Fluorescence and Physical Indicators for Sediment Cores from a Protected island in south Wilkinson Bay in the northeast portion of Barataria Bay, Louisiana in September 2018

Website: https://www.bco-dmo.org/dataset/855277
Data Type: Other Field Results
Version: 1
Version Date: 2021-09-08

Project
» Fate of Coastal Wetland Carbon Under Increasing Sea Level Rise: Using the Subsiding Louisiana Coast as a Proxy for Future World-Wide Sea Level Projections (Submerged Wetland Carbon)

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Abstract

Triplicate core samples were collected at three different distances at sites on the North, East, South, and West sides of a protected island in South Wilkinson Bay in the Northeast portion of Barataria Bay, Louisiana in September 2018. Samples were then analyzed for fluorescence and other physical indicators.

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Coverage

Spatial Extent: **Lat**:29.4669 **Lon**:-89.9108
Temporal Extent: 2018-09 - 2018-09

Methods & Sampling

Triplicate core samples were collected at three different distances from the island’s edge at sites on the North, East, South, and West sides of the island. These core samples were then broken down into 10 centimeter (cm) sections and these sections were then further divided into two subsets. The samples in the first subset were used for the soil physiochemical analysis. The samples in the second set were centrifuged to yield pore water samples that were spectroscopically analyzed.

Sample Collection: Thirty-six cores, which were 0.5 – 1 meters long, were collected on four sides (cardinal directions) of the island with a manual push-coring method using an acrylic tube (1.7 m long x 7.6 cm diameter). On each side, cores were extracted in triplicates at 16 m outland, the edge of the marsh (0 m), and 2 m inland. Upon extraction in the field, each core was sectioned in 10 cm sections, sealed in polyethylene bags, and stored on ice during transportation back to the lab, where they were stored at 4 degrees C in the dark until analysis.

Surface water samples were collected 10 cm below the surface at the edge of the marsh and 16 m outland following the procedures in Haywood et al. (2018).

Soil Physiochemical Analysis: The 10 cm sections were homogenized and weighed prior to analysis to determine gravimetric moisture content, bulk density, percent organic matter, and total carbon.

Gravimetric Moisture Content: The entire 10 cm section (~30 grams) was oven-dried at 60 degrees C until constant weight was achieved.

Bulk Density: The total weight of the dried 10 cm section of core was divided by the volume of the 10 cm section (385 cm3)

Percent Organic Matter: 1 gram of the dried 10 cm section of core was ground using a mortar and pestle. It was combusted in a Thermolyne furnace (Thermofischer Scientific, Waltham, MA) at 550 degrees C for 4 hours. After cooling, the sample was weighed. The difference in weight following combustion determined percent organic matter.

Total Carbon: 8 milligrams (mg) of the dried 10 cm section of core was used to determine total carbon. These samples were placed into a Shimadzu Total Organic Carbon Analyzer with SSM-5000 A (Shimadzu, Columbia, MD) and combusted at 900 degrees C for 13 minutes.

Porewater Analysis: To remove pore water from the wet soil samples, samples were centrifuged at 2578 *g* for 10 minutes. The pore water was decanted and filtered through a 0.45-micrometer x 22-millimeter Nylon syringe filter. After filtration, the pore water was stored at 4 degrees C in the dark until analysis. To determine the dissolved organic carbon, a Total Organic Carbon Analyzer (TOC-L) (Shimazdu, Columbia, MD) was used. A Cary 100 Spectrophotometer (Varian Inc., Palo Alto, CA) was used to collect UV–Vis absorbance spectra, and a Spex Fluorolog-3 spectrofluorometer (HORIBA Scientific, Edison, NJ) was used to collect fluorescence, methods based on Haywood et al. (2018).

The UV–Vis absorbance spectra were collected from 200 to 600 nm using a 0.5 nm bandpass and a 1 cm quartz cell, on a Cary 100 spectrophotometer.

Fluorescence EEMs were collected using a 1 cm quartz cell with excitation wavelengths of 250 to 550 nm and emission wavelengths of 250 to 600 nm with 5 nm increments for both on a Spex Fluorolog-3 spectrofluorometer. Along with sample EEMs, blank EEMs of Milli-Qnwater were collected daily.

To minimize temperature effects, samples were allowed to reach room temperature and shielded from light prior to analysis.

