

Dataset: Increasing Greenhouse model application in tidally restricted and restored salt marshes across New England and the mid-Atlantic East Coast

This document provides detailed information about a dataset that was generated through a 2015-2019 collaborative research project titled *Bringing Wetlands to Market Phase 2: Expanding Blue Carbon Implementation*. This document also provides information [about the project](#). The project was supported by the National Estuarine Research Reserve System (NERRS) Science Collaborative, which is funded by the National Oceanic and Atmospheric Administration. All Science Collaborative supported projects that collect new data adhere to federal data sharing and archiving requirements.

Five related datasets are described in this document:

1. Instantaneous greenhouse gas flux data and environmental variables for natural (downstream of structure) and restored (upstream of structure) areas of four Cape Cod marshes and three natural marshes in Rhode Island
2. Instantaneous greenhouse gas flux data and environmental variables in four ecosystems (dry forest, wet forest, wet, cattail, and phragmites) in the Herring River estuary
3. Carbon burial data for natural (downstream of structure) and restored (upstream of structure) areas of four Cape Cod marshes
4. Carbon burial data for four ecosystems (dry forest, wet forest, cattail, and phragmites) in the Herring River estuary
5. Continuous environmental variables (PAR, soil and air temperature, water level, water temperature, salinity) in four ecosystems (dry forest, wet forest, wet, cattail, and phragmites) in the Herring River estuary

About the Associated Project

Project title:

Bringing Wetlands to Market Phase 2: Expanding Blue Carbon Implementation
Name of reserve(s) involved in the project: Waquoit Bay National Estuarine Research Reserve (Massachusetts)

Project period: September 2015 to September 2019

Science Collaborative project page:

<http://www.nerrssciencecollaborative.org/project/Rassman15>

Project leads and contact information:

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Project abstract:

Blue carbon storage – carbon sequestration in coastal wetlands – can help coastal managers and policymakers achieve broader wetlands management, restoration, and conservation goals, in part by securing payment for carbon credits. Despite considerable interest in bringing wetland restoration projects to market, the transaction costs related to quantifying greenhouse gas fluxes and carbon storage in restored marsh has been a significant limiting factor to realizing these projects.

The Waquoit Bay National Estuarine Research Reserve has been at the forefront of blue carbon research and end user engagement. Building on the efforts of a previous project, [Bringing Wetlands to Market in Massachusetts](#), this project developed a verified and generalized model that can be used across New England and the mid-Atlantic East Coast to assess and predict greenhouse gas fluxes and potential wetland carbon across a wide environmental gradient using a small set of readily available data. Using this model, the project conducted a first-of-its-kind market feasibility assessment for the Herring River Restoration Project, one of the largest potential wetland restoration projects in New England. The project team developed targeted tools and education programs for coastal managers, decision makers, and teachers. These efforts have built an understanding of blue carbon and the capacity to integrate blue carbon considerations into restoration and management decisions.

About Each Dataset

1. Instantaneous greenhouse gas flux data and environmental variables for natural (downstream of structure) and restored (upstream of structure) sections of four Cape Cod marshes and three natural marshes in Rhode Island

Collection period: May – October 2016
May-September 2017

Geographic extent:

Cape Cod Massachusetts

- Quivett Creek, Dennis MA, 41 44.813'N 70 8.614'W
- State Game Farm, Sandwich MA, 41 43.777'N 70 25.766'W
- Bass Creek, Yarmouth MA, 41 42.966'N 70 14.226'W
- Stony Brook, Brewster MA, 41 45.275'N 70 6.767'W

File format: Excel spreadsheet

Data access and archival: This dataset has been archived and will be made publicly available in September 2021 at the CCRCN Carbon Atlas. Prior to fall 2021, individuals may reach out to Dr. Jim Tang, Associate Scientist, Marine Biological Laboratory (jtang@mbl.edu) to discuss potential applications and request access to the data.

