Greenhouse gas emissions may correlate with soil stability in salt marshes behind shoreline oyster shell formations

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Background

- Salt marshes are carbon (C) sinks, offsetting natural methane (CH_4) and carbon dioxide (CO_2) emissions
- Changes to hydrology influence inundation frequency and alter sulfate inputs from sea water, both of which impact greenhouse gas (GHG) emissions
- Oyster rakes are large shell accumulations along marsh edges that rise above sea level
- Uncertainty remains regarding the impact of oyster rakes on tidal regulation and their potential influence on wetland stability and GHG dynamics

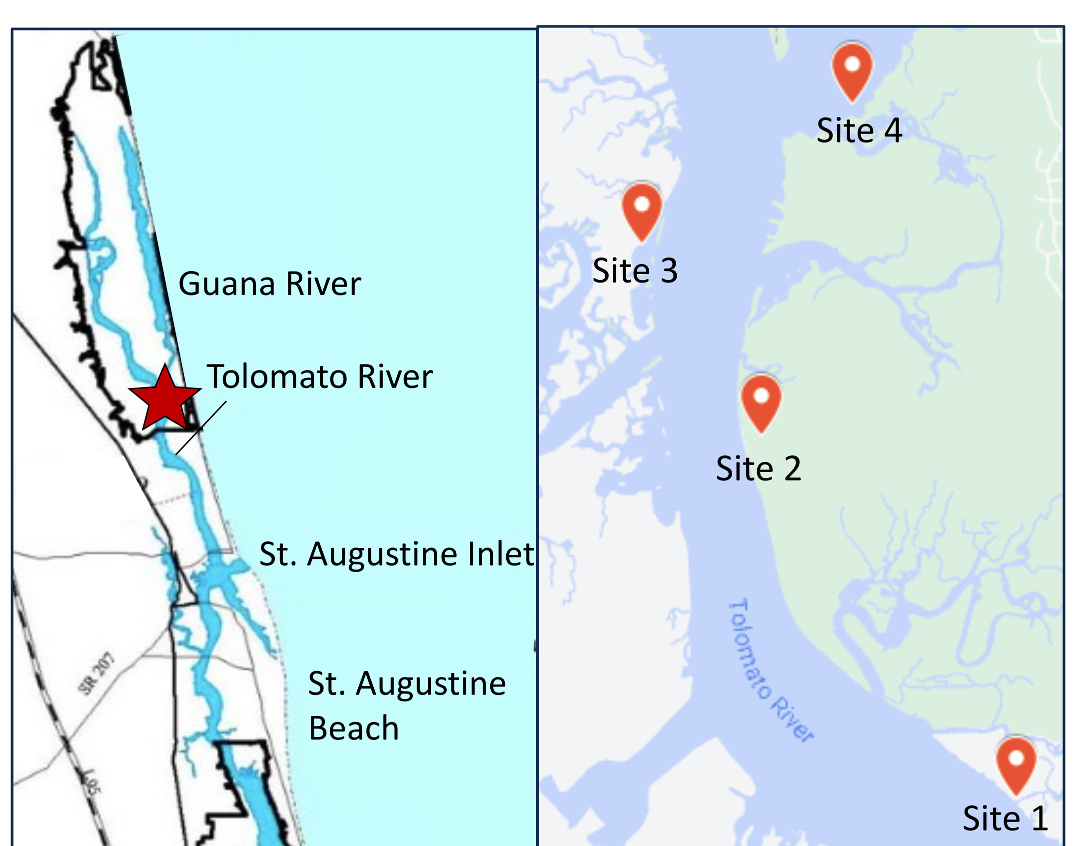
Questions

- Do GHG emissions differ between stable and unstable plots in marshes behind oyster rakes?
- Do plant traits and porewater chemistry alter GHG emissions in stable and unstable plots?

