Outline

1. Carbon stocks, sequestration, and emissions
2. Carbon markets and credits
3. Making the connection
Why Coastal Blue Carbon?

- Estuary Restoration
- Coastal Wetland Conservation
- Adaptation to Sea Level Rise
- Climate Mitigation
Carbon Stocks, Sequestration, and Emissions
Distribution of carbon in coastal ecosystems

<table>
<thead>
<tr>
<th>Ecosystem</th>
<th>tCO$_2$e/ha/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seagrasses</td>
<td>5.1 ± 1.4</td>
</tr>
<tr>
<td>Tidal Salt Marsh</td>
<td>8.0 ± 0.9</td>
</tr>
<tr>
<td>Estuarine Mangroves</td>
<td>8.3 ± 1.4</td>
</tr>
<tr>
<td>Oceanic Mangroves</td>
<td></td>
</tr>
<tr>
<td>All Tropical Forests</td>
<td>0.2 ± 0.1</td>
</tr>
</tbody>
</table>

Soil-Carbon Values for First Meter of Depth Only (Total Depth = Several Meters)

Data summarized in Crooks et al., 2011; Murray et al., 2011
Carbon Storage

- Seagrasses: 66 - 1,467 tCO₂e/ha
- Salt marsh: 330 - 1,980 tCO₂e/ha
- Mangroves: 1,060 - 2,020 tCO₂e/ha

Carbon Sequestration

- Seagrasses: 4.4 ± 0.95 tCO₂e/ha/yr
- Salt marsh: 8.0 ± 8.5 tCO₂e/ha/yr
- Mangroves: 6.3 ± 4.8 tCO₂e/ha/yr

Carbon Emissions – 0.15 to 1.02 billion tCO₂/yr

Sources:

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<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Hummer</td>
<td>15,000 miles</td>
<td>11 tons CO$_2$e</td>
</tr>
<tr>
<td>Prius</td>
<td>15,000 miles</td>
<td>3.7 tons CO$_2$e</td>
</tr>
<tr>
<td>Salt Marsh</td>
<td>1 hectare</td>
<td>8 tons CO$_2$e/year</td>
</tr>
</tbody>
</table>
Activities with Potential Net GHG Benefits

- Restoration of tidal wetlands via enhancing, creating and/or managing hydrological conditions, sediment supply, salinity characteristics, water quality and/or native plant communities.

- Creation of tidal wetlands.

- Conservation/avoided loss of existing tidal wetlands, including adaptation.
Carbon Markets and Credits
Carbon Markets

1. Compliance Markets, e.g. Cap and Trade
   • $175 billion in 2011
   • UNFCC, Europe, Regional Greenhouse Gas Initiative, California

2. Voluntary Markets
   • $576 Million in 2011 ($178 million in N. America)
   • Average price $6.20/ton (2011)
   • Anticipated market growth of 400% by 2020

3. Standards
   • Climate Action Reserve (CAR) - 12% market share
   • American Carbon Registry (ACR) - 6%
   • Verified Carbon Standard (VCS) - 58%
   • VCS is “most sought after certification” in 2011

4. Registries (Markit, APX, CDC)
# Requirements for Carbon Credits

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real</td>
<td>Demonstrate that reductions have actually occurred</td>
</tr>
<tr>
<td>Additional</td>
<td>Ensure reductions result from activities that would not happen in the absence of a GHG market</td>
</tr>
<tr>
<td>Permanent</td>
<td>Mitigate risk of reversals</td>
</tr>
<tr>
<td></td>
<td>Verify reductions ex-post</td>
</tr>
<tr>
<td>Verified</td>
<td>Provide for independent verification that emission reports are free of material misstatements</td>
</tr>
<tr>
<td>Owned unambiguously</td>
<td>Ownership of GHG reductions must be clear</td>
</tr>
<tr>
<td>Not harmful</td>
<td>Avoid negative externalities</td>
</tr>
<tr>
<td>Practicality</td>
<td>Minimize project implementation barriers</td>
</tr>
</tbody>
</table>
Types of Carbon Credits

Sample Credit Project Types
- Clean cook stoves
- Biochar
- Methane reduction
- Wind energy

Agriculture, Forestry and Other Land Uses (AFOLU)
- 25% of voluntary market in 2011
- Average price $9 - $13/ton in 2011
- VCS is leader in AFOLU
- Wetlands projects currently not allowed
Existing VCS AFOLU Activities

- Afforestation, Reforestation, Revegetation (ARR)
- Agricultural Land Management (ALM)
- Improved Forest Management (IFM)
- Reduction Emissions from Deforestation and Degradation (REDD)
- Peatland Rewetting and Conservation (PRC)
- *Wetland Restoration and Conservation (WRC), forthcoming*
GHG Accounting

1. Set project boundary and GHG pools
   • CO₂, CH₄, N₂O
2. Additionality assessment
3. Baseline assessment
   • What would have happened with no project
4. Monitoring, Reporting and Verification (MRV) of GHG reductions and removals
5. Credit issuance
Application to Tidal Wetlands Activities

