Blue Carbon 101: Science Requirements for the Voluntary Carbon Market

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+ Mangrove Working Group Workshop
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What is Blue Carbon?

Blue Carbon: All biologically-driven carbon fluxes and storage in marine systems that are amendable to management (IPCC 2019)

In coastal settings, blue carbon focuses on rooted vegetation and underlying soils in three primary habitats:

Tidal Salt Marsh

Mangroves

Seagrass

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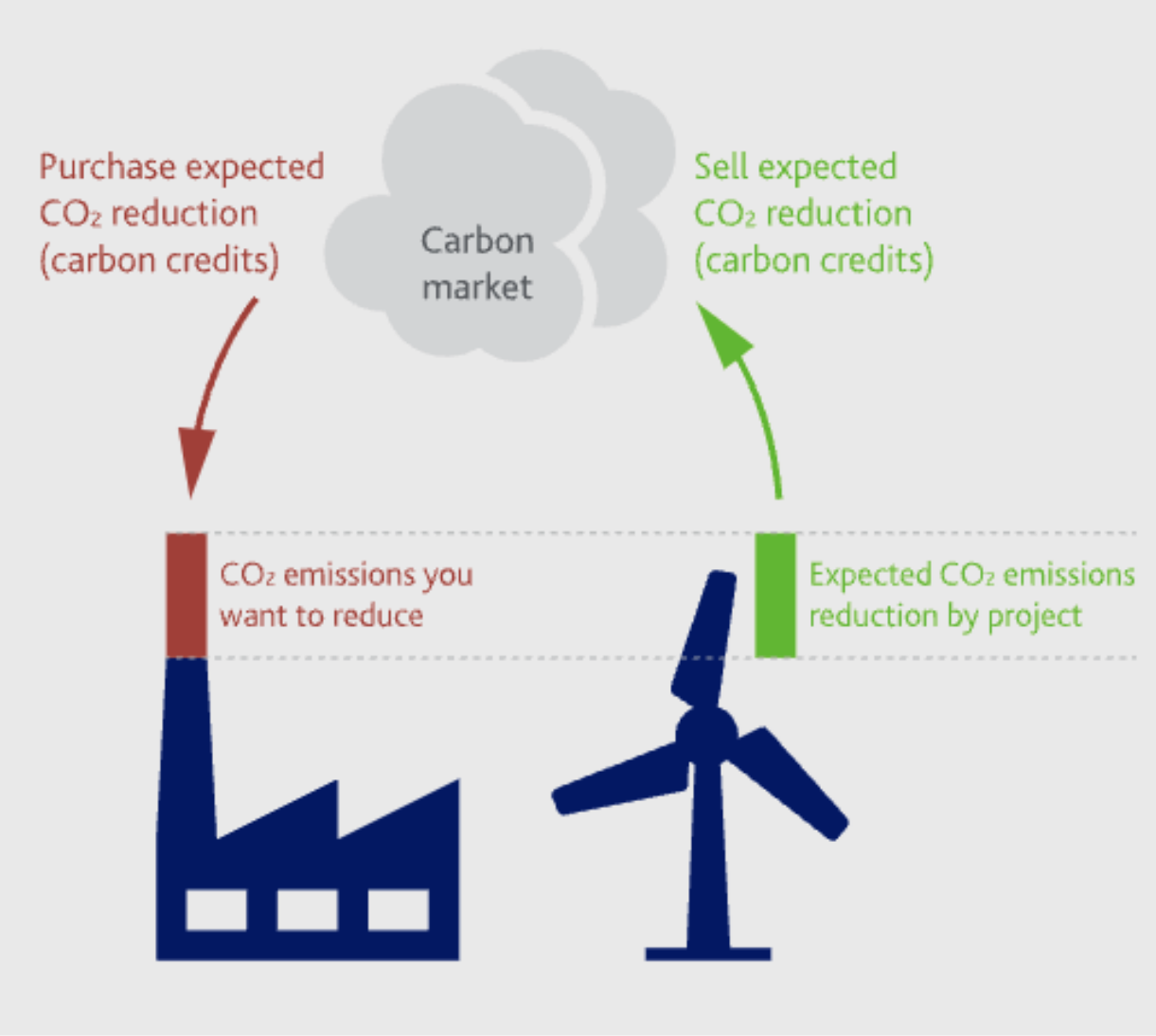
The Voluntary Carbon Market (VCM) and Carbon Offsets