Methods

Site Location in GTMNEER

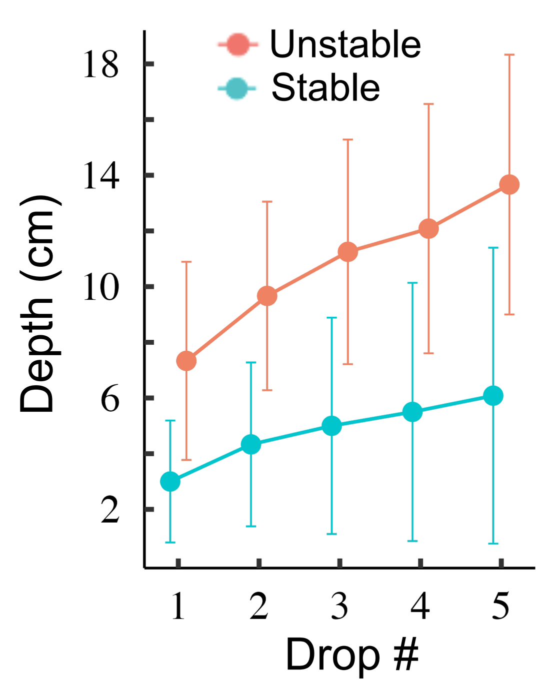
Sites 1 & 2 measured in July
Sites 2 & 4 measured in October

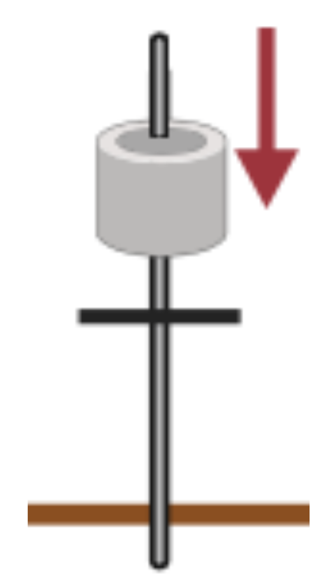


Block Design
Stable Unstable

Additional measurements:

– Estimation of plant biomass
– Porewater sulfate at depth





Soil stability via penetrometer

Estimation of soil compaction (Pascals, Pa) across depth obtained through five drop tests per plot using a standardized weight and drop height

GHG flux measurements

CO_2 and CH_4 emissions were measured within each plot

GHG Source	Method or Chamber type
Ecosystem	Clear chamber
Soils	Dark PVC chamber
Plants	Estimated (ecosystem - soils)

