FCE ASM 2014

BIOGEOCHEMICAL CYCLING WG

Co-Leads: John Kominoski, Steve Davis

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CENTRAL QUESTIONS

GOAL II (Carbon): Determine how the balance of fresh and marine water supplies to the oligohaline ecotone, by influencing P availability, water residence time, and salinity will control the rates and pathways of C sequestration, storage, and export.
CENTRAL QUESTIONS

GENERAL QUESTION 1: How does the balance of fresh and marine water supply to the oligohaline ecotone influence microbially-mediated C and nutrient cycling in soils and water?
HYPOTHESES

Hypothesis 1.1: The balance of fresh and marine water supplies influences microbially-mediated C and nutrient cycling in wetland soils through interacting effects on P availability, salinity, and water residence time, culminating in gains or losses in C storage.

Hypothesis 1.2: The balance of marine and freshwater supplies of dissolved organic carbon (DOC) to Everglades estuaries will determine bioavailability for bacterioplankton and the microbial loop.
How does the balance of fresh and saltwater influence coastal wetland dynamics?

**Drivers**
- P
- Salt
- Hyd
- Other Nuts
- T
- Disturb

**Structural Attributes**
- Soil Microbes
- Peri

**Functional Attributes**
- Plants
- Consumers

**Metabolism**
- R
- GEE
- NEE
- NPP

**C storage**
- AG
- BG
- Soil
- Other

**Landscape pattern and morphology**
- Marsh elevation

**Efficiency**
- C/NUE

**BGC Cycles**
How does the balance of fresh and saltwater influence coastal wetland dynamics?

**DRIVERS**

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**Structural Attributes**

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**Functional Attributes**

**Metabolism**

- R
- NEE
- GEE
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**C storage**

- AG
- BG
- Soil
- Other

**Lead investigator(s):**

Chamber, Troxler, Davis, Scinto, Boyer, Downey-Wall

**Question:** 1) How do salinity and inundation control soil microbial respiratory losses of carbon and nutrient mineralization?
## RESULTS

Inundation $\uparrow$ NH$_4^+$, salinity $\uparrow$ SRP

<table>
<thead>
<tr>
<th>Water level–salinity</th>
<th>DOC (mg l$^{-1}$)</th>
<th>NO$_3^-$ (mg l$^{-1}$)</th>
<th>NO$_2^-$ (mg l$^{-1}$)</th>
<th>NH$_4^+$ (mg l$^{-1}$)</th>
<th>SRP (mg l$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control–ambient</td>
<td>14.8 ± 1.6</td>
<td>1.65 ± 0.27</td>
<td>0.26 ± 0.05</td>
<td>141.6 ± 57.0</td>
<td>7.2 ± 2.3</td>
</tr>
<tr>
<td>Control–elevated</td>
<td>12.0 ± 2.9</td>
<td>1.29 ± 0.13</td>
<td>0.27 ± 0.06</td>
<td>140.9 ± 67.1</td>
<td>8.6 ± 3.7</td>
</tr>
<tr>
<td>Inundated–ambient</td>
<td>18.4 ± 4.2</td>
<td>1.51 ± 0.23</td>
<td>0.27 ± 0.08</td>
<td>211.7 ± 89.9</td>
<td>8.5 ± 3.0</td>
</tr>
<tr>
<td>Inundated–elevated</td>
<td>17.5 ± 5.0</td>
<td>1.26 ± 0.22</td>
<td>0.32 ± 0.13</td>
<td>287.7 ± 78.5</td>
<td>12.0 ± 3.0</td>
</tr>
</tbody>
</table>

Chambers et al. 2013
RESULTS

Salinity ↑ inundation ↓ CO₂-C flux

Chambers et al. 2013
How does the balance of fresh and saltwater influence coastal wetland dynamics?

**Lead investigator(s):** Chamber, Troxler, Davis, Scinto, Boyer, Downey-Wall

**Question:** 1) How do salinity and inundation control soil microbial respiratory losses of carbon and nutrient mineralization?
How does the balance of fresh and saltwater influence coastal wetland dynamics?

