Greenhouse Gas Soil Emission Fluxes in a south Texas Coastal Saltmarsh

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Background/Introduction

Estuarine riparian plant communities and associated sediments have an important role in providing valuable ecosystem services along the coast. Among the many ecosystem services provided, estuarine ecosystems maintain shoreline stabilization, provide nursery habitats for commercially important and threatened species, are Blue Carbon sinks and sequester nutrients. Along the south Texas coast, Black Mangrove (*Avicennia germinans*) stands coexist with herbaceous halophytes (e.g. *Batis Maritima*) and mudflats (cyanobacterial mats) usually in well-defined zone sequences perpendicular to the water edge. Greenhouse gas emissions from these zones may vary due to distinct plant biomass and soil flooding patterns.

Objective

This study aims to quantify fluxes of soil emissions of the greenhouse gases, Carbon Dioxide (CO_2) and Methane (CH_4), emitted from the Mangrove, Batis and Mudflat zones.

Methods

- Study site: mangrove stand at Boca Chica, TX (25°59'47"N/97°10"46"W)
- Direct, short-term, measurements of CH_4 and CO_2 gases emitted from soil using an Ultraportable Greenhouse Gas (UGGA) analyzer taken at *in-situ* field chambers placed at each of the sampling zones (Fig.1)
  - Mangrove (*Avicennia germinans*)
  - Herbaceous halophytes (*Batis maritima*)
  - Mud (unvegetated)
- Soil fluxes measured in 6 transects and 6m apart within distinct habitat zones (Fig. 2)
- Sampling 4 dates over a period of 3 months
- Fluxes calculated using the linear phase slope (21 to 105s) and subtracting fluxes measured from vegetation clippings (aboveground *B. maritima* and pneumatophores):
  - Flux = total gas molecules x gas emission rate (CH_4 or CO_2)
- One-way repeated measures ANOVA: *Batis* vs. Mangrove

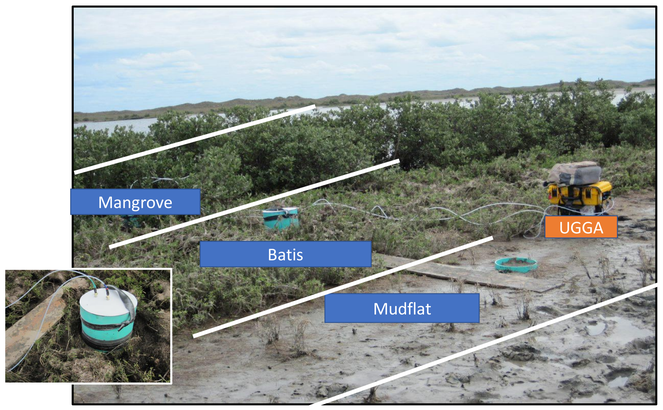

Figure 1: Study site habitat zones at Boca Chica, TX., and custom chamber

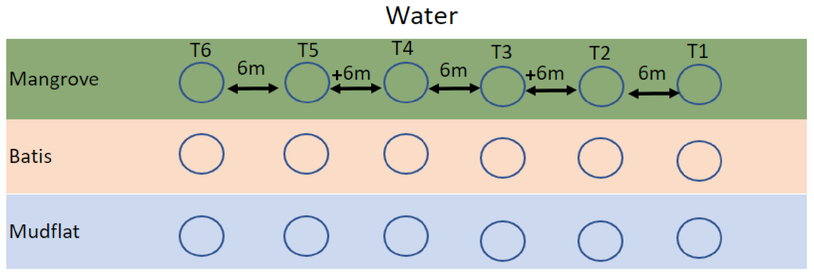

Figure 2: Chamber base collars at each habitat zone throughout Transects 1-6 perpendicular to the water edge.

Results

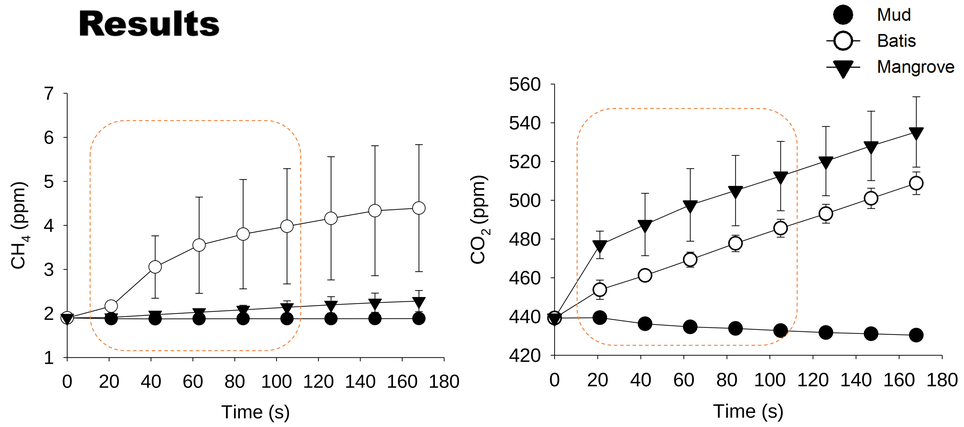

Figure 3: Time course of CH_4 and CO_2 concentration during a measurement cycle in soil chambers at three zones: Mud, *Batis*, Mangrove (n=6). Flux calculations used the linear fit line slopes for time 21-105s (indicated by the orange rectangle).