Results

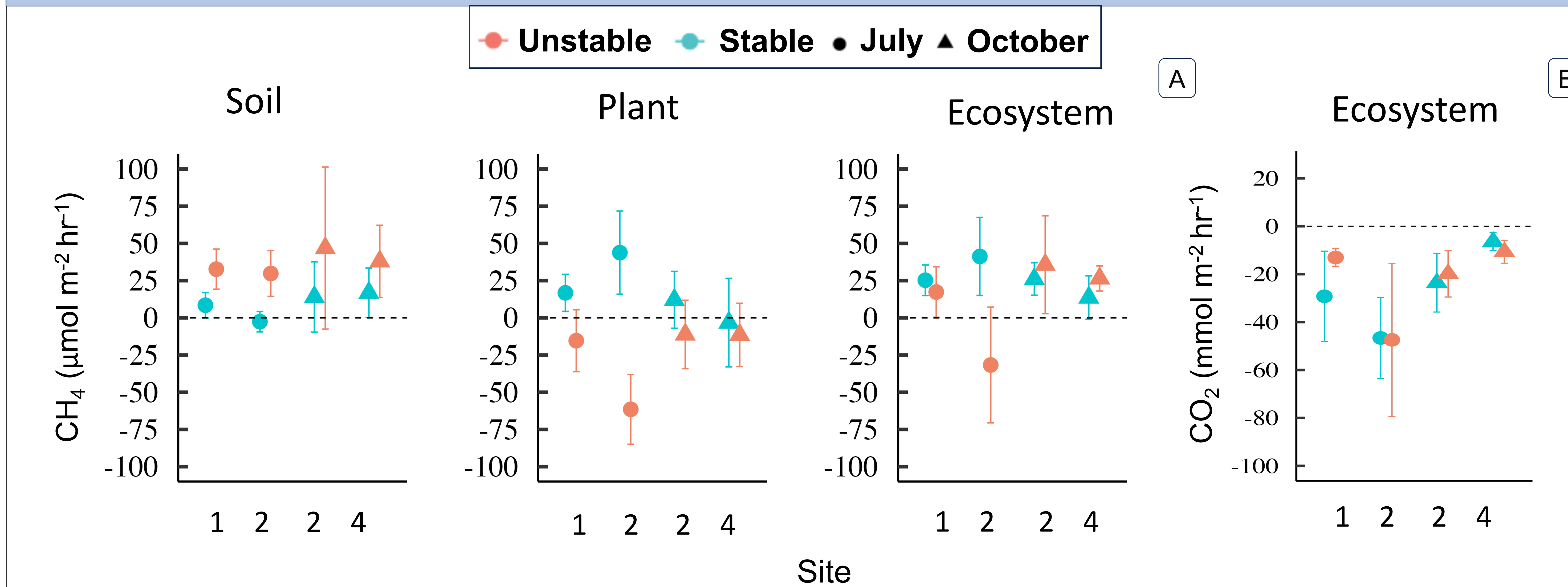


Figure 1: Greenhouse gas emissions behind oyster rakes in stable and unstable plots across different sites and time points. A) CH_4 emission rates for soils, plants, or ecosystems (soil + plants). B) CO_2 emission rates for whole ecosystem (soil + plants). Stable plots appear to be driven by plant CH_4 emissions and unstable plots appear to be driven by soil CH_4 emissions.

