Wetlands and Carbon Offsets: Setting Standards and to Support Restoration and Ecosystem Function

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Photo: Lisa Windham-Myers
Global efforts deliver improved management of coastal carbon including tradable offsets

- Reason for interest
- Strategy to deliver
- Achievements
  - IPCC
  - VCS Global Methodology for Coastal Wetland Restoration
  - Networks and science
- Project selection criteria
- Links to the Sacramento – San Joaquin Delta
- Next steps
## Greenhouse gases

<table>
<thead>
<tr>
<th>Gas</th>
<th>Current (1998) Amount by volume</th>
<th>Global warming Potential</th>
<th>Percent increase since 1750</th>
<th>Radiative forcing (W/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide (CO₂)</td>
<td>365 ppm</td>
<td>1</td>
<td>31%</td>
<td>1.46</td>
</tr>
<tr>
<td>Methane (CH₄)</td>
<td>1,745 ppb</td>
<td>21 (25, 34)</td>
<td>150%</td>
<td>0.48</td>
</tr>
<tr>
<td>Nitrous oxide (N₂O)</td>
<td>314 ppb</td>
<td>310</td>
<td>16%</td>
<td>0.15</td>
</tr>
</tbody>
</table>
Goal of Carbon Management

Figure 1. Four Hypothetical Baseline Scenarios that Illustrate the Net Positive Impacts of a Project

Source: Forest Trends
Goal of Estuary Restoration

Degraded Estuary

Decreasing Coping Range

Existing Coping Range

Time

Sustainable Estuary

Shifting Coping Range

Existing Coping Range

Time

Restoring Estuary

Increasing Coping Range

Existing Coping Range

Time
Ecosystems in focus for climate change mitigation

- Forest
- Peatland
- Mangroves
- Tidal Marshes
- Seagrass
Loss of biomes and carbon stocks.

Ongoing emissions
Examples from San Francisco Estuary

300,000 acres lost

200,000 acres lost
Estimating Global “Blue Carbon” Emissions from Conversion and Degradation of Vegetated Coastal Ecosystems

Linwood Pendleton¹, Daniel C. Donato²*, Brian C. Murray¹, Stephen Crooks³, W. Aaron Jenkins¹, Samantha Sifleet⁴, Christopher Craft⁵, James W. Fourquarean⁶, J. Boone Kauffman⁷, Núria Marbà⁸, Patrick Mgonegal⁹, Emily Pidgeon¹⁰, Dorothee Herr¹¹, David Gordon¹, Alexis Baldera¹²

Table 1. Estimates of carbon released by land-use change in coastal ecosystems globally and associated economic impact.

<table>
<thead>
<tr>
<th>Ecosystem</th>
<th>Global extent (Mha)</th>
<th>Current conversion rate (% yr⁻¹)</th>
<th>Near-surface carbon susceptible (top meter sediment+biomass, Mg CO₂ ha⁻¹)</th>
<th>Carbon emissions (Pg CO₂ yr⁻¹)</th>
<th>Economic cost (Billion US$ yr⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tidal Marsh</td>
<td>2.2–40 (5.1)</td>
<td>1.0–2.0 (1.5)</td>
<td>237–949 (593)</td>
<td>0.02–0.24 (0.06)</td>
<td>0.64–9.7 (2.6)</td>
</tr>
<tr>
<td>Mangroves</td>
<td>13.8–15.2 (14.5)</td>
<td>0.7–3.0 (1.9)</td>
<td>373–1492 (933)</td>
<td>0.09–0.45 (0.24)</td>
<td>3.6–18.5 (9.8)</td>
</tr>
<tr>
<td>Seagrass</td>
<td>17.7–60 (30)</td>
<td>0.4–2.6 (1.5)</td>
<td>131–522 (326)</td>
<td>0.05–0.33 (0.15)</td>
<td>1.9–13.7 (6.1)</td>
</tr>
<tr>
<td>Total</td>
<td>33.7–115.2 (48.9)</td>
<td></td>
<td></td>
<td>0.15–1.02 (0.45)</td>
<td>6.1–41.9 (18.5)</td>
</tr>
</tbody>
</table>

*Comparing to national emissions from all sources, Poland and Japan.
Wetlands Carbon Management: The Game Plan

• United Nations Framework Convention on Climate Change
  o Brief national climate change negotiators
  o Identify policy opportunities
  o Engage IPCC
  o International demonstration (e.g. GEF project)

• National Governments
  o Establish science research
  o Recognize wetlands in national accounting
  o Agency awareness, action, funding

• Local Demonstration and Activities
  o Landscape level accounting
  o Establish carbon market opportunities
  o Look for synergistic conservation benefits
  o Demonstration projects and public awareness

• Other Nations
  o Indonesia, Costa Rica, Abu Dhabi, Australia
Methodological Guidance for Coastal Wetlands in the 2013 SUPPLEMENT TO THE 2006 IPCC GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORIES: WETLANDS
1. Introduction
2. Cross cutting guidance on organic soils
3. Rewetting and restoration of organic soils
4. Coastal wetlands
5. Other freshwater wetlands
6. Constructed wetlands
7. Good practice and implications for reporting

