

Radiocarbon and ^{13}C of sediment from cores collected pre- and post-hurricane Harvey at the Aransas and Anahuac National Wildlife Refuges, Texas on January 2018

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Project

» [Hurricane Harvey Impacts on Local and Landscape Scale Salt Marsh Carbon Storage](#) (Harvey Marsh Carbon Storage)

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Abstract

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Coverage

Spatial Extent: N:29.57492 E:-94.55862 S:28.30388 W:-96.80315

Temporal Extent: 2014 - 2018

Acquisition Description

Three sediment cores were collected for analytical analyses from each site for a total of six cores. Sediments were extracted using a polycarbonate push core (7 cm ID x 50 cm L) with beveled edges pushed into the marsh surface. Cores were sectioned into 1-cm intervals on site on the day of collection and stored cold until laboratory analysis at the University of North Carolina, Chapel Hill, NC. All sediment samples were weighed damp, placed into a drying oven at 60°C for at least 48 hours for evaporation of water content and re-weighed dry. Bulk plant material, such as root mats and rhizomes, was manually removed with tweezers after the samples dried. Dried sediment samples were then homogenized using a mortar and pestle.

One 2014 pre-storm core from both sites, AR2 and AN2 (sediment collected in a previous study), and one 2018 post-storm core from Aransas, B, and two 2018 post-storm cores from Anahuac, D and E, were selected for bulk radiocarbon analyses. Samples were paired, one sample from the pre-storm core and one sample from the post-storm core, based on deposition age determined by ^{210}Pb geochronology. Four pairs of samples were selected from each study site to be analyzed for bulk ^{14}C age. In addition, one sediment surface sample from each site from the 2018 post-storm cores was selected for bulk ^{14}C age analyses, for a total of 18 samples.

Aliquots of approximately 300 mg of dried and homogenized sample were placed into acid cleaned and pre-baked glass tubes with 3 mL of a 10 % hydrochloric acid solution, with the sediment slightly agitated to ensure full saturation, and left to soak overnight to thoroughly remove inorganic carbon. After sediments settled the acid was carefully removed via pipette as to not resuspend or extract fine sediments. Samples were then rinsed five times with 5 mL of Milli-Q water over the course of 48 hours, with at least 4 hours between rinses to allow sediment to settle, to raise the pH of the samples back to neutral, and then placed in a 60 °C oven until dry. About 1 mg of OC, based on % TOC results, was weighed into tin capsules, sealed, and analyzed for bulk $\Delta^{14}\text{C}$ at the National Ocean Sciences Accelerator Mass Spectrometry facility at the Woods Hole Oceanographic Institution, Woods Hole, MA (NOSAMS).

A slow thermal ramp of 5 °C min⁻¹ was performed on only three pairs of acid rinsed aliquots of pre- and post-storm samples and the post-storm surface sample from Aransas, for a total of seven sediment samples, in order to collect fractions of evolved CO₂ as temperatures increased (i.e. fraction 1 is lower temperatures and 4 are higher). Detailed RPO experimental set-up and methods are available in Rosenheim et al. (2008) and Hemingway et al. (2017b). Detailed CO₂ to graphite conversion methods are provided in Pearson et al. (1998) and Shah Walter et al. (2015). Graphite was analyzed for ^{14}C on a Continuous Flow Accelerator Mass Spectrometer at NOSAMS. Samples were normalized to OX-I (Olsson, I.U., 1970) and radiocarbon-free acetanilide (J.T. Baker, A068-03) was used for blank correction. Standards from multiple international radiocarbon intercalibration comparisons and from International Atomic Energy Agency were used for secondary standards. $\delta^{13}\text{C}$ was analyzed from gas samples on an Optima or Prism stable isotope mass spectrometer.

Analysis of raw RPO data, described in detail in Hemingway et al. (2017a) and Hemingway (2016), was performed using the Python® package rampedpyrox.