- VCM refers to trade in carbon emissions offsets used against a voluntary (non-regulatory) climate commitment
- 1 carbon offset = 1 metric ton (Mg) of greenhouse gas (GHG) emissions avoided or removed
- Sectors: Land use, Energy, Energy Efficiency, Other
- GHGs: CO_2, CH_4 and N_2O + industrial GHGs ⇒ Collectively traded as CO_2 equivalents (CO_2e)

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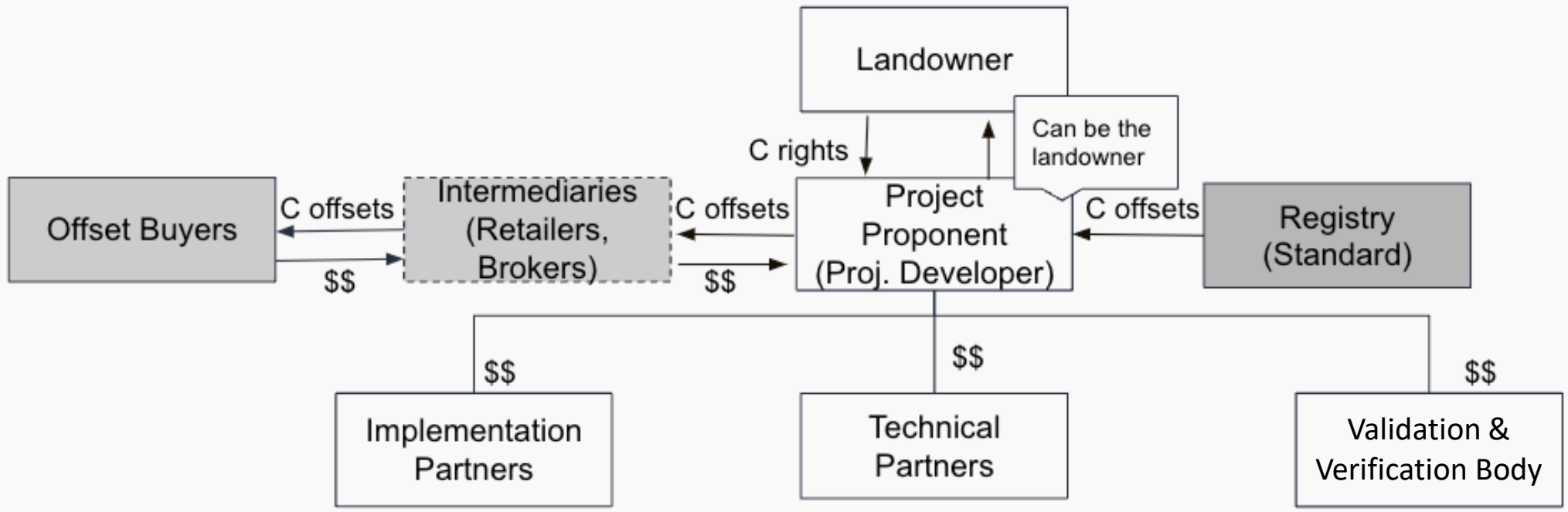
Carbon Offset Project Participants and Cash Flows



