Dissolved inorganic carbon and total alkalinity fluxes from sediment incubation experiments during four R/V Pelican cruises to the Louisiana shelf in 2017 and 2018

Website: https://www.bco-dmo.org/dataset/896598
Data Type: Cruise Results
Version: 1
Version Date: 2023-05-30

Project
» Collaborative Research: A RAPID response to Hurricane Harvey's impacts on coastal carbon cycle, metabolic balance and ocean acidification (HarveyCarbonCycle)

Contributors	Affiliation	Role
Lehrter, John	University of South Alabama; and Dauphin Island Sea Lab (USA-DISL)	Principal Investigator
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Abstract
These data include the measurements of dissolved inorganic carbon (DIC) and total alkalinity (TA) fluxes from sediment incubation experiments at several sites on the Louisiana shelf. Data were collected during four cruises in 2017 and 2018. Cruises were conducted aboard the R/V Pelican in April (PE17-18), July (PE18-02), and September-October (PE18-11) of 2017 and January of 2018 (PE18-19). The study domain included the Louisiana and Texas continental shelf from the Mississippi River Bird's Foot delta to south of Galveston Bay. The objective of this work was to quantify how hurricanes and tropical storms affect metabolic rates and the concentrations of oxygen and DIC/pH. These data assess the sediment metabolism response before and after Hurricane Harvey and were collected by Dr. John Lehrter of the University of South Alabama.

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Coverage

Spatial Extent: **N**:28.8732 **E**:-90.48246 **S**:28.50066 **W**:-94.29978
Temporal Extent: 2017-04-05 - 2018-01-26

Methods & Sampling

At each site during the R/V Pelican cruises, a box corer was used to collect surface sediment. The box core

was subsampled in triplicate using 40 cm acrylic tubes that were pushed into the sediment to refusal, i.e. 20-30 cm. Cores were extracted in the acrylic tubes, capped on the bottom with an acrylic cap and o-ring, and submerged in a dark incubator filled with bottom water collected at the site. Each core was carefully filled with *in situ* near bottom water with minimum disturbance to the sediment-water interface and closed to ensure no visible headspace or air bubbles at the top. The submerged cores were allowed to equilibrate with the water in the incubator for 12 hours. A control was included that was an acrylic liner filled with bottom water only. Following this equilibration step, the cores were capped on their tops with an acrylic cap and o-ring. The top caps contained two sampling ports that were opened to collect water samples from the water overlying the sediments in the core tubes. The overlying water was mixed by a slowly turning magnetic stir bar suspended from the top cap. All cores were attached to a reservoir containing bottom water for gravity driven replenishment of water inside the core tubes during sampling. After capping, sampling commenced.

Samples for DIC were taken every 4-8 hours for up to 23 hours (4-6 time points) from the four cores, i.e. one control core with bottom water only (identified as 'Control') and three cores with sediments and bottom water (identified as 'Rep1', 'Rep2', and 'Rep3'). Dissolved inorganic carbon (DIC) and total alkalinity (TA) concentrations were analyzed in each sample by Wei Jun Cai's lab at the University of Delaware. For DIC, 1 ml of water sample was measured in triplicate with an infrared CO2 detector-based DIC analyzer (AS-C3 Apollo Scitech). For TA, a 25 ml water sample was measured in duplicate with the open-cell Gran titration method using a temperature-controlled, semi-automated titrator (AS-ALK2 Apollo Scitech). Certified Reference Materials provided by A. G. Dickson, Scripps Institution of Oceanography, were analyzed for DIC and TA for quality control.

Detailed methods are provided in Wang et al. (2020) and Lehrter et al. (2012).

Problem report: Data for a few time points are missing due to lost or broken sample containers. For 1801 C6, there is missing data, so assumed depths are presented based on the depths similar to the last sampling on cruise 1710 C6-2.

Data Processing Description

Sediment-water exchanges, i.e., fluxes, were calculated based on the rate of change in the DIC concentrations over time. Slopes were calculated for the rate of change for each core with sediments and for the core with bottom water only. The net flux was then calculated as the difference between mean of the sediment core slopes and the control slope.

