Developing a Research Agenda for Carbon Dioxide Removal and Reliable Sequestration

National Oceanic and Atmospheric Administration
A Sponsor’s Perspective: Coastal ‘Blue Carbon’ Ecosystems
What is Coastal Blue Carbon?

Carbon sequestered in coastal habitats

Black Carbon (human emissions)

Green Carbon (terrestrial biota)

Blue Carbon

Coastal habitats: Salt marshes, Mangroves, Sea Grasses

Term ‘blue carbon’ coined in 2009, reflects increased recognition on improving coastal wetland management for their carbon ‘services’

www.pmel.noaa.gov/co2/story/Research
Why is interest in Blue Carbon growing?

Potential major role in carbon mitigation

- Although coastal habitats cover a smaller part of the globe than forest systems, they are potentially an \textit{~equivalent annual sink because of their higher soil sequestration rates per area}.

- Once degraded or destroyed, these ecosystems go \textit{from being impressive natural carbon sinks to becoming large carbon sources.}

There is growing interest to understand how this ‘carbon service’ can be used to improve climate mitigation, as well as the management and conservation of coastal systems. 

Why NOAA cares about Coastal Blue Carbon

Broad relevance across NOAA’s missions

• The topic of CO₂ and carbon (GHG) in coastal wetlands connects to NOAA’s much broader goals of sustainably managing our coasts, including fisheries, recreation, and sustaining coastal communities and economies
• Strong link between efforts to preserve and restore coastal blue carbon ecosystems with:
  • Conservation of key fishery habitats,
  • Increased coastal resilience, coastal protection and climate adaptation
  • Maintain coastal ecosystem services

A win-win-win for habitat conservation, coastal resilience, and climate mitigation
NOAA’s support related to Coastal Blue Carbon

Examples of Activities

- National GHG inventory reporting
- Voluntary Carbon Standard (VCS) Methodologies
- Pilot Feasibility Projects
- Herring River, MA (salt marshes)
- Rookery Bay, FL (mangroves)
- Research (many areas)
- Policy Analysis
Baseline information exists on C flux and coastal wetlands

Monitoring efforts
• NASA Carbon Monitoring System projects

National level accounting
• Inclusion in the U.S. annual GHG inventory

Place-based studies
• Waquoit Bay “Bringing Wetlands to Market”

There is still a need for a **complete, objective assessment** of the role of coastal wetland carbon in GHG emissions and the potential to provide climate mitigation opportunities.
NAS Study Focus is on Active CO$_2$ Removal (CDR)

In coastal wetlands, best sequestration opportunity is two-fold:

1. Wetlands sequester carbon annually
2. The potential for new sequestration when we restore coastal wetlands
Let's think broadly about CDR and blue carbon

In coastal wetlands, a huge part of the story is about **avoided emissions from prevention of loss** (this is bigger than sequestration potential).

- Could “avoided emissions of methane” be included in a CDR strategy?
- What management practices can limit these emissions?
Suggestions for inclusion in the CDR report

Categories of research questions

1. State of the Science
2. Improving GHG accounting in coastal wetlands
3. Threats to coastal blue carbon habitats
4. Landscape Connectivity Implications
5. Resource Management Applications
6. Policy and Market Implications: Maximizing CDR potential
Suggested research: State of the Science

Where does coastal carbon fit into the broader carbon/GHG story?

• How big is this as a source and sink compared to other sectors?
• What is their potential to continue to sequester?
• And how much easier or harder is to manage coastal wetland carbon than other emissions or sinks?
  • For example, relative to other natural or technological sinks
Suggested research: State of the Science

• What is the total estimated CDR and GHG reduction potential for existing submerged and tidal lands within the next 100 year horizon in the US and globally?
• What are the scientific and technical needs at national and regional scales (mapping, bathymetry, estimates of carbon, and assessments of potential) to more accurately catalog and evaluate blue carbon habitat?
• What research is needed to better understand the CDR potential for blue carbon habitats?
• Need to understand relationships between tidal inundation, coastal habitat distribution, and carbon production and storage, to account for current blue carbon assets and predict the impact of environmental change on blue carbon habitats (links between adaptation, mitigation, and management)
Suggested research: Improving GHG accounting

How can we use technical advances to better **monitor and measure** GHG in coastal wetlands?