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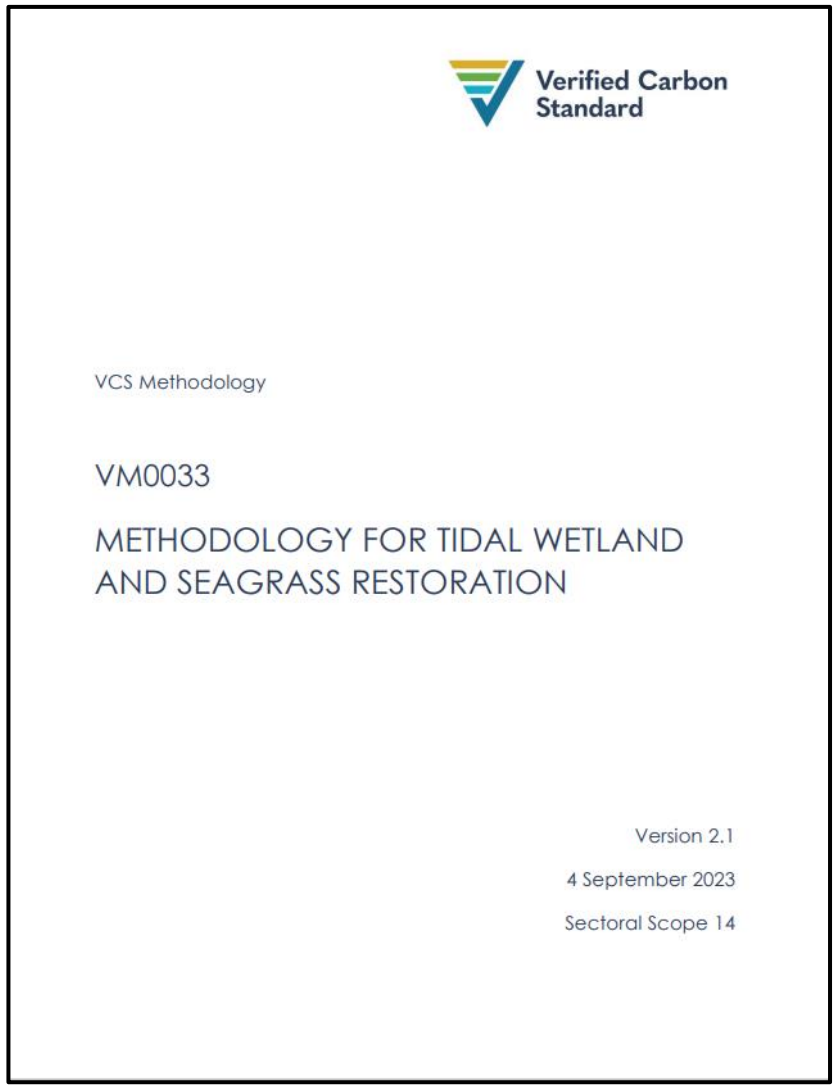
Available Standards and Methodologies



Wetland conservation, creation, and conservation methodologies under Verra's Verified Carbon Standard (VCS) are the most widely applied:

- VM0033 Methodology for Restoration of Tidal Wetlands and Seagrass Meadows, v2.1
- VM0024 Methodology for Coastal Wetland Creation, v1.0
- VM0007 REDD+ Methodology Framework (REDD+MF), v1.6

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Blue Carbon Project Activities

Restoration Activities

- Restoring tidal connectivity
- Rewetting drained organic soils
- Replanting vegetation

Protection Activities

- Avoiding planned conversion or degradation
- Avoiding unplanned conversion or degradation