Adopted by IPCC Oct 2013, Published Feb 2014
http://www.ipcc-nggip.iges.or.jp/
Wetlands Restoration and Conservation (WRC)
Adopted into Standard Oct 4, 2012
http://v-c-s.org/wetlands_restoration_conservation

Other Categories:
• Afforestation, Reforestation, Revegetation (ARR)
• Agricultural Land Management (ALM)
• Improved Forest Management (IFM)
• Reduced Emissions from Deforestation and Degradation (REDD)
Steps in Awarding Carbon Credits to Wetlands Projects

- **Standards** for project activities
  - General requirements and guidance for GHG accounting
  - Procedures for validation and verification
  - Registry and clearing house for ‘carbon credits’

- **Methodologies** are step-by-step explanations of how emission reductions or removals are to be estimated in line with the requirements following accepted scientific good practice

- **Project description** or design documents provide information on how a specific project complies with the requirements and applies the methodology
Example Project Activities Likely to be Covered by VCS Coastal Wetlands Restoration Methodology

- Rewetting of drained wetlands (dike breach, managed wetlands)
- Subsidence reversal (managed reed beds soil building)
- Restoring sediment supply
- Lowering of water levels on impounded wetlands
- Raising soil surfaces with dredged material
- Restoring salinity conditions
- Improving water quality
- Revegetation (marsh / forest / seagrass)
- Combinations of the above

**Status**
- Submitted Dec 2013
- Public Comments – March 14
- Validation review x 2
- Release mid-late 2014
- Peer review paper
- Translation for practitioners
Guiding Principles for Coastal Carbon Projects

• Carbon project development
• Coastal wetlands project experience
• Community engagement
• Linking to environmental policies and financing frameworks
• Global case studies

Report for the United Nations Environment Programme
Due for Release at SBSTA June 2014.
Priorities for site selection

- Economies of scale
  - Typically forestry projects are 10,000 ha+ in size
  - Some fixed costs irrespective of size but returns scale dependant
  - Capacity to plan at landscape scale and allow for change
  - Potential for aggregation of "like" smaller projects
Priorities for site selection

• High relative net GHG benefits
  o Avoided emissions: $\text{CO}_2$, $\text{N}_2\text{O}$, $\text{CH}_4$
  o High C sequestration: e.g., forested tidal wetlands, subsidence reversal
Priorities for site selection

- Financial fitness
  - Funding for planning, design and construction
  - Stacking of credits?
    - Carbon
    - Nitrogen?
    - Conservation?
    - Water?
    - Flood?
Priorities for site selection

- Low complexity/low risk
  - Clear GHG reductions
  - High sea level resilience
  - Community support
  - Finance risk management;
Priorities for site selection

• Improved adaptation
  o Plan for long-term landscape change
  o Avoid conflicting locations for mitigation projects
Priorities for site selection

• Workable timeline
  o Near term results, or
  o Capacity to wait for return.
Project Planning Process

1. Project idea and preliminary assessment
2. Project design and planning
3. Develop a project design document
4. Review project activities and develop a project implementation strategy
5. Finalize financing and investment arrangements
6. Approvals, validation and registration
7. Implementation and monitoring
8. Verification and issuance.
Links with the Delta

Delta to Global

• Quantification methods being developed for the Delta can form the basis for project documentation under the Global VCS Methodology and be applied elsewhere.

Global to Delta

• Challenges to project delivery go beyond quantification:
  • Additionality
  • Aggregation
  • Cost barriers
  • Risk
  • Community engagement
  • Linking adaptation and mitigation.
Next Steps

• VCS Methodology
  • due Late 2014

• Guiding principles: Carbon Projects in Coastal Wetlands
  • due June 2014

• US National Working Group (Hosted by Restore America’s Estuaries)
  • Connect State and regional working group
  • Inform policy development
  • Build and link demonstration projects
  • Support transition from voluntary to compliance markets

• Science Conference and Workshops
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Delta Carbon and Methodology Development for Greenhouse Gas Reduction Accounting

Delta Stewardship Council
March 17, 2014
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Objective

• Provide information about methodology development
Overview

• Background
• Methodology development
• Future
Background

• How did we arrive here?
• Recent developments
Subsidence & Carbon Loss

Consequences
Early Emissions Measurements

• Baseline measurements began at USGS in 1990 (chambers)¹

Carbon capture wetlands - Twitchell Island, first estimates of carbon sequestration in early 1990s


Carbon capture wetlands - Twitchell Island

- Two 7 acre wetlands, established in 1997
Accreted biomass

Photo courtesy of Robin Miller, USGS
Wetland accretion

Recently…. 