General description of data:

Two years of carbon dioxide ($\mu\text{mole}/\text{m}^2/\text{s}$) and methane ($\text{nmol}/\text{m}^2/\text{s}$) fluxes were measured monthly in growing seasons. The GHG flux measurements were made in-situ with a mobile gas measurement system, which uses cavity ring down technology (G2301-F Fast CO_2 , CH_4 and H_2O Analyzer, Picarro, Inc., Santa Clara, CA). The analyzer was connected via tubing to a portable chamber and a gas-tight air pump and was placed on permanent chamber bases, consisting of an aluminum ring in a rubber gasket, installed at each site. During measurements, we sealed the transparent acrylic chamber, measuring 12 inches in diameter and 2 feet in height, over soil and vegetation (Fig. 1). Air inside the chambers was mixed using a battery-powered fan. The air was pumped through a 30-70 foot long tube to the instruments and back through a tube of equal length to the chamber in a closed loop (Fig. 1).



Fig. 1. The transparent chamber used for CO_2 and CH_4 measurement.

This dataset also included two years of discrete air temperature, solar radiation, photosynthetically active radiation, ground water level, soil water content, and soil temperature data.

2. Instantaneous greenhouse gas flux data and environmental variables in four ecosystems (dry forest, wet forest, cattail, and phragmites) in the Herring River estuary

Collection period: May 2016 to October 2016
May 2017 to September 2017

Geographic extent:

Five sites in the Herring River estuary

- Sunken Meadow , Eastham MA 41 52.576'N 70 0.015'W
- Chequesset Neck, Wellfleet MA, 41.930457N, 70.071033W
- High Toss Rd, Wellfleet MA, 41.94375N, 70.05590W
- Old County Rd, Wellfleet MA, 41.96058N, 70.05587W

File format: Excel spreadsheet

Data access and archival: This dataset has been archived and will be made publicly available in September 2021 at the CCRCN Carbon Atlas. Prior to fall 2021, individuals may reach out to Dr. Jim Tang, Associate Scientist, Marine Biological Laboratory (jtang@mbi.edu) to discuss potential applications and request access to the data.

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Fig. 1. The transparent chamber used for CO_2 and CH_4 measurement.

This dataset also included two years of discrete air temperature, solar radiation, photosynthetically active radiation, ground water level, soil water content, and soil temperature data.

3. Carbon burial data for natural (downstream of structure) and restored (upstream of structure) areas of four Cape Cod marshes

Collection period: Summer 2015

Geographic extent:

Cape Cod Massachusetts

- Quivett Creek, Dennis MA, 41 44.813'N 70 8.614'W
- State Game Farm, Sandwich MA, 41 43.777'N 70 25.766'W
- Bass Creek, Yarmouth MA, 41 42.966'N 70 14.226'W
- Stony Brook, Brewster MA, 41 45.275'N 70 6.767'W

File format: XLSX and CSV

Data access and archival: The data are being released in two waves, coincident with two separate papers in 2021. Prior to fall 2021, individuals may reach out to Meagan Eagle, Ph.D. / Research Scientist, U.S. Geological Survey Woods Hole Coastal and Marine Science Center, mgonneea@usgs.gov to discuss potential applications and access to the data. Data will be archived at

<https://www.sciencebase.gov/catalog/item/5a748e35e4b00f54eb19f96c> (this site is the same as site used for previous BWM data, the page will be updated when the new data is released)

General description of data:

1. Site selection

At each site, we established two 5m x 5m plots. At marshes where we were comparing restored versus natural marshes, plots were established upstream and downstream of where the tidal restriction was repaired, resulting in a total of four plots. Within each plot, we collected one sediment core, 50-90 cm in length.

2. Core collection

Cores were collected with a modified piston coring system that is designed to minimize compaction of sediments during collection.

