Carbon Cycling in a Big Cypress National Preserve Marsh

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Photo taken by Patrick Lynch (SFWMD)
Measurement of ET in Big Cypress National Preserve, South Florida
Acknowledgements

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Hensen Marsh
• Measures ET and CO₂
• Net radiation
• Solar radiation
• Rainfall
• Surface/groundwater stage
• Ground-water temperature
• Surface-water temperature
• Air temperature
• Relative humidity
• Soil temperature
• Soil heat flux

Photo taken by Patrick Lynch (SFWMD)
EDDY CORRELATION METHOD
Most direct measurement of turbulent flux

• Flux depends on vertical speed and concentration of all eddies.
• Measure vertical wind-speed ($w$) and vapor density ($\rho_v$) rapidly (10 times per second) at a point → Statistically significant sample.
• Vapor flux ($E$) = covariance of $w$ with $\rho_v$:

$$E = \overline{w'\rho_v'}$$

where overbars are 30-min means, primes' are rapid deviations from means.

• Sensible heat flux ($H$) = covariance of $w$ with temperature ($T$):

$$H = \rho C_P \cdot \overline{w'T'}$$

where $\rho C_P$ is volumetric specific heat capacity of air.

Modified from Standard (2000)
Carbon Dioxide (CO2) Measurements

Using LICOR-7500 gas analyzer
Turbulent flux of water vapor

Modified from Standard (2000)
Carbon Dioxide (CO2) Measurements

These data are preliminary and have not received peer-review and USGS approval for publication
**Biomass**: total dry-mass of the plants \([\text{M}] \text{ (g)}\)

**Primary Production**: total plant-biomass per unit area \([\text{ML}^{-2}] \text{ (g m}^{-2}\)\)

**Productivity**: rate of production \([\text{ML}^{-2}\text{T}^{-1}] \text{ (g m}^{-2} \text{ year}^{-1}\)\)

**Gross Ecosystem Productivity (GEP)**: gross plant productivity. Excludes respiration by the plants.

**Ecosystem Respiration (ER)**: plant and soil respiration

**Net Ecosystem Productivity (NEP)**: net amount of carbon uptake by the ecosystem, including plants, soil and woody debris
Ecosystem Convention

\[ \text{+ flux is into ecosystem} \]
\[ \text{- flux is out of ecosystem} \]

\[ \text{GEP} = \text{NEP} + \text{ER} \]

Photo taken by Patrick Lynch (SFWMD)
Carbon Exchange

\[ \text{GEP} = \text{NEP} + \text{ER} \]
## Annual Totals

\[
\text{NEP} = \text{GEP} - \text{ER}
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>GEP (g C m(^{-2}))</th>
<th>ER (g C m(^{-2}))</th>
<th>NEP (g C m(^{-2}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>905</td>
<td>783</td>
<td>125</td>
</tr>
<tr>
<td>2009*</td>
<td>610</td>
<td>645</td>
<td>-34</td>
</tr>
</tbody>
</table>

*missing November and December 2009
Net Ecosystem Production (NEP)
Future Work

Dwarf Cypress (55’ tower)

- Measures ET
- Net radiation
- Solar radiation
- Rainfall
- Wind speed and direction
- Surface/groundwater stage
- Ground-water temperature
- Surface-water temperature
- Air temperature
- Relative humidity
- Sap flow (Bovard, FGCU)

Photo taken by Patrick Lynch (SFWMD)
Cypress Swamp (120’ tower)
- Measures ET
- Net radiation
- Solar radiation
- Rainfall
- Wind speed and direction
- Surface/groundwater stage
- Ground-water temperature
- Surface-water temperature
- Air temperature
- Relative humidity
- Soil temperature
- Soil heat flux
- Soil moisture
- Sap flow (Bovard, FGCU)

Future Work

Photo taken by Patrick Lynch (SFWMD)
Future Work

Pine upland (120’ tower)
- Measures ET
- Net radiation
- Solar radiation
- Rainfall
- Surface/groundwater stage
- Ground-water temperature
- Surface-water temperature
- Air temperature
- Relative humidity
- Soil moisture
- Soil temperature
- Soil heat flux
- Sap Flow (Bovard)

Photo taken by Patrick Lynch (SFWMD)
Conclusions

1. Site can be a carbon source or sink.
   \[ \text{NEP(Jan08 to Dec08)} = 125 \text{ g C m}^{-2} \]
   \[ \text{NEP(Jan09 to Nov09)} = -34 \text{ g C m}^{-2} \]

2. Air temp and hydro-period partly explain NEP variability.

Any questions? Email Barclay at bshoemak@usgs.gov

Photo taken by Patrick Lynch (SFWMD)
WISH US LUCK AND THANKS!

Pyranometer
Air Temperature Relative Humidity Probe
Net Radiometers