ecosystem respiration (ER)] in coastal wetlands along a latitudinal gradient?
- How do tidal and seasonal changes in water interact with saltwater intrusion to affect biogeochemical cycling and carbon loss in coastal wetlands?
- Which coastal regions are most vulnerable ecologically to changes in salinity with sea-level rise?



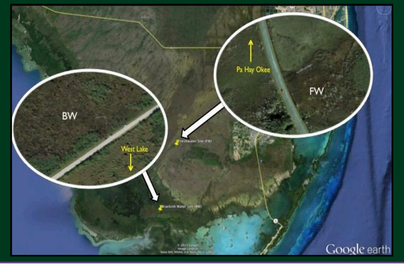
Massachusetts: Plum Island Ecosystem (PIE-LTER); Maryland: Wimico River (WICO); Virginia: Virginia Coastal Reserve (VCR-LTER), Cumberland Marsh Natural Area Preserve (CMNAP); North Carolina: Timberlake Wetland Restoration (TOWeR); South Carolina: Brookgreen; Georgia: GCE-LTER; Florida: FCE-LTER.

Field experiments at Cumberland Marsh Natural Area Preserve (CMNAP), Virginia, USA (Lee et al. 2016 Wetlands)



Seawater Addition Long Term Experiment (SALTEx), a field experiment, GCE-LTER, Altamaha River Estuary, Georgia, USA

Peat Collapse & Saltwater Intrusion, field & mesocosm experiments, FCE-LTER, Everglades National Park, Florida, USA



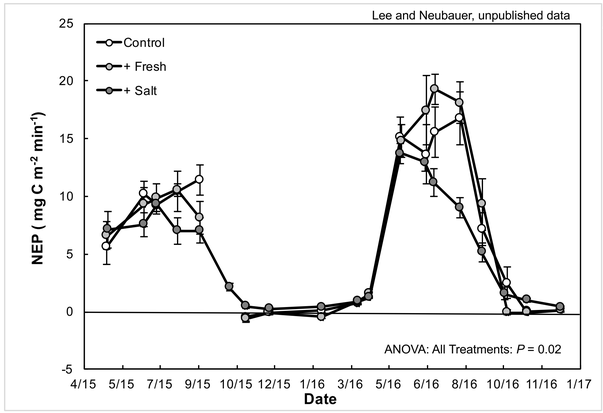
Drought in experimental field sites at FCE-LTER, Everglades National Park, Florida, USA

Peat collapse is likely due to drought-salinity interactions at FCE-LTER, Everglades National Park, Florida, USA

Salinity dosing in the field, FCE-LTER, Everglades National Park, Florida, USA

Salinity dosing in mesocosms, FCE-LTER, Everglades National Park, Florida, USA

Results

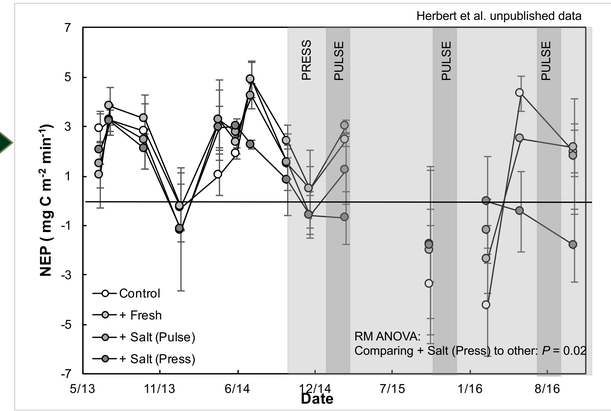


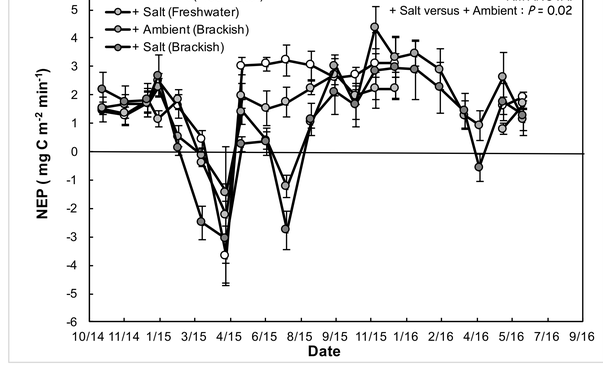
CMNAP, Virginia

- Strong seasonal peaks in NEP in a freshwater tidal marsh in summer
- Salinity attenuates summer NEP via similar reductions in GPP and ER.
- Effects were detected after one year of treatment.

GCE-LTER, Georgia

- Pressed—but not pulsed—salinity decreases NEP in a river floodplain tidal freshwater marsh.





FCE-LTER, Florida

- Salinity decreases NEP in freshwater (FW) and brackish water (BW) marshes during drought (greater declines in BW than FW).

Conclusions

- Tidal freshwater marshes in temperate latitudes have higher but stronger seasonal variability in NEP than subtropical freshwater marshes.
- Low temperatures reduce NEP to near zero, whereas drought reduces NEP below zero (carbon loss).
- Both GPP and ER are inhibited by salinity, whereas drought increases ER.
- Further understanding of how plant-soil-water chemistry drive differential responses to salinity in coastal wetlands is needed.

This material is based upon work supported by the National Science Foundation through the Florida Coastal Everglades, Georgia Coastal, Virginia Coastal Reserve, and Plum Island Ecosystem Long-Term Ecological Research programs under Cooperative Agreements #DEB-1237517, #DBI-0620409, #DEB-9910514, #OCE-9982133, #OCE-0620959, #OCE-1237140, #DEB-1237733, #OCE-1058747, #OCE-1238212, #OCE-1637630. Any opinions, findings, conclusions, or recommendations expressed in the material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.