3. Core processing

Cores were returned to U.S. Geological Survey in Woods Hole, Ma for processing (Fig. 4 and 5). Core barrels will be opened vertically, photographed and described. Cores were sectioned at 1 cm intervals for the top 30 cm, and 2 cm intervals thereafter. Sections will be weighted and immediately froze at 40C. Samples were freeze dried and reweighed to determine dry bulk density.

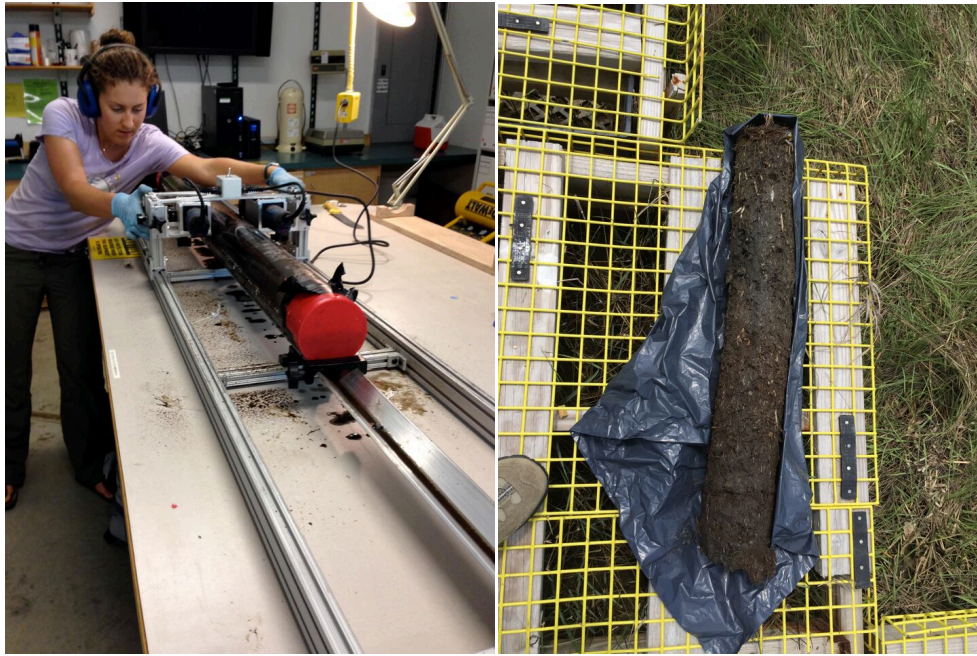


Fig. 2 (left) A core sample in the lab
Fig. 3 (right). A core sample removed from its barrel.

4. Core analysis.

A subsample will be used for

- 1) carbon content and isotopic composition and
- 2) lead-210 and cesium-137 activity

4. Carbon burial data for four ecosystems (dry forest, wet forest, cattail, and phragmites) in the Herring River estuary.

Collection period: Summer 2015

Geographic extent:

Five sites in the Herring River estuary

- Sunken Meadow , Eastham MA 41 52.576'N 70 0.015'W
- Chequesset Neck, Wellfleet MA, 41.930457N, 70.071033W
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File format: XLSX and CSX