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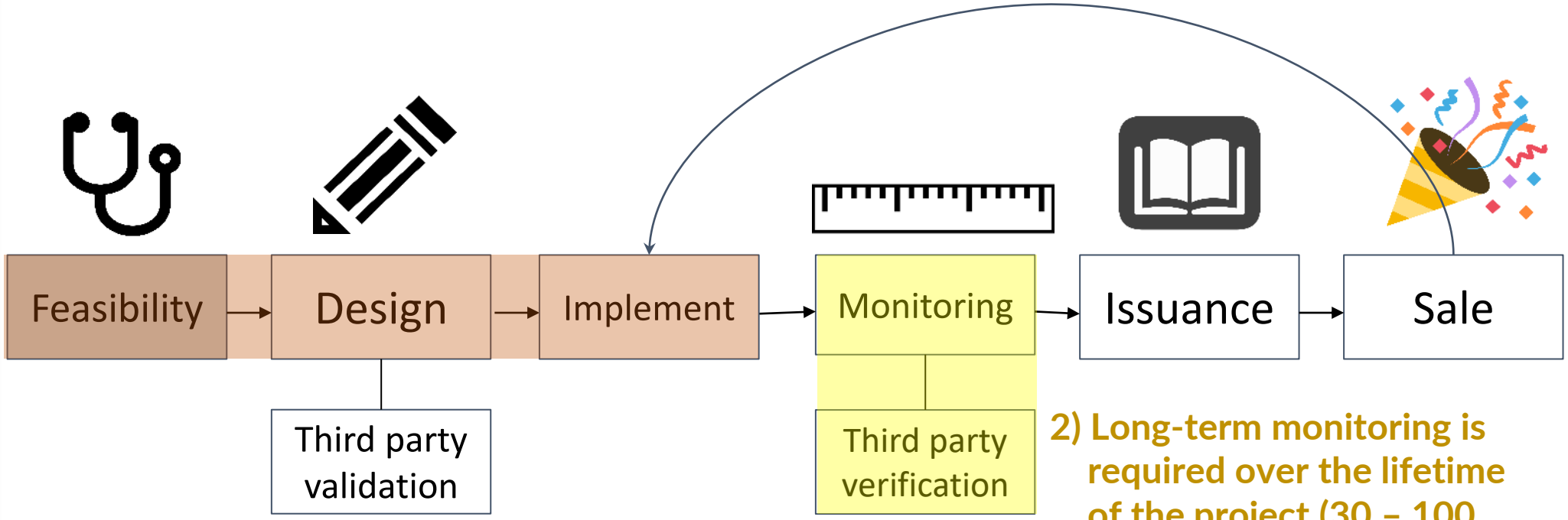
Life Cycle of a Blue Carbon Project: Where Do Science and Monitoring Fit In?



1) Ongoing (pre-existing) monitoring that includes carbon measurements (especially fluxes & burial rates) can greatly aid in project development and significantly reduce upfront development costs

2) Long-term monitoring is required over the lifetime of the project (30 – 100 years) in order to continue to generate and sell emissions offset credits

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Important Metrics and Monitoring Parameters for Blue Carbon Projects

- **Mangroves:**
  - Tree diameter at breast height
  - Tree height
  - Canopy density
  - Seedling count & height
- **Seagrass:**
  - Seagrass density
  - Blade height/length
- **Sea-level rise** (non-permanence risk)
  - Recent local modeling (availability, quality, scenarios, etc.)
  - Long-term habitat impacts (accretion rates, habitat transitions/conversions, etc.)
- **Low-salinity (< 18) environments:**
  - Methane and nitrous oxide
- **Sediments (all habitat types):**
  - Soil C or OM content via EA or LOI
  - Dry bulk density
  - Accretion/C burial rates
    - Marker horizon,
    - Radiometric dating,
    - Surface elevation table (SET)