1. Seagrass
   - Soil carbon sequestration
     - CO$_2$ through water column?
     - Source of sediment (plant-based or offsite)
   - Biomass
   - Loss of seagrass beds
     - Loss of sequestration, unknown fate of soil carbon
   - Restoration – good potential, if issues resolved, for sequestration and biomass
   - Avoided loss – uncertainties
Application to Tidal Wetlands Activities

2. Mangroves
   • Soil carbon sequestration, source?
   • Biomass (tree carbon)
   • Conversion to shrimp ponds
     • High emissions, loss of sequestration
     • Avoided conversion - high credit potential for maintaining soil and biomass sequestration, avoiding emissions
   • Restoration - good potential for soil and biomass sequestration
3. Salt marsh
   • Soil carbon sequestration, source?
   • Biomass – one time credit if restored
   • Conversion to other land uses
     • High emissions, loss of sequestration
     • Erosion/drowning due to sea level rise
     • Fate of soil carbon?
     • Loss of sequestration
   • Avoided conversion to other land use - high credit potential
   • Avoided erosion/drowning from SLR - good potential, depends on fate of soil C
   • Restoration – good potential
Application to Tidal Wetlands Activities

4. Brackish marsh
   • Generally same as salt marsh, plus methane considerations

5. Freshwater wetland
   • Generally same as salt marsh, plus methane considerations
   • Subsidence reversal – high potential for rapid carbon sequestration, avoided ongoing emissions, e.g. Sacramento Delta
## Value of carbon sequestration for marsh restoration
(3 tons CO$_2$/yr; 50 years)

<table>
<thead>
<tr>
<th>Price per ton CO$_2$</th>
<th>100 acres</th>
<th>1000 acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5.00</td>
<td>$75,000</td>
<td>$750,000</td>
</tr>
<tr>
<td>$10.00</td>
<td>$150,000</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>$40.00</td>
<td>$600,000</td>
<td>$6,000,000</td>
</tr>
<tr>
<td>$80.00</td>
<td>$1,200,000</td>
<td>$12,000,000</td>
</tr>
</tbody>
</table>

Before subtracting baseline, methane, uncertainty, insurance, verification, …
Are Wetland Carbon Credits Attractive?

- Existing standards for co-benefits, require additional certification, increase value of credit
- 54% of credits are purchased for Corporate Social Responsibility and public relations reasons
- Tidal wetlands credits could be highly charismatic in the marketplace
Making the Connection
Making the Connection

2010 National Blue Ribbon Panel and Action Plan Described Four Focus Areas

1. Eligibility – VCS Requirements
2. Additionality – concept, approach
3. Quantification – NCEAS model, science working group, integration into methodology
4. Permanence – addressing with methodology
Making the Connection

VCS Requirements

• RAE leading technical team
• Expanding AFOLU requirements to include wetlands
• Higher level rules for projects and methodologies
• Necessary precursor to methodologies
• Peer review Feb 2012, public review June 2012
• Awaiting VCS Board approval Sept 2012

www.v-c-s.org, search “wetlands”
Making the Connection

Additionality

- Funded by NOAA OHC
- RAE leading working group
- Develop tools for restoration community/coastal managers to address “additionality”
- Shifted to new VCS standardized approach
- Researching “activity penetration” to justify inclusion on the “positive list”
- Will make all tidal wetlands restoration projects additional, if not otherwise required
- Incorporate into methodology
Making the Connection

Tidal wetlands restoration GHG offsets methodology

- NERRS Science Collaborative funded project with research in Waquoit Bay and a GHG flux model
- Step by step requirements for project managers for baseline, additionality, MRV, permanence, verification, etc.
- Describes eligible project activities
- Team includes Crooks, Emmer, Myers, Needelman, Megonigal
- Future – guidance for the restoration/management community, training for NERRS managers
Making the Connection

Snohomish Estuary Coastal Blue Carbon Opportunities Assessment

- Funded by NOAA OHC
- Land use, SLR, restoration plans, carbon values
- What is the potential contribution of carbon?
- Anticipated report spring 2013
Making the Connection

Policy Initiatives
1. National Ocean Policy
2. Gulf Coast Restoration Task Force
3. National Legislation
Making the Connection

Outreach, Coordination, Partnerships

1. Coordination with Louisiana, Maryland, others
2. International Blue Carbon Initiative
3. GHG measurements at North River Farms, NCCF
4. Presentations, partner meetings, workshops
   (e.g. AAAS, SWS, RAE)
Next Steps

Field Demonstration

- Consider potential GHG values (baseline, avoided emissions, sequestration, all 3 GHGs)
- Baseline data
- Funding for project and for carbon accounting
- Relatively simple setting and project design/activities
- High chance for success
- Louisiana?, Texas?, Maryland ?, Other?
Thank you to our many funders and partners

Thank you.

Questions and Discussion

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