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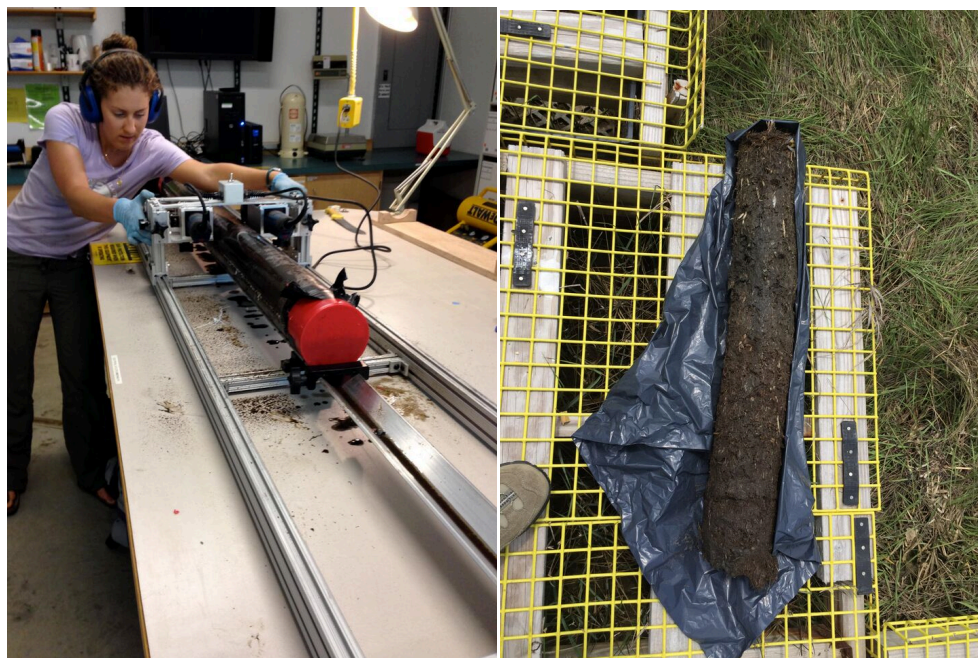


Fig. 2 (left) A core sample in the lab
Fig. 3 (right). A core sample removed from its barrel.

4. Core analysis.

A subsample will be used for

- 1) carbon content and isotopic composition and
- 2) lead-210 and cesium-137 activity

5. Continuous monitoring data from Herring River Wetlands

Collection period: 2015 to January 2020

Geographic extent: Bounding West - 70.0567088 East -70.0509867 North 41.9603891
South 41.9374193

File format: .TXT files

Data access and archival:

<https://www.sciencebase.gov/catalog/item/5eab1f3582cefae35a225504>

Contact: Jennifer A. O'Keefe Suttles, Chemist, Northeast Region: WOODS HOLE COASTAL & MARINE SCIENCE CENTER, jokeefesuttles@usgs.gov

General description of data: The Herring River estuary (Wellfleet, Cape Cod, Massachusetts) has been tidally restricted for over a century by a dike constructed near the mouth of the river. Behind the dike, the tidal restriction has caused the conversion of salt marsh wetlands to various other ecosystems including impounded freshwater marshes, flooded shrub land, drained forested upland, and wetlands dominated by *Phragmites australis*. This estuary is now managed by the National Park Service, which has plans to replace the dike and restore tidal flow to the estuary. To assist National Park Service land managers with restoration planning, study collaborators have been investigating differences in soil properties, carbon accumulation, and greenhouse gas fluxes across differing ecosystems within the Herring River Estuary. The U.S. Geological Survey collected continuous monitoring data (including water level, soil temperature, air temperature, and meteorological parameters). These datasets can help evaluate key ecosystem drivers to make predictions about potential changes as restoration commences.

Information about All Five Datasets

Data Quality Control / Quality Assurance Procedures:

All data have gone through first, second, and third level quality assurance/quality control (QA/QC) processes. At the first level of QA/QC, data for all collected variables were checked for consistency of units. In the second level of QA/QC, outliers (i.e., mechanistically unreasonable values) were removed by employing a range of methods, e.g., visual identification of unreasonable spikes in time-series plots, as well as flagging (and filtering, if appropriate) of extreme values by setting low and high thresholds based on percentiles. The third level of QA/QC included the preparation of datasets with concurrent/contemporary observations for greenhouse gas fluxes, carbon storage, lateral fluxes, and the associated climate/environmental variables. The data QA/QC plan was implemented and monitored for consistency among different field teams and labs on a regular basis through frequent interactions (monthly conference calls) among the project leads.