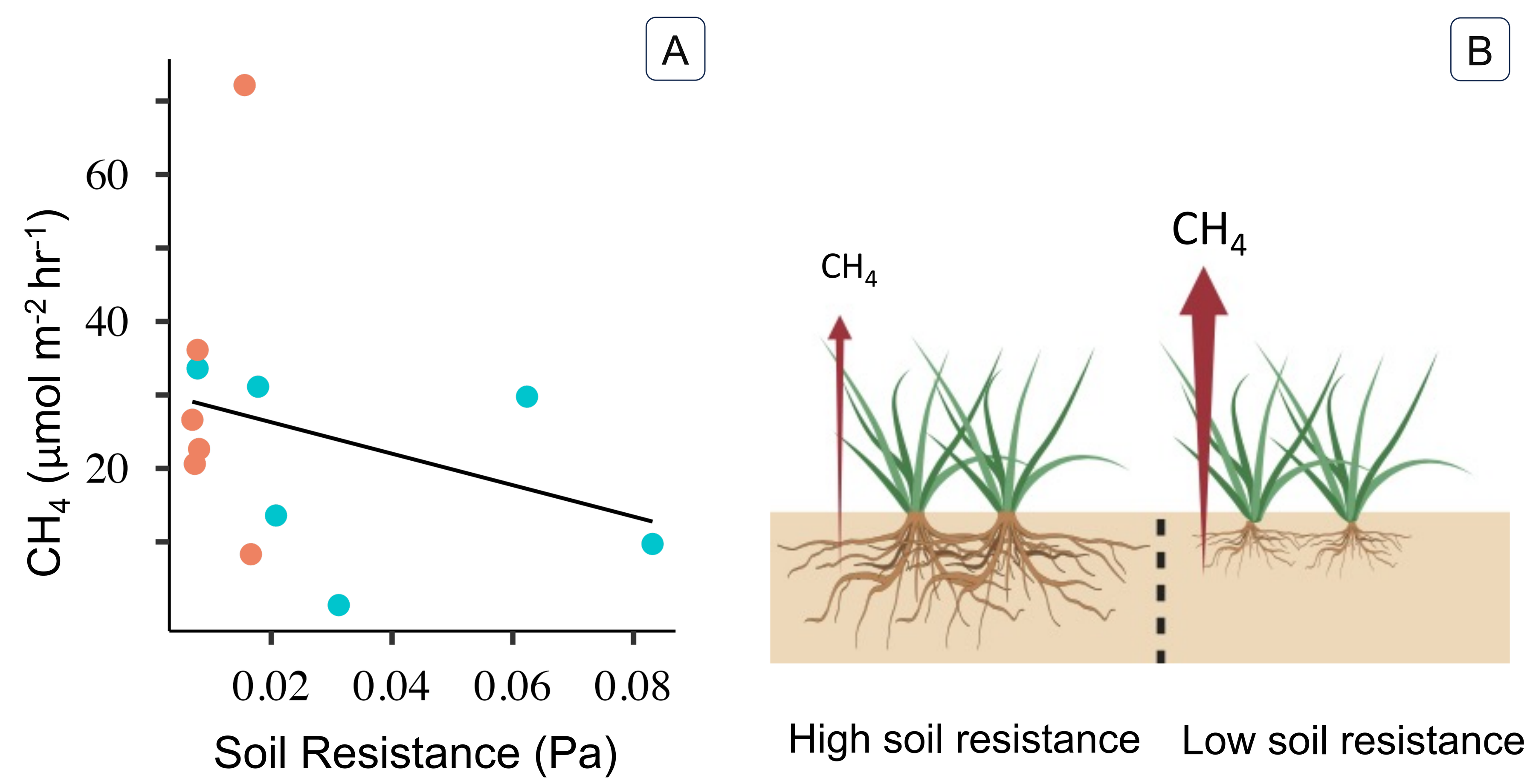


Figure 2: Soils with lower stability may emit greater CH_4 emissions. A) Relationship between CH_4 emissions and soil stability (p= 0.077, R^2=0.096). Soil resistance was measured in October at sites 2 and 4. CH_4 emissions represent a whole ecosystem flux. B) Schematic illustrating the relationship between soil resistance and CH_4 emissions.

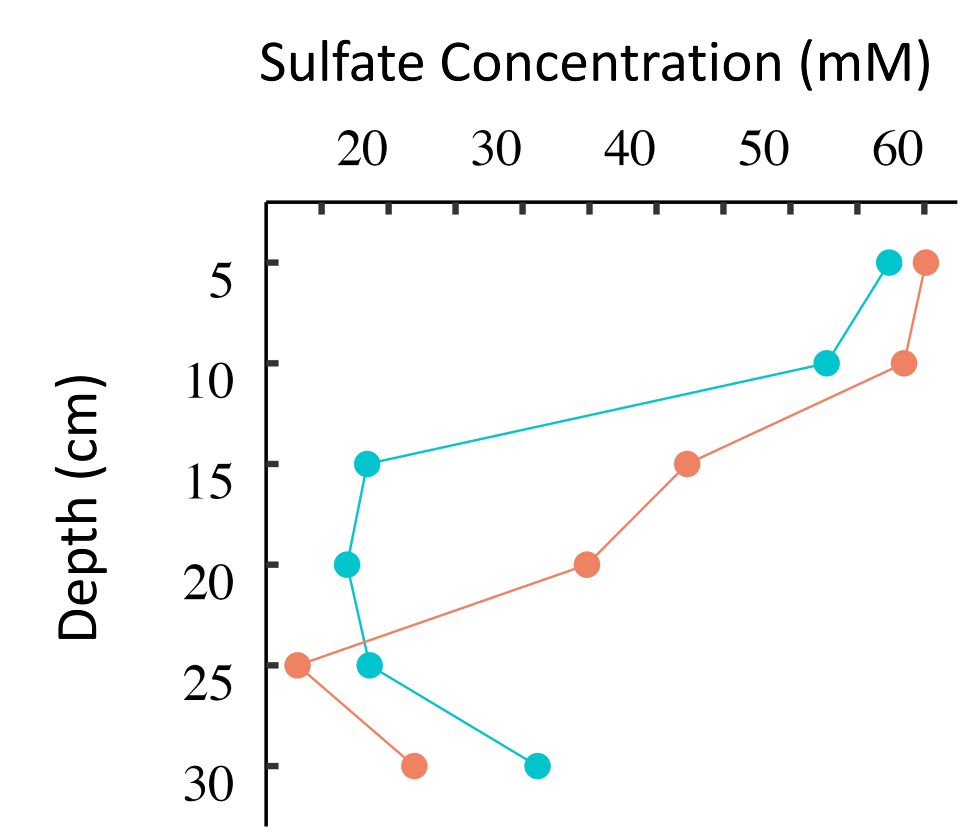


Figure 3: Porewater sulfate concentrations in stable plots may show a more dramatic decrease within the root zone (5-15 cm). Figure illustrates porewater sulfate concentrations at depth in stable and unstable plots. Samples were taken in October from sites 1 and 2.

Conclusions and Relevance

- Stable plots appear to be driven by plant CH_4 emissions
- Unstable plots appear to be driven by soil CH_4 emissions.
- Soil stability may serve as an indicator of GHG emissions
- Porewater sulfate may elucidate differences in GHG cycling
  - Hydrological cycling
  - Plant effects

Funding & Acknowledgements

Tess Adgie, Shannon Brew, Jocelyn Bravo, Aaron Freeman, Philip Rivera, Alia Al-Haj, the WE~ECO lab, the WETFEET lab