Processing Description

BCO-DMO Processing Notes:

- data submitted in Excel file "Radiocarbon.xlsx" extracted to csv
- extracted site, station, lat, and lon data into a separate stations .csv file
- created new columns for station and sample by splitting the Sample_ID column for use as a join key to the stations file
- joined the stations file to the radiocarbon file so lat, lon, and site are included in the final table
- added conventional header with dataset name, PI name, version date
- renamed columns to conform with BCO-DMO naming conventions (removed units and special characters)

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Related Publications

Hemingway, J. D., Galy, V. V., Gagnon, A. R., Grant, K. E., Rosengard, S. Z., Soulet, G., ... McNichol, A. P. (2017). Assessing the Blank Carbon Contribution, Isotope Mass Balance, and Kinetic Isotope Fractionation of the Ramped Pyrolysis/Oxidation Instrument at NOSAMS. *Radiocarbon*, 59(1), 179–193.

doi:10.1017/rdc.2017.3 <https://doi.org/10.1017/RDC.2017.3>

Methods

Hemingway, J. D., Rothman, D. H., Rosengard, S. Z., & Galy, V. V. (2017). Technical note: An inverse

method to relate organic carbon reactivity to isotope composition from serial oxidation. *Biogeosciences*, 14(22), 5099–5114. doi:[10.5194/bg-14-5099-2017](https://doi.org/10.5194/bg-14-5099-2017)

Methods

Hemingway, J.D. rampedpyrox: open-source tools for thermoanalytical data analysis, 2016-, <http://pypi.python.org/pypi/rampedpyrox> [online; accessed May 20, 2019] doi. 10.5281/zenodo.3960330.

Methods

Pearson, A., McNichol, A. P., Schneider, R. J., Von Reden, K. F., & Zheng, Y. (1997). Microscale AMS 14C Measurement at NOSAMS. *Radiocarbon*, 40(1), 61–75. doi:10.1017/s0033822200017902

<https://doi.org/10.1017/S0033822200017902>

Methods

Rosenheim, B. E., Day, M. B., Domack, E., Schrum, H., Benthien, A., & Hayes, J. M. (2008). Antarctic sediment chronology by programmed-temperature pyrolysis: Methodology and data treatment. *Geochemistry, Geophysics, Geosystems*, 9(4), n/a–n/a. doi:10.1029/2007gc001816

<https://doi.org/10.1029/2007GC001816>

Methods

Walter, S. R. S., Gagnon, A. R., Roberts, M. L., McNichol, A. P., Gaylord, M. C. L., & Klein, E. (2015). Ultra-small graphitization reactors for ultra-microscale 14 C analysis at the National Ocean Sciences Accelerator Mass Spectrometry (NOSAMS) facility. *Radiocarbon*, 57(1), 109-122.

https://doi.org/10.2458/azu_rc.57.18118

Methods

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Parameters

Parameter	Description	Units
Site	site identifier	unitless
station	station identifier	unitless
Sample_ID	sample identifier includes station and depth	unitless
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
Year	Year of deposition of sediments; year with decimal fraction (1/10 of year)	unitless
Fraction	thermally separated fractions of samples: 1; 2; 3; 4; or Bulk sediments	unitless
F14C	Fraction modern of 14C: a measurement of the deviation of the 14C/12C ratio of a sample from "Modern." Modern is defined as 95% of the radiocarbon concentration (in AD 1950) of NBS Oxalic Acid I (SRM 4990B; OX-I) normalized to $\delta^{13}C_{VPDB} = -19$ per mil (Olsson; 1970).	unitless
F14Cer	Measurement error of F14C	unitless
C_13	Stable isotope 13C	ppt