Contact information: For project information and data release updates:
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Maps and Schematics for Data Collection

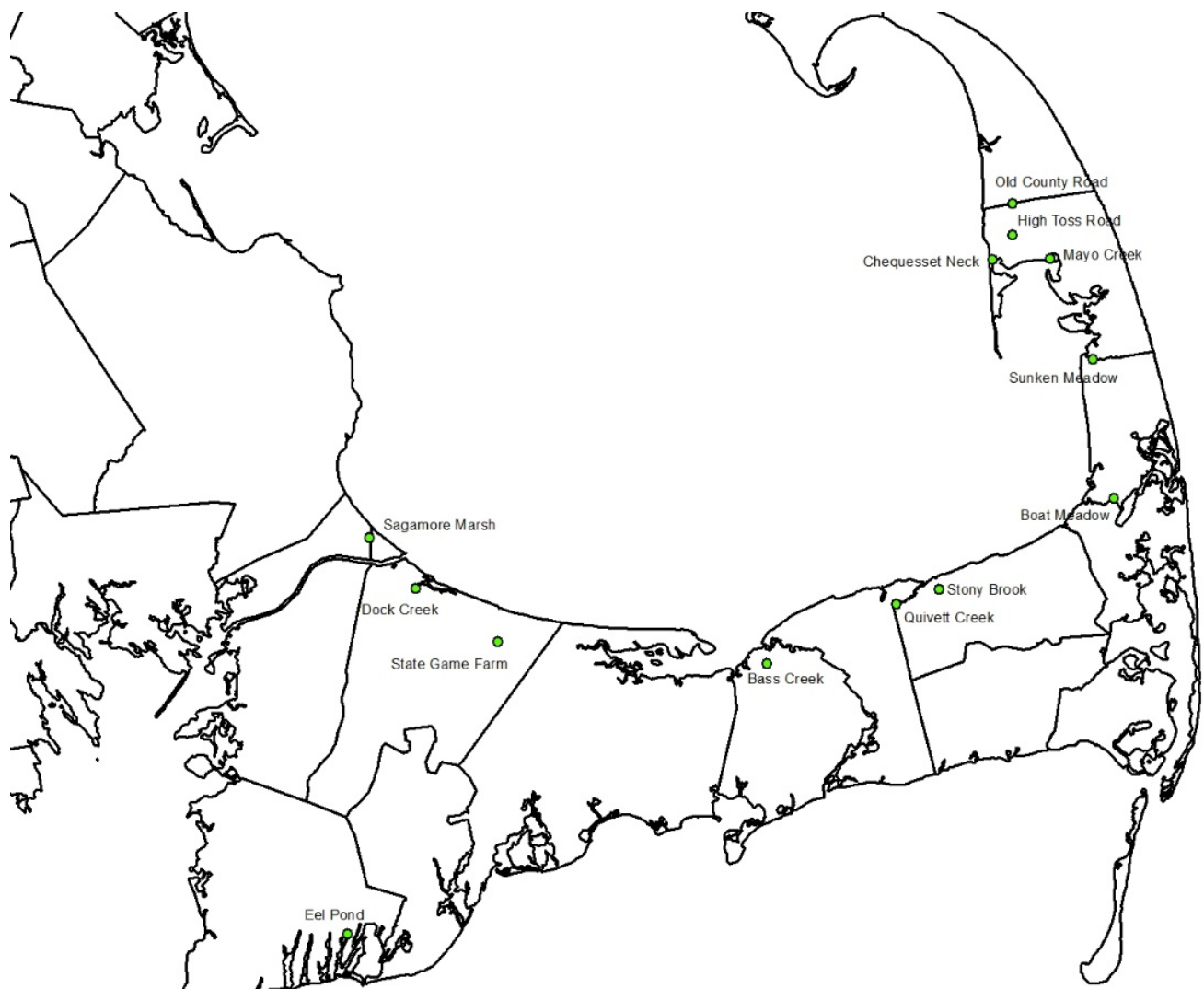


Figure 4. Data collection sites in Cape Cod, Massachusetts.