Data Processing Description

Analysis of Variance (ANOVA) was performed on R (Version 3.5.3; R Foundation for Statistical Computing, Vienna, Austria). The Tukey HSD method with Bonferonni correction was applied to the significant level (alpha = 0.003). The plots were created using ggplot2 (Wickhm, 2016) in R, too.

PCA analysis was performed in JMP (SAS Institute, Cary, NC).

For parallel factor analysis (PARAFAC) the pre-processed sample data were arranged into a three-way array with 114 samples, 61 excitation wavelengths in 5 nanometer (nm) increments ranging from 250 to 550 nm, and 71 emission wavelengths in 5 nm increments ranging from 250 to 600 nm. The fluorescence intensity was converted from arbitrary unites (A.U.) to Raman unites (R.U.) be-fore PARAFAC analysis. The PARAFAC analysis was performed with MATLAB R2015a (Math Works, Inc., Cambridge, MA) software program, utilizing open source drEEM toolbox version 2.0. The appropriate number of components for the dataset was determined using outlier identification and method validation techniques (i.e., least square fit and split-half analysis) following methods outlined in, with the best fit model having an explained variance of N95%. The identities of the components determined in the model were verified through comparison to previously identified component models using OpenFluor (DOM fluorescence spectral database).

BCO-DMO processing description:
- Adjusted field/parameter names to comply with BCO-DMO naming conventions
- Added a conventional header with dataset name, PI names, version date
- Converted dates to ISO date format (yyyy-mm-dd)
- Rounded columns to the hundredths place

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Data Files

File
core_fluorescent_indicators.csv(Comma Separated Values (.csv), 37.39 KB) MD5:225457cfb7836e4fba8e02ee81fffb8d Primary data file for dataset ID 855277

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Related Publications

Haywood, B. J., White, J. R., & Cook, R. L. (2018). Investigation of an early season river flood pulse: Carbon cycling in a subtropical estuary. Science of The Total Environment, 635, 867–877. doi:10.1016/j.scitotenv.2018.03.379
Methods

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Parameters

Parameter	Description	Units
Site_ID	Name of site	unitless
Latitude	latitude	Decimal degrees North
Longitude	longitude	Decimal degrees East (West is negative)
Date	date of sampling in format YYYY-MM	unitless
Island_Side	direction of site from island (North/South/East/West)	unitless
Replicate	replicate number	unitless
Depth	distance from surface	centimeters

Shore_Distance	2 meters inland, edge (0), 16 meters outland	meters
A254	UV/Vis Indicator	AU
A350	UV/Vis Indicator	AU
S275	UV/Vis Indicator	AU
FI	Fluorescence Indicator	AU
BIX	Fluorescence Indicator	AU
HIX	Fluorescence Indicator	AU
SUVA_254	UV/Vis Indicator	liters per milligram per meter (L mg^-1 m^-1)
SUVA_350	UV/Vis Indicator	liters per milligram per meter (L mg^-1 m^-1)
TOC	Total Organic Carbon	milligrams per liter (mg L^-1)
TC	Total carbon	milligrams per liter (mg L^-1)
IC	Inorganic Carbon	milligrams per liter (mg L^-1)
BD	Bulk Density	grams per cubic centimeter (g cm^-3)
LOI	Loss-On-Ignition	percent
Fluorophore_T	Fluorescence Indicator	Percent R.U.
Fluorophore_A	Fluorescence Indicator	Percent R.U.
Fluorophore_B	Fluorescence Indicator	Percent R.U.

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Instruments

Dataset-specific Instrument Name	Spex Fluorolog-3 spectrofluorometer (HORIBA Scientific, Edison, NJ)
Generic Instrument Name	Fluorometer
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

Dataset-specific Instrument Name	Thermolyne furnace (Thermofischer Scientific, Waltham, MA)
Generic Instrument Name	muffle furnace
Generic Instrument Description	A muffle furnace or muffle oven (sometimes retort furnace in historical usage) is a furnace in which the subject material is isolated from the fuel and all of the products of combustion, including gases and flying ash. A type of jacketed enclosure that is used to heat a material to significantly high temperatures while keeping it contained and fully isolated from external contaminants, chemicals or substances. Muffle furnaces are usually lined with stainless steel, making them largely corrosion-resistant.

