Dataset: Ecosystem dynamics of ditched and unditched sections of the Great Barnstable Marsh (MA, USA)

This document provides detailed information about seven datasets that were generated through a 2017 - 2020 collaborative research project titled *Evaluating the Impact of Hydrologic Alterations on Salt Marsh Sustainability in a Changing Climate*. 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.

Seven related datasets are described in this document:
1. Bulk soil properties and composition within the ditched and natural sections of the Great Barnstable Marsh, MA, 2018
2. Collection, analysis, and age-dating of sediment cores from Great Barnstable Marsh, Cape Cod, Massachusetts, 2018
3. Continuous Monitoring Data From Great Barnstable Marsh on Cape Cod, Massachusetts, 2017-19
4. Soil properties within ditched and natural marsh in Great Barnstable Marsh, Cape Cod, Massachusetts, 2018
5. Plant community properties within ditched and natural marsh within Great Barnstable Marsh, Cape Cod, Massachusetts, 2018
6. Porewater chemistry from ditched and natural marsh within Great Barnstable Marsh, Cape Cod, Massachusetts, 2018
7. Source code of the marsh evolution model (end user tool)

About the Associated Project

Project title: Evaluating the Impact of Hydrologic Alterations on Salt Marsh Sustainability in a Changing Climate

Reserves involved in the project: Waquoit Bay National Estuarine Research Reserve, Massachusetts

Project period: November 2017 to October 2020

Science Collaborative project page:
http://www.nerrssciencecollaborative.org/project/Spivak17

Project lead and contact information:
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Abstract:
Parallel grid ditches were dug in approximately 90% of mid-Atlantic and New England salt marshes in the 1920s through the 1940s. Today, managers must navigate the effects of past actions when making decisions about marsh hydrology and drainage that impact human health, ecosystem services, and marsh sustainability. Managers must also consider how stressors such as sea level rise impact marshes. Consequently, managers are faced with highly localized and complex scenarios that force them to make tradeoff decisions. Management decisions are often made in response to an on-the-ground problem, and the implications are learned later. This trial-and-error approach consumes time and budgets. As rising sea levels pose increasing challenges to coastal marshes, it is vital that managers have science-based tools that can help them identify best strategies, optimize critical ecosystem services, and save time and resources.

Coastal managers and restoration practitioners from Waquoit Bay National Estuarine Research Reserve in Massachusetts and partner local, state, and federal agencies and nonprofit organizations expressed a need to understand the tradeoffs of hydrologic management strategies (i.e., ditch remediation, density, maintenance) and identify actions that will achieve user-specified outcomes— such as drainage, maintaining elevation, and carbon burial. In this project, a team of scientists, including reserve staff, responded to that need by working iteratively with end user groups to develop a decision support tool for marsh hydrology management strategies that promote sustainability and delivery of valuable ecosystem services under future sea level scenarios. The tool predicts potential outcomes of ditch and runnel maintenance in micro- and macro-tidal salt marshes under different scenarios of suspended sediment input and sea level rise. Outputs include elevation, vertical accretion rates, and habitat distribution along creekbank edges and in the marsh interior. The tool is based on a two-dimensional model (Marsh2D) and informed by field data collected on Cape Cod, Massachusetts.

About Each Dataset

1. Bulk soil properties and composition within the ditched and natural sections of the Great Barnstable Marsh, MA,2018

General description of data:
Soil bulk density, water content, porosity, elemental, and $\delta^{13}C$ data from cores (~1m) collected at creekbank edges (0 m) or interiors (100 m) of three regions within the ditched and unditched sections of the Great Barnstable Marsh, MA.
Search keywords: salt marsh, soil

More about the data:
- Bulk soil properties: Soil cores (1m) were sectioned into 1cm horizons and freeze dried. Dry bulk density, water content, and porosity were determined gravimetrically.

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- Elemental properties: Freeze dried horizons were blended and ball milled for CHNS analysis. For total organic carbon content measurement, sediment was weighed into silver cups with 25ul of distilled H_2O and fumed with HCl overnight in a vacuum dessicator. For sulfur measurements, sediment was weighed into tin cups. Samples were analyzed with a Perkin Elmer 2400 series II CHNS/O
- Refer to the metadata record included with the data release for further information about data collection, data completeness, and logical consistency.

Data collection period: May 2018 to August 2018

Geographic extent: (41.732720°, -70.364732°), (41.726875°, -70.364687°),(41.730943°, -70.383323°),(41.734042°, -70.381412°).