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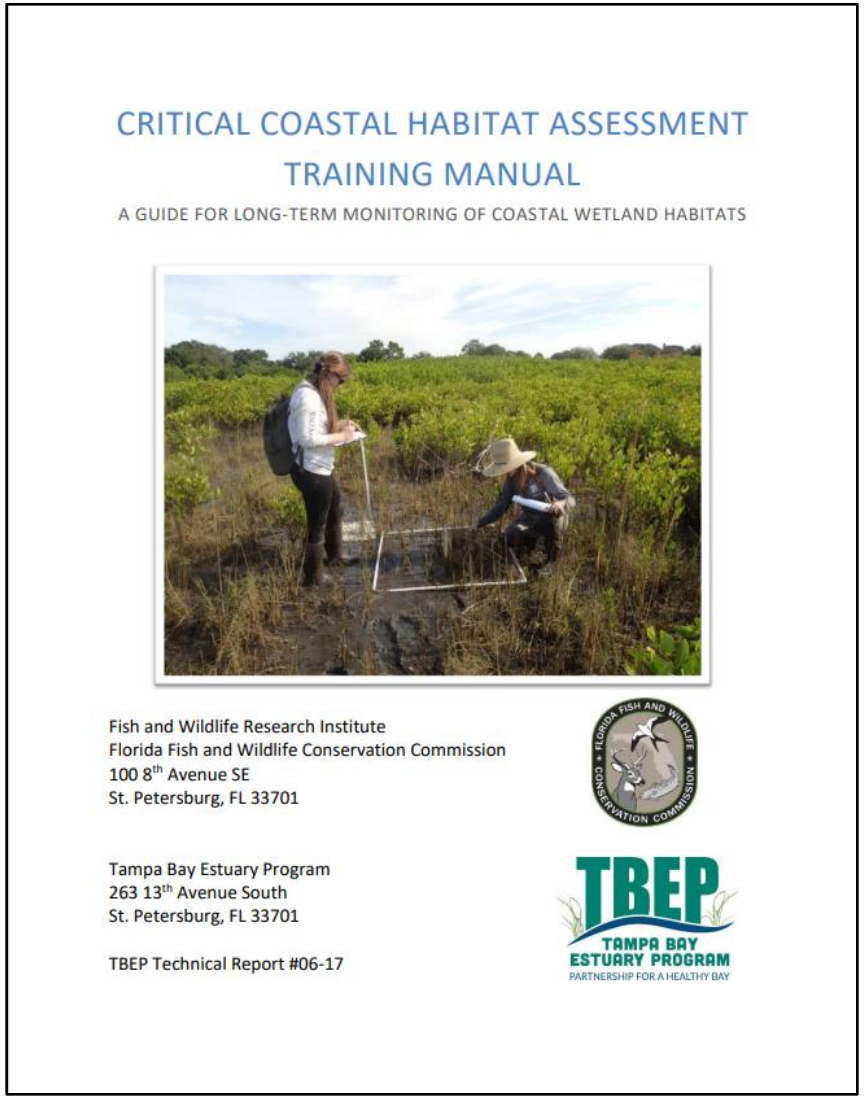
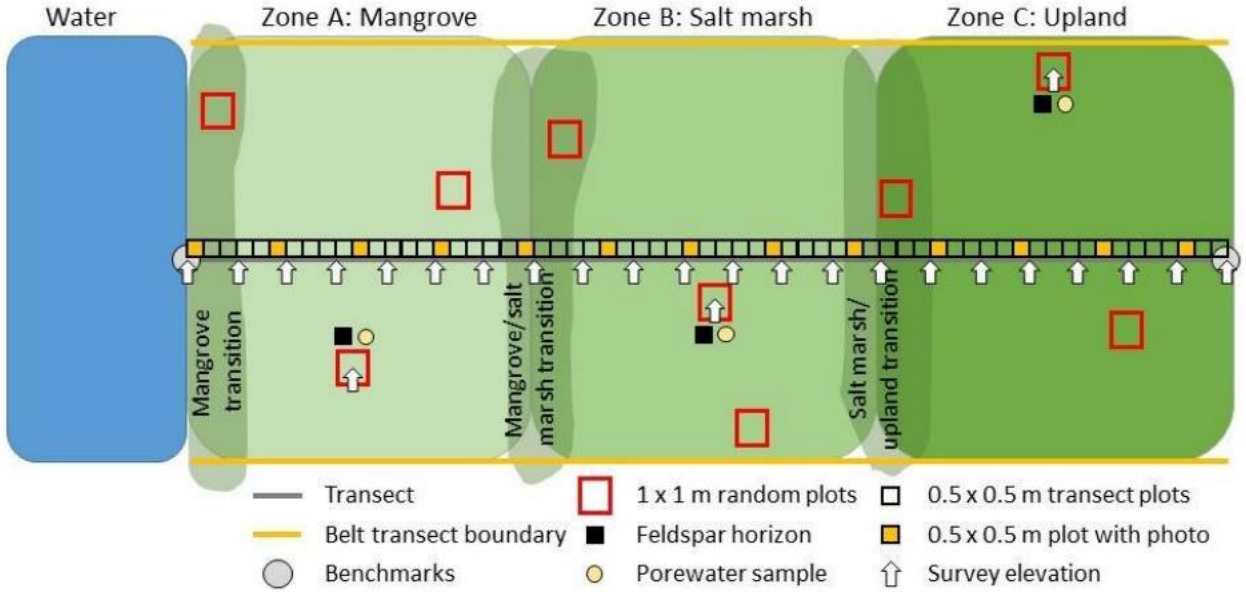
Importance of Coastal Monitoring Programs