- Satellite and land based monitoring, automated or remotely
- High resolution and temporal coverage for **methane** emissions
- How to include seagrass meadows (using remote sensing? Better estimates of emissions?)
- Improved quantification of fluxes from impounded tidal wetlands and potential sinks if restored
- Impacts of forestry activity on wetland soils (very little data on this)

How can we measure **methane** across the coastal landscape?

- Incorporate salinity gradient
- High resolution, temporal and spatial coverage
Suggested research: Threats to blue carbon habitats

How will the following impact CDR potential/sequestration?
- Climate variability and change processes (precipitation, temperature), migration of species and habitats etc.
- Climate variability and change impacts (sea level rise, migration of species and habitats)
- **Upstream changes** in hydrology/sediment inputs impact the CDR potential/sequestration? (e.g. Gulf loss)

How to **maintain this sequestration** in the face of future changes associated with climate change
- Sea level rise, etc.

What is the **longevity** of blue carbon habitats?
Suggested research: Landscape Connectivity Research

What are the **upstream & downstream impacts** on coastal wetland carbon?
- How is blue carbon storage impacted by upstream activities such as sediment and hydrology changes or nutrient inputs? How will this inform watershed management?
- How will sea level rise impact blue carbon (planning for inland migration?)?

What is the **ocean acidification buffering capacity** of BC habitats to adjacent habitats?
- Coral and oyster reefs, shellfish farms

If we do it right, we should be thinking **NOW** about land management adjacent to coastal wetlands to **FUTURE** facilitate inland migration, so we don’t lose future CDR/sequestration opportunities.
Suggested research: Landscape Connectivity Research

• Improved carbon cycle understanding and synthesis across offshore to onshore coastal environments

• Improve understanding of the biological, chemical, and physical processes that drive the exchange of carbon in coastal wetlands

• Refine the mechanistic representation of coastal carbon systems in the global earth system context including the role of hydrological, biogeochemical, ecological, and human interactions and assess carbon risks, benefits, and uncertainties
Suggested research: Resource Management Applications

What is the **restoration potential** for coastal wetlands?
- How much restoration is possible and where/how should we prioritize coastal wetland restoration & protection. For long-term carbon benefits? For climate change adaptation? (Snohomish estuary)

How can CDR information **support coastal habitat restoration and management decisions** at the landscape scale?
- How can the type of soil and location being used in restoration efforts maximize CDR? (organic soil, impounded water, erosion rate, etc.)
- Can we use CDR to help identify where restoration is needed, what places would benefit from further protection, etc.
Suggested research: Policy and Market Implications

• What are effective approaches to optimize the investment in blue carbon ecosystems for CDR?

• Will market approaches ensure that CDR potential is maximized?
  • Voluntary carbon markets, offsets as part of compliance markets, etc.

• Which national and international policies can accelerate and support the CDR potential of these habitats?
Suggested research: Maximize use of existing data

Best practices for centralizing/standardizing data from multiple sources?
• A community database and interface for emissions in coastal wetlands is being developed (NSF support)
• Will address the challenge of having data collected and hosted by many different federal and non-federal partners in the short-term (5 years)

How can we ensure that this foundational effort is sustained?
• Recommendations from panel or examples of best practices from other agencies or organizations’ efforts on how to do this? (Cost of maintaining, sharing, and QCing database)
What NOAA hopes for out of this NAS Study

Product and deliverables:
• ‘Avoided emissions’ are included as part of CDR report on coastal wetlands – should not be limited to sequestration potential
• A definitive statement on ‘state of the science’ for coastal carbon CDR is provided

Outcomes with most value to NOAA:
• Study improves baseline accounting of coastal carbon in U.S. and the world, including the national GHG inventory report
• Study facilitates the inclusion of carbon benefits (in addition to the many other benefits) of coastal wetlands into U.S. management approaches and environmental policies
Thank you!

Feel free to contact us if you would like any additional information
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