File format: csv

Data Access and Archival: This dataset has been archived and will be made publicly available via Sciencebase by Winter 2021. Prior to Winter 2021, individuals may reach out to Sheron Luk (sluk@whoi.edu) to discuss potential applications and request access to the data.

Maps and Schematics for Data Collection

2. Collection, analysis, and age-dating of sediment cores from Great Barnstable Marsh, Cape Cod, Massachusetts, 2018

General description of data:

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Salt marsh soil radioisotope measurements from cores (1m) collected at creekbank edges (0 m) or interiors (100 m) of three regions within the ditched and unditched sections of the Great Barnstable Marsh, MA.

More about the data:
- Radionuclide activities (^{210}Pb, ^{226}Ra, ^{137}Cs, ^{7}Be) were measured on planar gamma counters that were standardized to an EPA standard pitchblende ore in the same geometry as the samples.
- Refer to the metadata record included with the data release for further information about data collection, data completeness, and logical consistency.

Search keywords: Salt marsh accretion, age model, radioisotopes, geochronology

Data collection period: May 2018 to August 2018

Geographic extent: (41.732720°, -70.364732°), (41.726875°, -70.364687°),(41.730943°, -70.383323°),(41.734042°, -70.381412°).

File format: csv

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Maps and Schematics for Data Collection: see above

3. Continuous Monitoring Data From Great Barnstable Marsh on Cape Cod, Massachusetts, 2017-19

General description of data:
The U.S. Geological Survey (USGS) measured parameters for groundwater wells (water elevation, water depth below land surface, salinity, and water temperature), soil and air temperature, and other meteorological parameters. All of these parameters affect plant productivity and are key components of salt marsh carbon cycling, carbon storage, and its ability to maintain elevation in response to changing sea level. These USGS datasets can be used to evaluate changes in water levels across ditched and natural salt marsh regions and provide information for any future studies of salt marsh productivity and geomorphic models in Great Barnstable Marsh.

More about the data:
Refer to the metadata record included with the data release for further information about data collection, data completeness, and logical consistency.

Search keywords:
wetland ecosystems, water temperature, groundwater level, salinity, soil temperature, air temperature, atmospheric pressure, water level measurements, Cape Cod

Data collection period: April 2017 to December 2019

Geographic extent: [-70.38159502, 41.72976573, -70.36442384, 41.73219942]

File format: Text files

- GBM_meta_2017_2019.xml, "CSDGM metadata.", Original FGDC Metadata
- GBM_MET_deployments_2017_2019.txt, "Summary of deployment dates and serial numbers of meteorological sensors."
- GBM_TEMP_2017_2019.txt, "Continuous monitoring of soil and air temperature data." GBM_Well_2017_2019.txt, "Continuous monitoring of well water level, temperature, and salinity data."
- GBM_WellSensorDeploymentHeights_2017_2019.txt, "Summary of land elevation, deployment length, and well height measurements. "
- GBM_MET_2017_2019.txt, "Continuous monitoring of PAR and other meteorological parameters data."
- GBM_Ditches_Photo.jpg, "Aerial photograph of the ditched portion of Great Barnstable Marsh, Cape Cod, MA"

Data Access and Archival:
O'Keefe Suttles, J.A., Gonneea, M.E., Mann, A.G., Brooks, T.W., Kroeger, K.D., Spivak, A.C., Wang, F., and Tang, J., 2020, Continuous monitoring data from Great Barnstable Marsh on Cape Cod, Massachusetts, 2017-19: U.S. Geological Survey data release, https://doi.org/10.5066/P9FYDG9Z.

https://www.sciencebase.gov/catalog/item/5e945de982ce172707f03429

Maps and Schematics for Data Collection: see above

4. Soil properties within ditched and natural marsh in Great Barnstable Marsh on Cape Cod, Massachusetts, 2018

General description of data:
Measurements of soil bulk density, percent water, LOI, TOC, δ^{13}C, S, δ^{34}S collected at creekbank edges (0m), interiors (50m and 100m) along 3, 100m transects in ditched and natural salt marsh sites within the Great Barnstable Marsh. NAVD88 elevation data at each site is also included.

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Search keywords: salt marsh, organic matter, soil, elemental content, carbon, sulfur

More about the data:
- Soil cores (30cm) were section into 0-10cm and 10-30cm horizons and dried to constant mass at 60C. Bulk density and water percent were determined gravimetrically. Percent organic and percent inorganic were determined by loss on ignition.
- Core sections were then sieved to remove organic matter >1mm. The sieved fraction was ball milled for CHNS analysis. For total organic carbon, ~20mg of sediment was weighed into silver cups and fumed overnight with HCl in a vacuum dessicator. Samples were analyzed with a Perkin Elmer 2400 series II CHNS/O.