Dataset-specific Instrument Name	
Generic Instrument Name	Push Corer
Dataset-specific Description	Acrylic tube (1.7 m long x 7.6 cm diameter)
Generic Instrument Description	Capable of being performed in numerous environments, push coring is just as it sounds. Push coring is simply pushing the core barrel (often an aluminum or polycarbonate tube) into the sediment by hand. A push core is useful in that it causes very little disturbance to the more delicate upper layers of a sub-aqueous sediment. Description obtained from: http://web.whoi.edu/coastal-group/about/how-we-work/field-methods/coring/

Dataset-specific Instrument Name	Shimadzu Total Organic Carbon Analyzer (TOC-L) (Shimazdu, Columbia, MD)
Generic Instrument Name	Shimadzu TOC-L Analyzer
Generic Instrument Description	A Shimadzu TOC-L Analyzer measures DOC by high temperature combustion method. Developed by Shimadzu, the 680 degree C combustion catalytic oxidation method is now used worldwide. One of its most important features is the capacity to efficiently oxidize hard-to-decompose organic compounds, including insoluble and macromolecular organic compounds. The 680 degree C combustion catalytic oxidation method has been adopted for the TOC-L series. http://www.shimadzu.com/an/toc/lab/toc-l2.html

Dataset-specific Instrument Name	Cary 100 Spectrophotometer (Varian Inc., Palo Alto, CA)
Generic Instrument Name	Spectrophotometer
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

Dataset-specific Instrument Name	Shimadzu Total Organic Carbon Analyzer with SSM-5000 A (Shimadzu, Columbia, MD)
Generic Instrument Name	Total Organic Carbon Analyzer
Generic Instrument Description	A unit that accurately determines the carbon concentrations of organic compounds typically by detecting and measuring its combustion product (CO2). See description document at: http://bcodata.whoi.edu/LaurentianGreatLakes_Chemistry/bs116.pdf

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Project Information

Fate of Coastal Wetland Carbon Under Increasing Sea Level Rise: Using the Subsiding Louisiana Coast as a Proxy for Future World-Wide Sea Level Projections (Submerged Wetland Carbon)

Coverage: Coastal Lousiana

Description from NSF award abstract:
Coastal Louisiana is currently experiencing net sea level rise at rates higher than most of the world's coastlines and within the global range predicted to occur in the next 65 - 85 years, making Louisiana an ideal site to study potential future impacts of rising sea level on coastal systems. This project will use field collection and controlled tank experiments to study the changing organic carbon cycle resulting from erosion of marsh soils along with its impact on associated biogeochemical processes. The hypothesis tested in this study is that the majority of eroded soil organic carbon is converted to carbon dioxide (CO2) and released to the atmosphere, representing an addition to the anthropogenic input of CO2. This process has not been quantified and could be an important missing component in predictive models of atmospheric CO2 changes. While this process may be of only regional importance today in comparison to other sources of CO2, this study of the Louisiana coast will greatly enhance our full understanding of the potential impacts on the global carbon cycle that may result from coastal erosion as global sea level continues to rise.

The project will train graduate and undergraduate students in interdisciplinary research involving marine and wetland biogeochemistry, microbiology, and ecological modeling. It will also fund development of an interactive, educational display on the loss of coastal wetlands for the Louisiana Sea Grant's annual Ocean Commotion educational event attended by area middle and high school students, teachers, and parents. Results from this study may also inform community planners both regionally and worldwide as they prepare for sea level rise in coastal communities.

Eustatic sea level rise and regional subsidence have created a much greater rate of coastline loss in Louisiana than is being experienced in most of the world's coastal regions, reaching global rates that are predicted to occur worldwide in 65 - 85 years. This provides a unique potential to extrapolate data from Louisiana's changing coastal carbon cycle to both regional and global models of the future impact of sea level rise and coastal erosion. By quantifying and modeling the importance of CO2 emissions resulting directly from mineralized soil organic matter from eroding coastlines, a missing element can be added to climate change models. The PIs here plan to investigate the fate of the coastal wetland carbon pool as it erodes using field sampling, laboratory analysis, mesocosm manipulations, and the creation of a coupled physical-biogeochemical model for the basin being studied. Beyond quantifying increased CO2 emission, the PIs will also address the potential for increased eutrophication due to input of nutrients from eroded soils, as well as the potential for future contribution to existing hypoxic zones in the northern Gulf of Mexico that result from excessive nutrient input from the Mississippi River watershed.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1636052

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