• ARB process, 2006 AB32 → cap and trade
• 2008 – 2012 ARB/TNC/MWD/DWR interested in moving forward with carbon capture wetlands in Delta  
  o 2009 - 2010 MWD funded benefits and roadmap report, and conceptual design  
  o Reached out to landowners, ARB
• 2010 – present: pilot projects, additional baseline emissions measurements
• 2012 – 2013 Methodology  
  o Ongoing encouraging discussions with ARB about American Carbon Registry methodology development  
  o Funding from DWR, Metropolitan Water District, Sacramento Municipal Utilities District, California Coastal Conservancy
Methodology development

• Modular (Mississippi Delta template)

• Geography
  o Delta, Suisun Marsh, San Francisco Bay
Mission

To develop a GHG methodology for wetlands and rice in California based on sound science and the best available information and that provides a practical mechanism for producers to participate in the carbon market in an environmentally sound and economically viable way.
Interdependent and Parallel Processes

Synthesis and utilization of available science for methodology development

Ongoing data collection, analysis and modeling
- Pilot projects – Twitchell, Sherman islands
- Rice – Twitchell Island
- Baseline emissions
Teams

• Writing team
  o Steve Deverel (HydroFocus)
  o Patty Oikawa (UC Berkeley)
  o John Callaway (USF)
  o Sarah Mack (Tierra Resources, author of original methodology)
  o Jessica Orrego (ACR)
  o Kyle Hermes (ACR)
  o Listmarie Windham-Myers (USGS)

• Technical Working Group Members
  o Bryan Brock (DWR)
  o Dennis Baldocchi (UCB)
  o Judy Drexler (USGS)
  o Matt Gerhart (CCC)
  o Will Horwath (UCD)
  o Campbell Ingram (DC)
  o Michelle Passero (TNC)
  o Russ Ryan (MWD)
  o Sara Snider (EDF)
  o Leo Winternitz (TNC)
Modular Structure

Wetland – Rice Cultivation Methodology Framework
Describes structure and function of modules, applicability, activities (wetlands and rice cultivation). requirements
Sacramento-San Joaquin Delta Suisun Marsh, San Francisco Bay

Carbon Pool Modules
CP-TB Estimation of carbon stocks in above-and belowground biomass
CP-S Estimation of carbon stocks in the soil organic carbon pool

Emissions Modules:
E-E Estimation of greenhouse gas emissions
E-FFC Estimation of emissions from fossil fuel combustion

3 Baseline Modules for BAU for agricultural, non-agricultural, open water

Project Modules for estimation of GHG benefit for wetlands and rice,

Uncertainty Module UC W/RC

Tools (including models)
Recent Estimated Net GHG Benefit for Managed Wetlands

<table>
<thead>
<tr>
<th>Activity</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT CO₂ equivalent per acre-year (UC Berkeley)</td>
<td>7.5</td>
</tr>
<tr>
<td>Carbon sequestration</td>
<td></td>
</tr>
<tr>
<td>Methane emission</td>
<td>-5.5</td>
</tr>
<tr>
<td>CO₂ loss due to soil oxidation</td>
<td>8 (9*)</td>
</tr>
<tr>
<td>Net benefit</td>
<td>10</td>
</tr>
</tbody>
</table>

* Deverel, Steven J. & Leighton, David A. 2010. Historic, Recent, and Future Subsidence, Sacramento–San Joaquin Delta, California, USA. San Francisco Estuary and Watershed Science, 8(2), 1-23
Potential Additional Benefits – Nitrous Oxide Emission Reductions

• Nitrous oxide emissions:
  o 1.2 +/- 0.7 MT CO2-e/A-year (Teh and others, 2011, pasture)
  o 3 – 11 tons CO2-e/A-yr (Assa and others, 2010, unpublished, Twitchell corn field))

• Evidence for zero nitrous oxide emissions or removal in rice and wetlands

Delta Rice Cultivation

- Studies of water quality, hydrology, agronomy, wildlife benefit, greenhouse gases since 2004
- Reduces subsidence and GHG loss
- Ongoing efforts to develop management practices for minimizing N2O emissions

5 Jaclyn A. Hatala*, Matteo Detto, Oliver Sonnentag, Steven J. Deverel, Joseph Verfaillie, Dennis D. Baldocchi, 2012, Greenhouse gas (CO2, CH4, H2O) fluxes from drained and flooded agricultural peatlands in the Sacramento-San Joaquin Delta, Agriculture, Ecosystems and Environment, 150, 1-18
Summary of key data needs for methodology development

Baseline
- Expanded geography, soils and hydrology
- N2O

Project
- Stratified GHG measurements (wq, plant, hydrology, etc.)
- Physical measurements of carbon stocks (cores, SET)
- N2O

Uncertainty (project)
- Quantification of spatial and temporal uncertainty
Summary

• Demonstrated benefits for carbon sequestration wetlands and rice
  o Subsidence mitigation
  o GHG benefit
  o Increased sustainability

• Modular methodology to provide mechanism to producers to realize economic benefit
  o 3 regions – Delta, Suisun Marsh and Coast
  o Rice and wetlands
  o Technical working group/writing teams

• Parallel efforts
  o Methodology development
  o Pilot projects/research
Future

- Draft methodology late 2014
- ACR publication 2015
  - Peer review
  - Public input
- Continue to share progress with ARB
- Pilot project on private land in the Delta