**DRIVERS**
- P
- Salt
- Hyd
- Other Nuts
- T
- Disturb

**Structural Attributes**
- Soil Microbes
- Peri
- Consumers

**Functional Attributes**
- Plants

**Metabolism**
- R/ER
- NEE
- GEP
- NEP
- C storage
  - AG
  - BG
  - Soil
  - Other

**Lead investigator(s):** Servais, Pachón, Davis, Gasier, Troxler, Kominoski

**Question(s):**
1) How do plant-soil interactions mediate storm impacts on coastal C loss?
2) P and mangrove defoliation affect plant-soil nutrients, soil C loss, and microbial enzyme production in mangrove peat soils?
3) P and soil R influence aquatic NEP?
Marine Storms: $P \times$ Mangrove Stress

- Added $P$
- Rod for soil redox potential
- Mesh to prevent soil loss
- Collar for gas flux chamber
- Porewater “sipper”
RESULTS

Added P ↓ porewater C:P by 150-300×

<table>
<thead>
<tr>
<th>Condition</th>
<th>C:P initial</th>
<th>C:P final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient P + No Stress</td>
<td>4359.5 (2120.4)</td>
<td>691.8 (650.6)</td>
</tr>
<tr>
<td>Ambient P + Stress</td>
<td>3983.9 (4384.9)</td>
<td>1509.8 (2732.1)</td>
</tr>
<tr>
<td>Elevated P + No Stress</td>
<td>4541.1 (3115.8)</td>
<td>15.2 (21.3)</td>
</tr>
<tr>
<td>Elevated P + Stress</td>
<td>1490.1 (959.1)</td>
<td>9.4 (10.5)</td>
</tr>
</tbody>
</table>

C = DOC, P = SRP; molar ratios
High internal P cycling reduces heterotrophic P demand
Stress increases P demand by plants and soils
RESULTS

Added P $\uparrow$ variance in soil C losses

Plant stress $\downarrow$ soil C losses

Servais, Kominoski et al., in prep
RESULTS

P × light ↑ periphyton-soil respiration

Servais, Kominoski et al., in prep
Florida Coastal Everglades
Long Term Ecological Research

RESULTS

P \uparrow \text{aquatic GEP}

![Phosphorus and No Phosphorus GEP](A:Absent, B:Present)

Servais, Kominoski et al., in prep
RESULTS

P↑ aquatic GEP, soil respiration ↑ aquatic ER

Servais, Kominoski et al., in prep
RESULTS

P ↑ aquatic NEP, soil respiration ↓ aquatic NEP

Servais, Kominoski et al., in prep
How does the balance of fresh and saltwater influence coastal wetland dynamics?

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Biogeochemical effects of simulated sea level rise on carbon loss in an Everglades mangrove peat soil

Lisa G. Chambers · Stephen E. Davis · Tiffany Troxler · Joseph N. Boyer · Alan Downey-Wall · Leonard J. Scinto
MAJOR MILESTONES

FIU-SFWMD-ENP Collaborative Grant
Troxler, Coronado, Davis, Gaiser, Kelly, Kominoski, Madden, Sklar, Stachelek. NOAA, Florida Sea Grant ($279,216)

“The effects of projected sea-level rise on Everglades coastal ecosystems: Evaluating the potential for and mechanisms of peat collapse using integrated mesocosm and field manipulations.”
MAJOR MILESTONES

Pachón, J. (REU 2013) awarded Society of Wetland Scientists Mentoring Award to present at 2014 Joint Aquatic Sciences Meeting, Portland, Oregon.
How does your group achieve synthesis?
Weekly “science development” meetings with 5 FCE graduate students that aim to synthesize plant, soil microbe, and periphyton responses to SLR, storms and overall wetland C.

Integrating microcosm-, mesocosm-, and field-level research that build on previous and contributes understanding of marine and freshwater impacts on coastal wetlands.

Integrating long-term water nutrients, DOC, and plankton community dynamics in Florida Bay.
3rd YEAR REVIEW

What does the group need to accomplish by the 3rd year review in 2015?

P × Stress 2013 Mesocosms:
- Periphyton-soil interactions with added P (fall 2014)
- Soil microbial community and enzymes (fall 2014)

Salinity × P mesocosms with sawgrass peats (summer 2014)

P periphyton collapse mechanistic experiments (spring 2014)

SeaGrant salinity pilot and experiment (spring 2014)

Florida Bay plankton time series (spring 2014)

What are the steps to getting there? Graduate students and database centralization

Are there any major data needs? Update and centralize data
DISCUSSION POINTS

What are some of the issues that need to be addressed in breakouts?
Florida Bay plankton productivity

What are integrative research needs and how can we attain them?
Propose to analyze Florida Bay time series and link DOC, C:nutrients, and salinity with plankton enzymatics

Are further working group workshops necessary? Not yet, but likely next year’s ASM