- Ongoing long-term monitoring program in Tampa Bay region (FWRI/TBEP)
- Incorporates most measurements (except CH_4/N_2O) needed to support blue carbon projects, while also informing habitat transitions due to long-term sea-level rise (primary goal)

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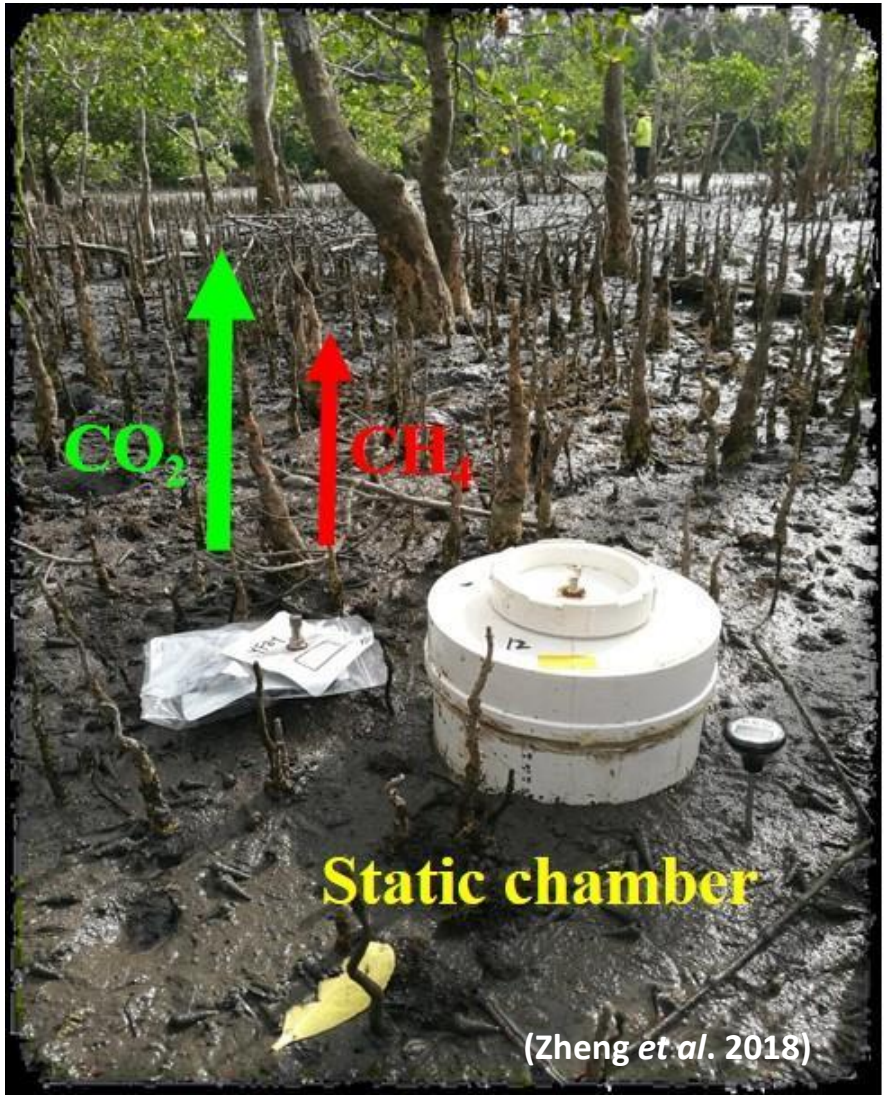
Methane and Nitrous Oxide Fluxes



