Soil physicochemical properties of coastal wetland soil cores collected in June 2018 from Barataria Bay, Louisiana

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Data Type: Other Field Results
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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)

Contributors	Affiliation	Role
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Abstract

Nine coastal wetland soil cores (150cm) collected in June 2018 from Barataria Bay, Louisiana were analyzed for biogeochemical properties, organic matter fractionation, and stable isotope signatures

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Coverage

Spatial Extent: **Lat**:29.443547 **Lon**:-89.8998
Temporal Extent: 2018-06 - 2018-06

Methods & Sampling

Nine coastal wetland soil cores were collected in June 2018 from Barataria Bay, Louisiana, a shallow open water basin located west of the Mississippi River Delta. Soil cores were collected along three transects, roughly 1 meter apart, that consisted of three points: the coastal fringe (0 m inland), 1 meter inland, and 2 meters inland. Soil cores were collected in polycarbonate tubes via the push core method to a depth of 150 cm, and field-extruded into 15 separate 10-cm intervals. Soils were stored in polyethylene bags on ice and immediately transported back to the laboratory, where they were kept at 4 °C until sample analysis was complete.

This dataset includes analyses of biogeochemical properties, organic matter fractionation, and stable isotope signatures.

Moisture Content and Bulk Density: A subsample of soil was dried using a gravimetric oven at 70°C for 3 days or until a constant weight was achieved. Dried soils were ground using a SPEX Sample Prep 8000M Mixer/Mill (Metuchen, NJ).

Total Carbon and Nitrogen content: %C and %N were determined using a Vario Micro Cube CHNS Analyzer on dried, ground subsamples.

Organic Matter Content: Dried, ground sub- samples were used to determine percent organic matter using the loss- on-ignition method, where soils were burned at 550°C in a muffle furnace for a total of 3 hours

Extractable Nitrate, Extractable Ammonium, Extractable Soluble Reactive Phosphorus: 2.5 grams of wet soil (both from the field and from the bottle incubation) were placed into 40 mL centrifuge tubes and 25 mL of 2 M KCl was added. Samples were then shaken continuously on an orbital shaker for 1 hour at 25 °C and 150 rpm, then centrifuged for 10 minutes at 10 °C and 5000 rpm. Following the centrifuge step, samples were immediately filtered through Supor 0.45 µM filters and acidified with double distilled H2SO4 to a pH of < 2 for preservation. Samples of Extractable nutrients were then analyzed using an AQ2 Automated Discrete Analyzer (Seal Analytical, Mequon, WI, EPA methods 231-A Rev.0, 210-A Rev.1, and 204-A Rev.0).

Carbon and Nitrogen isotopes: Stable isotope analysis was performed at the Stable Isotope Mass Spectroscopy Laboratory, Department of Geological Sciences at the University of Florida. Dried, ground subsamples from only the 1 meter inland cores were initially combusted on a Carlo Erba NA1500 CNS elemental analyzer. Following the removal of oxygen and water from the sample gas, the stream was passed through a 0.7 m GC column (120 °C), which separated the N2 gas from CO2. Effluent then passed into a ConFlo II system, and into a Thermo Electron Delta V Advantage isotope ratio mass spectrometer, where sample gas was measured in relation to laboratory reference gases. Carbon isotope results are expressed in relation to Vienna PDB, in standard delta notation.

Cellulose, Hemicellulose, and Refractory Carbon: Dried, ground subsamples were subjected to sequential extraction with H2SO4, following Rovira and Vallejo (2002) and Oades et al. (1970), with modifications. The first fraction is referred to hereafter as Labile Pool 1 (LP1) and consists of either plant- or microbially-derived non-cellulosic polysaccharides, including hemicellulose. Labile Pool 1 was extracted by adding 20 mL of 5 N H2SO4 into a 50 mL flask containing 0.5 grams of soil. The solution was heated for 30 minutes at 105 °C and subsequently allowed to cool. Samples were then filtered through Whatman #41 filters to separate particulates from the solution, and then diluted to a final volume of 50 mL. Labile Pool 2 (LP2), which consists of cellulose, was determined by adding 2 mL of 26 N H2SO4 to 0.5 grams of dried, ground soil. Samples were shaken at 100 rpm for 16 hours, then diluted to a final concentration of 2 N H2SO4 with deionized water. Samples were heated for 3 hours at 105°C, then filtered in the same manner as LP1. Determinations of LP1 and LP2 concentrations were conducted by use of a Shimadzu TOC-L (Shimadzu, Kyoto, Japan). The refractory pool was calculated as total soil C minus the sum of the labile pools. All pools were normalized to total soil C content.