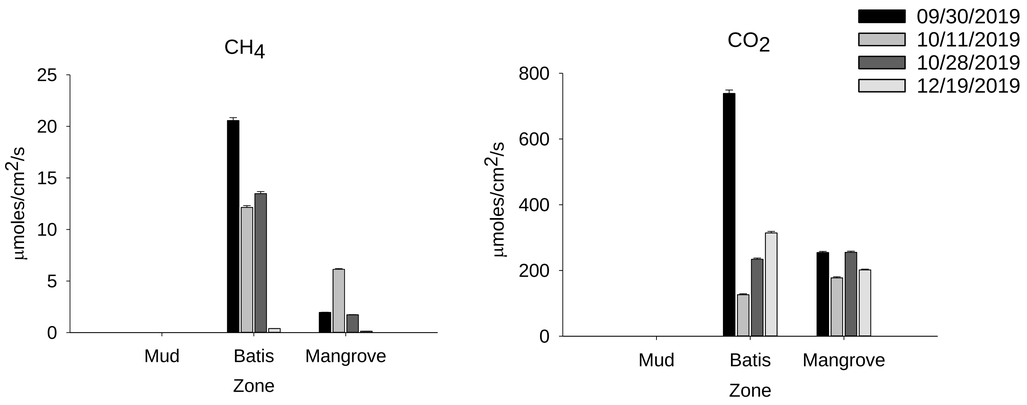

Figure 4: Net soil fluxes (= total emissions – plant emissions) of CH_4 and CO_2 at the three zones during 4 sampling dates.

Results *(continued)*

- Mud zone did not have CH4 or CO2 emissions greater than atmospheric values (Fig 3)
- Vegetated zones have net emissions of greenhouse gases
- Higher fluxes trends in herbaceous vegetation zone were observed, compared to the mangrove zone (Fig 4)
- Considerable temporal variability was observed in soil fluxes

Conclusions/Recommendations

- In estuarine habitats, mud flats have no net emissions of greenhouse gases and may be a net Carbon (C) sink
- Vegetated zones are known to be net sinks of C, nonetheless their soils also emit CH_4 and CO_2
- The macroinvertebrate community such as fiddler crabs' habitat preference may also account for the observed differences in greenhouse gas fluxes; further investigation is needed.
- Environmental conditions to be monitored include tidal flooding as it may slow the process of soil organic matter mineralization and rates thus, influencing fluxes of CO_2 and CH_4.
- Future work should also incorporate pore water salinity measurements as it is known to influence soil CH_4 emissions at salinities >18 ppt (Poffenbarger et. al., 2011)

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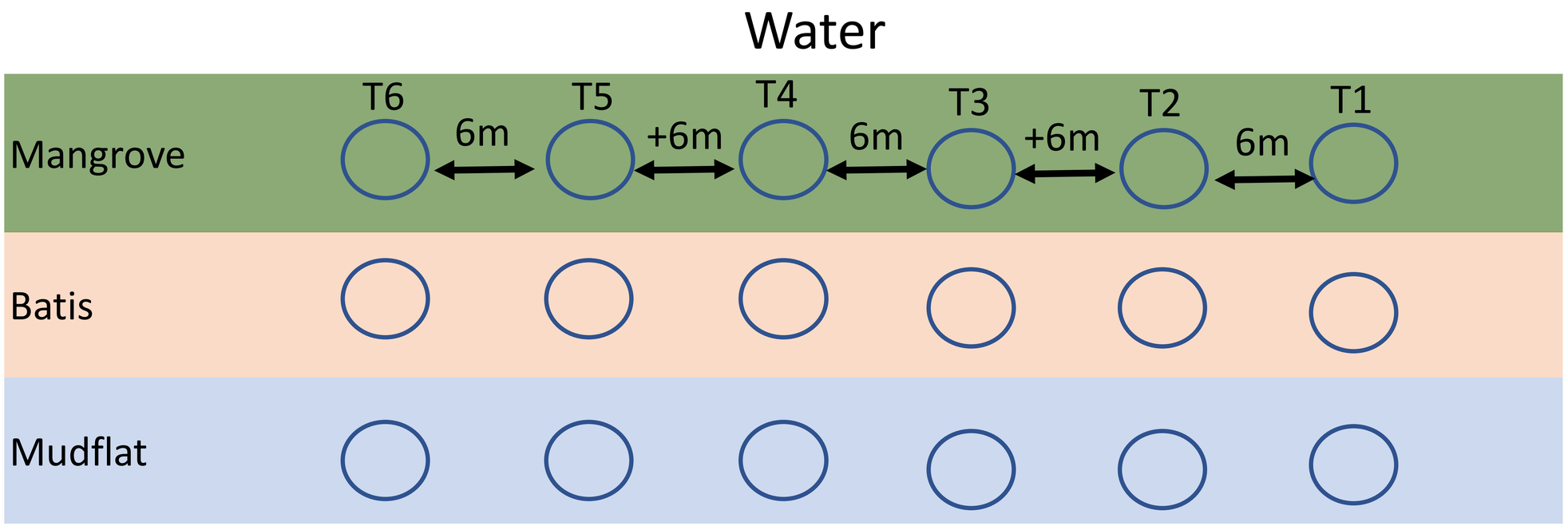
Water
Mangrove
T6
6m
T5
+6m
T4
6m
T3
+6m
T2
6m
T1
Batis
Mudflat