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Data Files

File
sed_flux_dic_totalk.csv (Comma Separated Values (.csv), 50.02 KB) MD5:31015360eb85610a5a64705620a56503 Sediment flux of DIC and Total Alkalinity

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Related Publications

Lehrter, J. C., Beddick, D. L., Devereux, R., Yates, D. F., & Murrell, M. C. (2011). Sediment-water fluxes of dissolved inorganic carbon, O2, nutrients, and N2 from the hypoxic region of the Louisiana continental shelf. Biogeochemistry, 109(1–3), 233–252. https://doi.org/10.1007/s10533-011-9623-x
Methods

Wang, H., Lehrter, J., Maiti, K., Fennel, K., Laurent, A., Rabalais, N., Hussain, N., Li, Q., Chen, B., Scaboo, K. M.,

& Cai, W. (2020). Benthic Respiration in Hypoxic Waters Enhances Bottom Water Acidification in the Northern Gulf of Mexico. Journal of Geophysical Research: Oceans, 125(10). Portico. https://doi.org/10.1029/2020jc016152 https://doi.org/10.1029/2020JC016152
Results

,
Methods

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Parameters

Parameter	Description	Units
Cruise	Cruise ID	unitless
Station	Station ID where samples were collected	unitless
Latitude	Latitude of station	decimal degrees
Longitude	Longitude of station	decimal degrees
ISO_DateTime_UTC	Datetime of sampling	unitless
Bottle_number	Sample ID tracking bottle number for each cruise	unitless
DIC_conc_volume	DIC concentration (volumetric)	micromoles per liter (umol/L)
Salinity	Salinity of water sample	unitless
Density	Density of water sample	kilogram per liter (kg/L)
DIC_conc_weight	DIC concentration (weight)	micromoles per kilogram (umol/kg)
TA	Total Alkalinity concentration	micromoles per kilogram (umol/kg)
Rep	Sample replicate names where Rep 1, Rep 2, Rep 3 for sediment cores and Control for cores with bottom water only	unitless
DateTime_local	Local datetime of sampling	unitless
Overlying_Water_Depth	Depth of the bottom water within the sampling tubes	meters
Bottom_Depth	Depth of the seafloor at sampling site	meters
CruiseStation	Cruise and Station ID combination	unitless
Date_Sediment_Collection	Date of sediment collection	unitless
Comments	Comments	unitless

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Instruments

Dataset-specific Instrument Name	AS-ALK2 Apollo Scitec
Generic Instrument Name	Apollo SciTech AS-ALK2 total alkalinity titrator
Dataset-specific Description	For total alkalinity, a 25 ml water sample was measured in duplicate with the open-cell Gran titration method using a temperature-controlled, semi-automated titrator (AS-ALK2 Apollo Scitech).
Generic Instrument Description	An automated acid-base titrator for use in aquatic carbon dioxide parameter analysis. The titrator provides standardisation and sample analysis, using the Gran titration procedure for alkalinity determination of seawater and brackish waters. It is designed for both shipboard and land based laboratory use. The precision of the instrument is 0.1 percent or higher, and sample volumes may range from 10-25 ml. Titration takes approximately 8 minutes per sample, and the repeatability is within plus or minus 1-2 micromoles per kg.

Dataset-specific Instrument Name	Apollo SciTech AS-C3 Dissolved Inorganic Carbon (DIC) analyzer
Generic Instrument Name	Apollo SciTech AS-C3 Dissolved Inorganic Carbon (DIC) analyzer
Dataset-specific Description	For DIC, 1 milliliter of water sample was measured in triplicate with an infrared CO2 detector-based DIC analyzer (Apollo SciTech AS-C3 Dissolved Inorganic Carbon analyzer).
Generic Instrument Description	A Dissolved Inorganic Carbon (DIC) analyzer, for use in aquatic carbon dioxide parameter analysis of coastal waters, sediment pore-waters, and time-series incubation samples. The analyzer consists of a solid state infrared CO2 detector, a mass-flow controller, and a digital pump for transferring accurate amounts of reagent and sample. The analyzer uses an electronic cooling system to keep the reactor temperature below 3 degrees Celsius, and a Nafion dry tube to reduce the water vapour and keep the analyzer drift-free and maintenance-free for longer. The analyzer can handle sample volumes from 0.1 - 1.5 milliliters, however the best results are obtained from sample volumes between 0.5 - 1 milliliters. It takes approximately 3 minutes per analysis, and measurement precision is plus or minus 2 micromoles per kilogram or higher for surface seawater. It is designed for both land based and shipboard laboratory use.