Data Processing Description

Data processing:

All statistical analysis was performed in R (R Institute for Statistical Computing, Vienna, Austria) using RStudio (RStudio Inc., Boston, MA, USA). The Shapiro-Wilk test was used to verify assumptions of normality, and a logarithmic transformation was performed on all datasets. Levene’s test was used to determine homogeneity of variance. A linear mixed-effect model (package ‘lmer’) was used to test the following predictor variables: depth, distance inland, and the interaction of depth and distance inland on the samples collected from the marsh. Transect was included as a random effect. Distance inland was found to be a non-significant predictor variable for all parameters except for extractable NH4+. As such, distance inland and the interaction of depth and distance was removed as a predictor variable from models except extractable NH4+. Isotopic determinations and quantitative PCR analysis was performed exclusively on the three replicate cores taken 1 meter inland, and thus depth was the only predictor variable tested for those parameters. Following determination of significance within one of the predictor variables, the package ‘lsmeans’ was used for post-hoc pairwise comparisons using the Tukey method.

BCO-DMO processing:
- Added a conventional header with dataset name, PI names, version date
- Adjusted parameter names to comply with database requirements
- Units removed and added to Parameter Description metadata section
- Added Latitude and Longitude columns, converted DMS to DD
- Added column for Date of collection
- Entries with 'Analysis Not Conducted' were replaced with 'nd' (BCO-DMO's default missing data identifier)

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Data Files

File
Soil_data.csv (Comma Separated Values (.csv), 17.37 KB) MD5:44634e007da295b9d8e49afdf44c9e89 Primary data file for dataset ID 840246

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Related Publications

Oades, J. M., Kirkman, M. A., & Wagner, G. H. (1970). The Use of Gas-Liquid Chromatography for the Determination of Sugars Extracted from Soils by Sulfuric Acid. Soil Science Society of America Journal, 34(2), 230–235. doi:10.2136/sssaj1970.03615995003400020017x
Methods

R Core Team (2018). R: A language and environment for statistical computing. R v3.5.1. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/
Software

RStudio Team (2018). RStudio: Integrated Development for R. RStudio 1.1.456, PBC, Boston, MA URL http://www.rstudio.com/.
Software

Rovira, P., & Vallejo, V. R. (2002). Labile and recalcitrant pools of carbon and nitrogen in organic matter decomposing at different depths in soil: an acid hydrolysis approach. Geoderma, 107(1-2), 109–141. doi:10.1016/s0016-7061(01)00143-4 https://doi.org/10.1016/S0016-7061(01)00143-4
Methods

Sapkota, Y., & White, J. R. (2021). Long-term fate of rapidly eroding carbon stock soil profiles in coastal wetlands. Science of The Total Environment, 753, 141913. doi:10.1016/j.scitotenv.2020.141913
General

Steinmuller, H. E., & Chambers, L. G. (2019). Characterization of coastal wetland soil organic matter: Implications for wetland submergence. Science of The Total Environment, 677, 648–659. doi:10.1016/j.scitotenv.2019.04.405
Methods

Steinmuller, H. E., Dittmer, K. M., White, J. R., & Chambers, L. G. (2019). Understanding the fate of soil organic matter in submerging coastal wetland soils: A microcosm approach. Geoderma, 337, 1267–1277. doi:10.1016/j.geoderma.2018.08.020
General

Steinmuller, H. E., Foster, T. E., Boudreau, P., Hinkle, C. R., & Chambers, L. G. (2020). Characterization of herbaceous encroachment on soil biogeochemical cycling within a coastal marsh. Science of The Total Environment, 738, 139532. doi:10.1016/j.scitotenv.2020.139532
General

Steinmuller, H. E., Hayes, M. P., Hurst, N. R., Sapkota, Y., Cook, R. L., White, J. R., Xue, Z., & Chambers, L. G.

(2020). Does edge erosion alter coastal wetland soil properties? A multi-method biogeochemical study. CATENA, 187, 104373. https://doi.org/10.1016/j.catena.2019.104373
General

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Related Datasets

IsRelatedTo

Steinmuller, H. E., White, J. R., Cook, R. L., Xue, Z., Chambers, L. G. (2021) **Microbial gene abundance of coastal wetland soil cores collected in June 2018 from Barataria Bay, Louisiana.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-02-10 doi:10.26008/1912/bco-dmo.840278.1 [view at BCO-DMO]

Steinmuller, H. E., White, J. R., Cook, R. L., Xue, Z., Chambers, L. G. (2021) **Nutrient properties of coastal wetland soil cores collected in June 2018 from Barataria Bay, Louisiana.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-02-10 doi:10.26008/1912/bco-dmo.840293.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Distance	Distance from marsh edge	meters (m)
Rep	Denotation of whether core was the 1st (A), 2nd (B), or 3rd (C) core pulled from the site as field replicate	unitless
Depth	Soil depth below the surface	centimeters (cm)
Moisture_pcnt	Percentage of moisture within a soil sample	percent (%)
Bulk_Density	Weight per unit volume of a soil sample	grams per cubic centimeter (g/cm^3)
OM_pcnt	Concentration of organic matter within a soil sample, expressed as a percent	percent (%)
d15N	Isotopic signature of Carbon within soil (permil vs VPDB)	per mil (o/oo)
d13C	Isotopic signature of Nitrogen within soil (per mil vs AIR)	per mil (o/oo)
N_pcnt	Percentage of Total Nitrogen within a soil sample	percent (%)
C_pcnt	Percentage of Total Carbon within a soil sample	percent (%)

