Reducing Uncertainty of Greenhouse Gas Fluxes from Mississippi River Delta Wetland Projects

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Outline of Topics

• Context of carbon in Louisiana wetlands
• Research questions
• Field results
• Future progress
Importance of coastal wetlands and carbon

Coastal wetlands are bioreactors

- **C-export**: fuels estuarine production

- **C-preservation**: drives soil formation to adjust for sea level rise

In Miss. R Delta...imbalance toward carbon loss
Carbon burial capacity: Louisiana coastal wetlands types are similar over the long-term

**Mature Coastal Wetland Soils in Louisiana**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil accretion (Cesium)</td>
<td>0.7 cm/yr</td>
</tr>
<tr>
<td>Soil carbon content</td>
<td>30 mg/cm³</td>
</tr>
<tr>
<td>C accumulation rate</td>
<td>200 g C/m²/yr</td>
</tr>
<tr>
<td></td>
<td>3 t/ac/yr CO₂e</td>
</tr>
<tr>
<td></td>
<td>7.3 t/ha/yr CO₂e</td>
</tr>
</tbody>
</table>

48 cores dated from Chenier and Delta Plains (Piazza et al. 2011)
Magnitude of wetland carbon loss
CO2 emissions equivalents:
Louisiana at 10,000 ac/yr

Loss of annual sequestration potential
missed opportunity to stem pollution from 1.2 M cars over 20 years

Loss from soil
25 cm of soil = 1.1 M cars
20 years = > 20 M cars
Impetus for carbon research

Market:
• wetland carbon has monetary value, voluntary offset markets

Restoration science:
• carbon established currency to assess ecosystem productivity
Measuring wetland carbon flows serve dual purposes

Restoration Science

**Wetland creation**
What is the pace of wetland development and the flow of ecosystem services?

**River diversions**
How does diversion operation influence wetland production and respiration?

Carbon Market Perspective

Monitoring and verification is well developed for forestry, not as much for wetlands.
There is a need to improve the science to reduce project monitoring cost.
CPRA’s Methodology for Coastal Wetland Creation (VM0024)

- 2014 CPRA’s methodology approval to develop voluntary wetland carbon projects
- Overall goal: use carbon finance to increase project penetration
- Designed for wetland creation project types that use dredged sediments
- In Louisiana, we have 25 MCY per year that can be more wisely used for wetland creation
- Nationwide, there are 200 MCY of dredged sediments each year
CPRA’s carbon research and monitoring
Research questions

1. How do carbon fluxes vary across a salinity gradient, most especially methane?
2. To what degree does river diversion operation, have an effect on wetland productivity and respiration?
3. What are carbon sequestration rates of natural and created wetlands?

Methods

- Landscape level fluxes of CO$_2$, H$_2$O, and CH$_4$ with eddy flux towers
- Chamber comparisons with USGS, also N$_2$O
Design helps to answer environmental, wetland age, and management factors

Factors
- Salinity
- Diversion

Created vs Natural

Locations
- Davis Pond  2 yr
- P. aux Chenes  1 yr
- Goose Point  1 yr
Question 1: What effect does salinity have on methane fluxes at the ecosystem level?
Comparison of methane fluxes freshwater and brackish (2012)

- 2012 river discharge was low through Davis Pond
- H. Issac influenced both sites with significant flooding
- Salinity at brackish site was 8-10 ppt
- Freshwater methane flux is twice is great
Comparison of ecosystem level fluxes with chamber fluxes across the salinity gradient

- Study by Poffenbarger et al. 2011 developed general predictive relationship of methane flux as a function of salinity (proxy for sulfate availability)

- Data were from static chambers across a range of tidal wetland habitats
Comparison of ecosystem level fluxes with chamber fluxes across the salinity gradient

- Semi-continuous, ecosystem level annual budget similar magnitude
- Louisiana wetlands are close to the mean, rather than outliers
- Methane emission at freshwater site exceeds long-term burial of carbon
- Salinity may become a more cost effective proxy than GHG monitoring

![Graph showing comparison of ecosystem level fluxes with chamber fluxes across the salinity gradient. The graph includes a linear regression equation: Log CH4 Flux = -0.0572x + 1.4179 and an R² value of 0.53. The data points are labeled Poffenbarger et al. Study and CPRA Study.](image-url)
Objective 2: How does river diversion affect methane fluxes?

Expected responses:

1. CH4: availability of iron, nitrogen, sulfate could reduce methane emissions

2. CO2: nutrient loading could increase soil respiration and/or increase plant productivity
Annual comparison of methane fluxes: Davis Pond diversion effects 2012 and 2013

Cumulative diversion discharge (m):
- Average discharge
- Low discharge

CH4 Measured and Predicted methane flux (umol/m²/s):
- 2012
- 2013

Graphs showing the comparison of methane fluxes and cumulative diversion discharge for 2012 and 2013.
## Diversion discharge does not have a suppressive effect on methane emissions

<table>
<thead>
<tr>
<th>Year</th>
<th>Cumulative diversion discharge by July (m)</th>
<th>Methane Annual Flux (g/m²/yr)</th>
<th>Methane Annual Flux GWP 21-25 (t CO₂-e/ac/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>21</td>
<td>63.0</td>
<td>5.4 - 6.4</td>
</tr>
<tr>
<td>2013</td>
<td>34</td>
<td>61.6</td>
<td>5.2 - 6.2</td>
</tr>
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</table>
Continuing Research, Created Wetlands
Other covariates for predicting carbon flux

- USGS (Krauss/Johnson) working on a multivariate analysis
- Evaluates the importance of:
  - salinity
  - water level
  - temperature
  - diversion operation
- High-freq data may be useful to build stronger relationships for ecosystem modeling and C-verification
Trajectory of soil carbon accumulation: Created wetlands

5 yr: Goose Point, Bayou Dupont
10 yr: Calcasieu
20 yr: LaBranche Wetlands
Acknowledgements

• CPRA: Rick Raynie, Chuck Killebrew, Jerome Zeringue, Kyle Graham
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• LDWF
• USFWS
• Apache
Further information on wetland carbon initiatives

- Perspectives of methodologies and carbon project development

- Jan-Feb 2014
  National Wetlands Newsletter
  “Coastal Blue Carbon”