Data collection period: May 2018 to August 2018

Geographic extent: (41.732720°, -70.364732°), (41.726875°, -70.364687°),(41.730943°, -70.383323°),(41.734042°, -70.381412°).

File format: csv

Data Access and Archival: This dataset has been archived and will be made publicly available via Sciencebase by Winter 2021. Prior to Winter 2021, individuals may reach out to Sheron Luk (sluk@whoi.edu) to discuss potential applications and request access to the data.

Maps and Schematics for Data Collection: see above

5. Plant community properties within ditched and natural marsh within Great Barnstable Marsh on Cape Cod, Massachusetts, 2018

General description of data:
Plant canopy height, percent cover, and biomass measured along three 100m transects within the ditched and natural marsh in Great Barnstable Marsh, MA.

More about the data:
Plant canopy height measurements represent the average of the five tallest plant species within a 1m^2 quadrat. Percent cover measurements represent an average visual estimate from within four adjacent 0.25m^2 quadrats. Plant biomass was collected from within a 0.0625m^2 quadrat placed randomly within the 1m^2 quadrat. Collected aboveground biomass was dried to constant mass at 60C and the dry weight was used to determine above ground biomass normalized to area.

Search keywords: salt marsh, plant, Spartina alterniflora, Spartina patens, Distchilis spicata

Data collection period: May 2018 to August 2018

Geographic extent: (41.732720°, -70.364732°), (41.726875°, -70.364687°),(41.730943°, -70.383323°),(41.734042°, -70.381412°).

File format: csv

Data Access and Archival: This dataset has been archived and will be made publicly available at http://www.nerrssciencecollaborative.org/resource/marsh-sustainability-and-hydrology-data by Winter 2021. Prior to that, individuals may reach out to Dr. Amanda Spivak to discuss potential applications and request access to the data.

Maps and Schematics for Data Collection: see above

6. Porewater chemistry from ditched and natural marsh within Great Barnstable Marsh on Cape Cod, Massachusetts, 2018

General description of data:
Porewater pH, salinity, and sulfide concentrations from about 1m depth, measured at 0, 25, 50, 75, and 100m along three 100m transects within the ditched and natural marsh in Great Barnstable Marsh, MA.

More about the data:
- Salinity was measured using a handheld refractometer. pH and sulfide measurements were made using a benchtop meter. A pH sensitive electrode, after a three-point calibration, was used to measure pH. Sulfide measurements were made with a silver/sulfide sensitive electrode. The silver/sulfide electrode was calibrated by titration of $Pb(NO3)2$ with $Na2S$. Concentration were calculated from a standard curve made with AgS.

Search keywords: salt marsh, pore water, pH, sulfide

Data collection period: May 2018 to August 2018

Geographic extent: (41.732720°, -70.364732°), (41.726875°, -70.364687°),(41.730943°, -70.383323°),(41.734042°, -70.381412°).

File format: csv

Data Access and Archival: This dataset has been archived and will be made publicly available at http://www.nerrssciencecollaborative.org/resource/marsh-sustainability-and-hydrology-data by Winter 2021. Prior to that, individuals may reach out to Dr. Amanda Spivak to discuss potential applications and request access to the data.

Maps and Schematics for Data Collection see above

7. Source code of the marsh evolution model (end user tool)

General description of data:
Source code for the marsh evolution model "MarshPondModel". This model constitutes the tier 3 end-user tool, i.e., it allows to simulate any arbitrary marsh geometry. This is the same model used in the tier 1 and 2 end-user tools, i.e., the tools with the pre-run simulations (which is available on the MSH website https://www2.whoi.edu/site/marshsustainabilityandhydrology/).

Search keywords: Marsh morphodynamics, Ponding, Ditching, Sea level rise

More about the data:
The model is written in the Matlab coding language. The model simulates marsh vertical accretion, bunk slumping, pond dynamics and ditching.

Data collection period: N/A

Geographic extent:
41.723319, -70.355312 (Barnstable, MA)

File format:
Text files (files have a ".m" extension but can be opened in any text editor)

Data Access and Archival:
The model is available on the CSDMS (NSF funded repository)
https://csdms.colorado.edu/wiki/Model:MarshPondModel
DOI: 10.5281/zenodo.4085606

Maps and Schematics for Data Collection: See above