Extractable_Nitrate	Concentration of Extractable Nitrate within a soil sample	milligrams per kilogram (mg kg-1)
Extractable_SRP	Concentration of Extractable Soluble Reactive Phosphorous within a soil sample	milligrams per kilogram (mg kg-1)
Extractable_Ammonium	Concentration of Extractable Ammonium (NH4+) within a soil sample	milligrams per kilogram (mg kg-1)
Hemicellulose	Concentration of Hemicellulose within soil	milligrams per kilogram (mg kg-1)
Cellulose	Concentration of Cellulose within soil	milligrams per kilogram (mg kg-1)
Recalcitrant_Fraction	Concentration of Refractory Carbon within soil	milligrams per kilogram (mg kg-1)
Latitude	Latitude of sampling location	decimal degrees
Longitude	Longitude of sampling location (West is negative)	decimal degrees
Date_collected	Date of sample collection	unitless

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Instruments

Dataset-specific Instrument Name	Carlo Erba NA1500 CNS elemental analyzer
Generic Instrument Name	Carlo-Erba NA-1500 Elemental Analyzer
Generic Instrument Description	A laboratory instrument that simultaneously determines total nitrogen and total carbon from a wide range of organic and inorganic sediment samples. The sample is completely and instantaneously oxidised by flash combustion, which converts all organic and inorganic substances into combustion products. The resulting combustion gases pass through a reduction furnace and are swept into the chromatographic column by the carrier gas which is helium. The gases are separated in the column and detected by the thermal conductivity detector which gives an output signal proportional to the concentration of the individual components of the mixture. The instrument was originally manufactured by Carlo-Erba, which has since been replaced by Thermo Scientific (part of Thermo Fisher Scientific). This model is no longer in production.

Dataset-specific Instrument Name	
Generic Instrument Name	Centrifuge
Generic Instrument Description	A machine with a rapidly rotating container that applies centrifugal force to its contents, typically to separate fluids of different densities (e.g., cream from milk) or liquids from solids.

Dataset-specific Instrument Name	ConFlo II system
Generic Instrument Name	Continuous Flow Interface for Mass Spectrometers
Generic Instrument Description	A Continuous Flow Interface connects solid and liquid sample preparation devices to instruments that measure isotopic composition. It allows the introduction of the sample and also reference and carrier gases. Examples: Finnigan MATConFlo II, ThermoScientific ConFlo IV, and Picarro Caddy. Note: This is NOT an analyzer

Dataset-specific Instrument Name	AQ2 Automated Discrete Analyzer
Generic Instrument Name	Discrete Analyzer
Dataset-specific Description	AQ2 Automated Discrete Analyzer (Seal Analytical, Mequon, WI)
Generic Instrument Description	Discrete analyzers utilize discrete reaction wells to mix and develop the colorimetric reaction, allowing for a wide variety of assays to be performed from one sample. These instruments are ideal for drinking water, wastewater, soil testing, environmental and university or research applications where multiple assays and high throughput are required.

Dataset-specific Instrument Name	gravimetric oven
Generic Instrument Name	Drying Oven
Generic Instrument Description	a heated chamber for drying

Dataset-specific Instrument Name	Vario Micro Cube CHNS Analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	%C and %N were determined using a Vario Micro Cube CHNS Analyzer on dried, ground subsamples.
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

Dataset-specific Instrument Name	SPEX Sample Prep 8000M Mixer/Mill
Generic Instrument Name	Homogenizer
Dataset-specific Description	Dried soils were ground using a SPEX Sample Prep 8000M Mixer/Mill (Metuchen, NJ)
Generic Instrument Description	A homogenizer is a piece of laboratory equipment used for the homogenization of various types of material, such as tissue, plant, food, soil, and many others.

Dataset-specific Instrument Name	Thermo Electron Delta V Advantage isotope ratio mass spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

Dataset-specific Instrument Name	
Generic Instrument Name	muffle furnace
Dataset-specific Description	Soils were burned at 550°C in a muffle furnace for a total of 3 hours for loss-on-ignition method
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
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	orbital shaker
Generic Instrument Name	Shaker
Dataset-specific Description	For extractable nitrate, ammonium, and soluble reactive phosophorus, samples were shaken continuously on an orbital shaker
Generic Instrument Description	A Shaker is a piece of lab equipment used to mix, blend, or to agitate substances in tube(s) or flask(s) by shaking them, which is mainly used in the fields of chemistry and biology. A shaker contains an oscillating board which is used to place the flasks, beakers, test tubes, etc.

Dataset-specific Instrument Name	Shimadzu TOC-L
Generic Instrument Name	Shimadzu TOC-L Analyzer
Dataset-specific Description	Shimadzu TOC-L (Shimadzu, Kyoto, Japan)
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

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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-1635837

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