Energy partitioning and sensitivity to low temperature events of Everglades wetlands

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Wetlands Have a Great Potential for Carbon Sequestration

- Slow decomposition and C accumulates over long time periods
- Representing just 5-8% land cover, wetlands contain ~68% soil C
- The stability of this large C pool is uncertain due to human influence and climate change
Subtropical Wetland Ecosystem

- **Average Maximum Daily**
- **Average Minimum Daily**

1380 mm yr$^{-1}$
Hydrology is the most important factor for wetland structure and function, including energy partitioning.

\[ R_n = H + LE + G_w + G_{w+S} \]

- **R\(_n\)**: Net Radiation
- **H**: Sensible Heat
- **LE**: Latent Energy
- **G\(_w\)**: Energy stored in water
- **G\(_s\)**: Energy Stored in the soil column

**Water Cycle**

**Wet Season**

**Dry Season**
Marl Taylor Slough
- Short-hydroperiod marsh
- Flooded 4 to 6 months
- Shallow marl soils

Shark River Slough
- Long-hydroperiod marsh
- Flooded ~12 months
- Peat soils

Freshwater Marsh
Bowen Ratio ($\beta$): sensible heat / latent heat

- $\beta$ seasonality increases with variation in hydroperiod.
- The $\beta$ was higher during the dry season when the amount of energy partitioned to the H flux increased.
Historical frequency (days) of low-temperature events (< 5 °C) in Everglades National Park (1950–2012).

<table>
<thead>
<tr>
<th>Station</th>
<th>Event frequency</th>
<th>Mean annual frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everglades (EVG)</td>
<td>476</td>
<td>7.8</td>
</tr>
<tr>
<td>Royal Palms Ranger Station (RPR)</td>
<td>404</td>
<td>8.4</td>
</tr>
<tr>
<td>Flamingo (FLG)</td>
<td>333</td>
<td>5.5</td>
</tr>
<tr>
<td>Tavernier (TAV)</td>
<td>37</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>313</strong></td>
<td><strong>5.9</strong></td>
</tr>
</tbody>
</table>
Average temperature during the low temperature days in 2010
Mangroves

Short-hydroperiod

Long-hydroperiod

National Climatic Data Center (NCDC) long-term weather data sets (1950-2012)
Short-Hydroperiod Freshwater Marsh

Long-Hydroperiod Freshwater Marsh

Mangrove Forest

NEE (g CO₂ m⁻² yr⁻¹)
Sensitivity

- A reduction in CO$_2$ exchange rates
Different sensitivities of CO$_2$ fluxes to low-temperature events

Short- and long-hydroperiod marsh

Mangroves

NEE
Conclusion

• Seasonal hydrological pattern controls ecosystem energy partitioning and further determines the frequency and intensity of low-temperature

• Where low-temperature events are less frequent (mangrove), there is an increase in NEE (greater CO$_2$ loss).
More frequent extreme events
Ecosystem carbon balance