- Important to projects where hydrology has changed (impounded marshes, drained wetlands)
- Low CH_4 & N_2Oemissions in high salinity (S > 18)
  - measure salinity and use default values
- High CH_4 & N_2O emissions in low salinity (S < 18)
  - highly variable (interannual/seasonal), no default values
  - few published values; modeling often hard to apply to other systems
  - Need to directly measure or model CH_4 & N_2O: requires seasonal (min.) monitoring for ~2 years
- **Measurements are absent in most cases; excellent opportunity to partner with academia or government monitoring programs and share costs**

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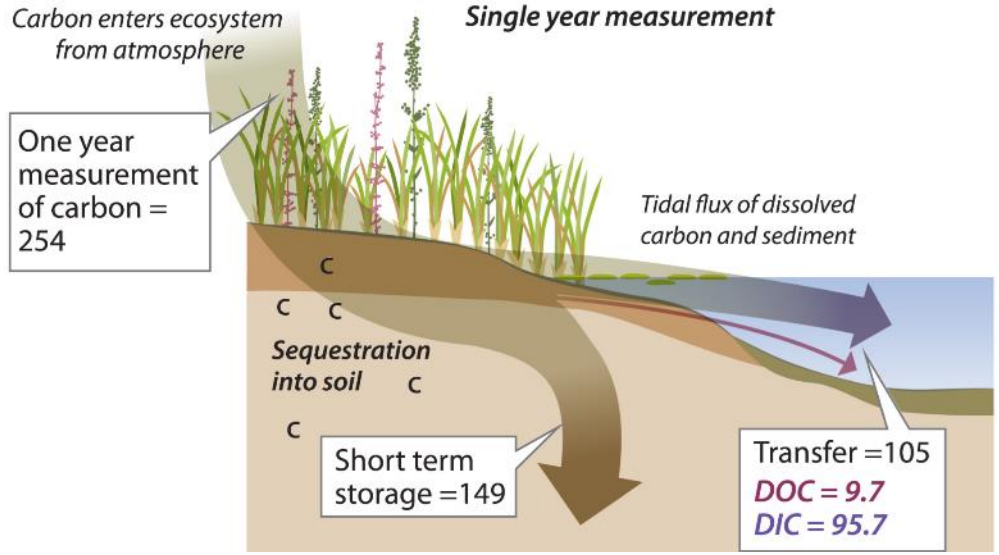
Academic Science Gaps

1. Lateral fluxes and fate of imported and eroded carbon
2. Short-term storage vs. long-term C burial in soil
3. Methane and nitrous oxide flux measurements
4. The role of dissolved inorganic carbon and the “bicarbonate pump” in carbon sequestration
5. Emerging blue carbon systems (kelp, algae, whale biomass, etc.)



One Earth

CellPress

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Primer

Methane and nitrous oxide emissions complicate the climate benefits of teal and blue carbon wetlands

Martino E. Malerba [1], Daniel A. Friess [2 3], Mike Peacock [4 5], Alistair Grinham [6], Pierre Taillardat [7], Judith A. Rosentreter [8], Jackie Webb [9], Naima Iram [10 11], Alia N. Al-Haj [12], Peter I. Macreadie [1]

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Questions?

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