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Instruments

Dataset-specific Instrument Name	Optima or Prism stable isotope mass spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Used to measure delta13C.
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	Continuous flow accelerator mass spectrometer
Generic Instrument Name	Accelerator Mass Spectrometer
Generic Instrument Description	An AMS measures "long-lived radionuclides that occur naturally in our environment. AMS uses a particle accelerator in conjunction with ion sources, large magnets, and detectors to separate out interferences and count single atoms in the presence of 1x10 ¹⁵ (a thousand million million) stable atoms, measuring the mass-to-charge ratio of the products of sample molecule disassociation, atom ionization and ion acceleration." AMS permits ultra low-level measurement of compound concentrations and isotope ratios that traditional alpha-spectrometry cannot provide. More from Purdue University: http://www.physics.purdue.edu/primelab/introduction/ams.html

Dataset-specific Instrument Name	Polycarbonate push core (7 cm ID x 50 cm L) with beveled edges
Generic Instrument Name	Push Corer
Dataset-specific Description	Used to collect the sediment samples.
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	
Generic Instrument Name	Drying Oven
Generic Instrument Description	a heated chamber for drying

Project Information

Hurricane Harvey Impacts on Local and Landscape Scale Salt Marsh Carbon Storage (Harvey Marsh Carbon Storage)

Coverage: Salt marshes in the Heron Flats at the Mission-Aransas NERR, Texas, and in the Aransas NWR, Texas

NSF Award Abstract:

Coastal wetlands store more than 20% of global carbon, and salt marshes are estimated to have the highest carbon burial rates of all coastal wetlands. Disturbances, like large storms, have the potential to reduce the storage of carbon in salt marshes and lower their overall impact on the global carbon cycle. Previous studies have shown that large quantities of sediment were deposited on salt marshes in Louisiana after Hurricanes Katrina and Rita in 2005, but little was known about the state of the marshes before these impacts. Consequently, we can only speculate about the true impact of those storms on sediment carbon storage. Comparing pre-storm carbon storage to post-storm storage immediately (weeks to months) following landfall allows us to quantify the storm impacts and capture critical data before inventory signals are lost to the next event. This project will take advantage of the fact that the investigators have recently (2014) sampled salt marshes near both of the locations where Hurricane Harvey made landfall in August, 2017. They will collect new salt marsh sediment samples and compare their data to 2014 data in order to study the impact of storm passage on these important systems.

Hurricane Harvey made landfall as a Category 4 storm at Rockport, TX, on 25 Aug 2017, moved inland, circled back, and made a second landfall as a tropical storm east of Port Arthur, TX, on 30 Aug 2017. These two major storm landfalls coincide with locations of salt marsh carbon burial studies performed in 2014 by this research group at the Aransas National Wildlife Refuge (NWR) and the Anahuac NWR. These data provide a baseline against which to assess the impacts of recent major storm landfalls on marsh accretion and carbon burial. It is imperative to return to these study sites as soon as possible to ensure that the perishable data resulting from the impacts of this storm on these marshes are not altered by other meteorological events or human disturbances. The investigators hypothesize hurricanes redistributed sediments from offshore and within the fringing salt marsh onto the marsh platform, increasing the elevation of the marsh and burying organic matter as stored carbon. The objectives of this research are 1) to quantify the impact of extratropical storm sediment accretion on carbon storage in two salt marshes at the local scale using 2014 baseline data; and 2) to extend these local storm-induced carbon changes to the landscape scale using pre- and post-storm LiDAR and satellite imagery. To address these objectives and preserve the perishable data, field work will take place at the Aransas and Anahuac NWRs during the week of 16 Oct 2017. Four 50 cm cores, two from each site, will be collected and sectioned based on stratigraphic changes. Sediment will be analyzed for total organic carbon, carbon-14, lead-210, and sediment physical properties (Obj. 1). Ground-truth measurements across the marsh will be obtained using a Macaulay auger and used to validate post- hurricane LiDAR measurements, which will be compared to pre-hurricane measurements from 2014 (Obj. 1 & 2). Freely available archived and new satellite imagery and LiDAR will be used to measure changes in marsh height and area (Obj. 2). The project will form part of the doctoral research of a graduate student, and will also support a senior undergraduate student.

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1760556

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