Dataset-specific Instrument Name	box corer
Generic Instrument Name	Box Corer
Dataset-specific Description	At each site, a box corer was used to collect surface sediment.
Generic Instrument Description	General description of a box corer: A box corer is a marine geological tool that recovers undisturbed soft surface sediments. It is designed for minimum disturbance of the sediment surface by bow wave effects. Traditionally, it consists of a weighted stem fitted to a square sampling box. The corer is lowered vertically until it impacts with the seabed. At this point the instrument is triggered by a trip as the main coring stem passes through its frame. While pulling the corer out of the sediment a spade swings underneath the sample to prevent loss. When hauled back on board, the spade is under the box. (definition from the SeaVox Device Catalog) Box corers are one of the simplest and most commonly used types of sediment corers. The stainless steel sampling box can contain a surface sediment block as large as 50cm x 50cm x 75cm with negligible disturbance. Once the sediment is recovered onboard, the sediment box can be detached from the frame and taken to a laboratory for subsampling and further analysis. The core sample size is controlled by the speed at which the corer is lowered into the ocean bottom. When the bottom is firm, a higher speed is required to obtain a complete sample. A depth pinger or other depth indicator is generally used to determine when the box is completely filled with sediment. Once the core box is filled with sediment, the sample is secured by moving the spade-closing lever arm to lower the cutting edge of the spade into the sediment, until the spade completely covers the bottom of the sediment box. (definition from Woods Hole Oceanographic Institution).

Dataset-specific Instrument Name	temperature-controlled recirculating water bath incubator
Generic Instrument Name	circulating water bath
Dataset-specific Description	Immediately after collection, three incubation cores per station were immersed in a temperature-controlled recirculating water bath incubator adjusted to the recorded bottom water temperature.
Generic Instrument Description	A device designed to regulate the temperature of a vessel by bathing it in water held at the desired temperature. [Definition Source: NCI]

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Deployments

PE17-18

Website	https://www.bco-dmo.org/deployment/772116
Platform	R/V Pelican
Start Date	2017-04-05
End Date	2017-04-16

PE18-02

Website	https://www.bco-dmo.org/deployment/784911
Platform	R/V Pelican
Start Date	2017-07-07
End Date	2017-07-21

PE18-11

Website	https://www.bco-dmo.org/deployment/789096
Platform	R/V Pelican
Start Date	2017-09-28
End Date	2017-10-11
Description	Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/PE18-11

PE18-19

Website	https://www.bco-dmo.org/deployment/831660
Platform	R/V Pelican
Start Date	2018-01-17
End Date	2018-01-26

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Project Information

Collaborative Research: A RAPID response to Hurricane Harvey's impacts on coastal carbon cycle, metabolic balance and ocean acidification (HarveyCarbonCycle)

Coverage: Northwestern Gulf of Mexico

NSF Award Abstract:
Understanding how extreme events, like hurricanes, impact coastal ecosystems and the cycling of elements like carbon and oxygen, is important for improving our ability to predict how the global carbon cycle will respond to climate. This team of investigators, who have already been working together on understanding the carbon cycle in the Gulf of Mexico continental shelves, have important recent data against which to measure the effects of the passage of Hurricane Harvey in August, 2017. They will sample the waters and sediments of the northwestern Gulf of Mexico in September, October, and January to assess Harvey's impacts on a timescale of weeks to months.

The researchers pose three specific questions: 1. Will the region become a major source of carbon dioxide to the atmosphere, releasing carbon accumulated in the bottom water and sediments, and will this potential impact be faster and greater than during normal fall and winter mixing events? Will this process acidify the surface water and for how long? 2. Will the metabolic balance be substantially pushed toward net heterotrophy as a result of the storm in comparison to other years? 3. Can the amount of material delivered or redeposited across the continental shelf by a tropical cyclone be considerably larger than that related to winter storm systems? The PIs will measure water column nutrients, oxygen, organic carbon, and inorganic carbon system parameters; determine water column and benthic metabolic and nutrient flux rates; and sediment organic matter deposition rates. They will also collect end member river samples. They will compare the immediate (mid-Sept) but limited post-hurricane data and one-month post-hurricane, more detailed data with those collected in July and April to study the impacts of the storms. they will also compare 2017-2018 seasonal data to seasonal data over the same region collected in the past (2006-2008 and 2009-2010). They will also compare the

impacts of Hurricane Harvey to those of Hurricanes Katrina and Rita (2005) and Tropical Storm Cindy (June 2017). The project will involve graduate and postdoctoral research and work to communicate results to the public.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1760747

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