DIC, TA, pH, DO from nGOM cruises conducted aboard the R/V Pelican throughout 2017, 2018 and July 2019.

Website: https://www.bco-dmo.org/dataset/831523
Data Type: Cruise Results
Version: 1
Version Date: 2020-12-03

Project
» Collaborative Research: pH Dynamics and Interactive Effects of Multiple Processes in a River-Dominated Eutrophic Coastal Ocean (nGOMx acidification)

Contributors	Affiliation	Role
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Abstract
DIC, TA, pH, DO from nGOM cruises conducted in February 2017, April 2017, May 2017, July 2017, September 2017, October 2017, January 2018, April 2018, June 2018, August 2018 and July 2019 aboard the R/V Pelican.

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Coverage

Spatial Extent: **N**:29.6429 **E**:-88.5955 **S**:27.4992 **W**:-95.3093
Temporal Extent: 2017-02-26 - 2019-07-22

Acquisition Description

DIC and TA

Measure of DIC using NDIR method and of TA using Gran titration. DIC and TA were measured using the instruments from Apollo Scitech Inc. Briefly, for DIC analysis, samples were analyzed at room temperatures. Each seawater sample (0.75 mL) was acidified using phosphoric acid and the evolved CO2 gas was extracted and carried by pure N2 gas to an infrared CO2 detector (Li-Cor 6262) for quantification. TA was determined on 25 mL seawater sample by potentiometric titration, using 0.1 M hydrochloric acid and an open-cell titration system. All TA samples were analyzed in pre-thermostated (25 °C) glass cells. For each DIC or TA sample, sub-samples were sequentially analyzed 2 or 3 times until we obtained two replicates with a precision within 0.1%. The average of the two values is reported. The precision of both

the TA and DIC measurements was +/- 2 umol/kg. The accuracies of the TA and DIC measurements were determined by routine analysis of certified reference material (CRM) provided by A. G. Dickson, Scripps Institution of Oceanography.

DO_spec

Winkler titration was used for DO analysis. Samples were drawn from Niskin bottles directly into 60 ml BOD bottles and pickled using manganese chloride and sodium iodide/sodium hydroxide. Iodine liberated by acidifying pickled sample was then measured spectrophotometrically using Genesis 30 (Thomas Scientific) spectrophotometer at 466 nm. Blank absorbance from sample turbidity was obtained by adding a few drops of sodium thiosulfate to the sample solution and subtracted from sample absorbance. Calibration was performed by spiking known amounts of potassium iodate.

Error on DO was from the uncertainty of measuring absorbance (0.001), which is equivalent of 0.7 uM. Samples which had blank absorbance exceeding 5% of sample absorbance were flagged.

pH_elec

pH samples were drawn in 60 ml glass bottles and temperature equilibrated at 25 oC. An Orion Combination electrode connected to a pH meter (Orion Star A211) was used to measure the potential (EMF, mV) generated by the H+ ions. EMF was calibrated using three NBS buffer solutions at pH 4.01, 7.0, and 10.01 purchased from Fisher Scientific. Probe was kept immersed in the sample until the EMF stabilized. Two EMF readings at a difference of 1 minute were obtained for each sample and average value used with calibration to calculate the pH.

Precision on pH is estimated from the standard deviation of the mean of two EMF readings. Samples where such deviation exceeded 0.16% of the mean EMF are flagged.

Processing Description

The software to do data processing is Microsoft Excel. CTD data was downloaded from CTD directly without any further data processing. Both TA and DIC was converted to units of µmol/kg from µmol/L with density equation. DO_spec was converted to unit of µmol L-1 at 25°C.

BCO-DMO Data Manager Processing Notes:
* added a conventional header with dataset name, PI name, version date
* modified parameter names to conform with BCO-DMO naming conventions
* blank values in this dataset are displayed as "nd" for "no data." nd is the default missing data identifier in the BCO-DMO system.
* removed all spaces in headers and replaced with underscores
* removed all units from headers
* converted dates to ISO Format yyyy-mm-dd
* created ISO_DateTime_UTC
* set Types for each data column

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Related Publications

Huang, W.-J., Wang, Y., & Cai, W.-J. (2012). Assessment of sample storage techniques for total alkalinity and dissolved inorganic carbon in seawater. Limnology and Oceanography: Methods, 10(9), 711–717. doi:10.4319/lom.2012.10.711
Methods

Jiang, Z., Cai, W., Chen, B., Wang, K., Han, C., Roberts, B. J., … Li, Q. (2019). Physical and Biogeochemical Controls on pH Dynamics in the Northern Gulf of Mexico During Summer Hypoxia. Journal

of Geophysical Research: Oceans, 124(8), 5979–5998. doi:10.1029/2019jc015140
https://doi.org/10.1029/2019JC015140
Results

Jiang, Z.-P., Cai, W.-J., Lehrter, J., Chen, B., Ouyang, Z., Le, C., & Roberts, B. J. (2019). Spring net community production and its coupling with the CO2 dynamics in the surface water of the northern Gulf of Mexico. doi:10.5194/bg-2019-88
Results

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Parameters

Parameter	Description	Units
Cruise	Cruise name	unitless
Date	Date in format yyyy-mm-dd	%Y-%m-%d
Time	Time in format hh:mm:ss (UTC time)	%H:%M:%S
ISO_DateTime_UTC	Date/Time (UTC) ISO formatted. This standard is based on ISO 8601:2004(E)	%Y-%m-%dT%H:%M:%SZ
Station	Station name	unitless
Cast	Cast number	unitless
Longitude	Longitude, west is negative	decimal degrees
Latitude	Latitude, south is negative	decimal degrees
Bot_Depth	Bottom depth	meter (m)
Depth	sampling depth	meter (m)
Temperature	temperature in sampling depth	degrees celsius
Salinity	salinity in sampling depth	PSU
OxygenSBE	CTD Dissolved oxygen concentration	milligram per liter mg/L
FluorescenceChl	CTD Fluorescence Chl	milligram per cubic meter ug/L
TA_final	Total Alkalinity	micromole per kilogram umol/kg
flag_TA	flag_1 means missing value; flag_2 means precision 0.1%	unitless
DIC_final	Total dissolved inorganic carbon	Micromole per kilogram (umol/kg)
flag_DIC	flag_1 means missing value; flag_2 means precision 0.1%	unitless
pHelec	NBS pH measured by electrode	unitless
flag_pHelec	flag_1 means missing value; flag_2 means precision ±0.02	unitless
DO_spec	DO measured by umol/L spectrometer @ 25 °C	unitless
flag_DOspec	flag_1 means missing value; flag_2 means precision 0.7µmol L-1	unitless

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Instruments

Dataset-specific Instrument Name	12-bottle rosette equipped with a SeaBird CTD 911
Generic Instrument Name	CTD Sea-Bird 911
Generic Instrument Description	The Sea-Bird SBE 911 is a type of CTD instrument package. The SBE 911 includes the SBE 9 Underwater Unit and the SBE 11 Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 and SBE 11 is called a SBE 911. The SBE 9 uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 and SBE 4). The SBE 9 CTD can be configured with auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). More information from Sea-Bird Electronics.

Dataset-specific Instrument Name	Winkler titration was used for DO_spec analysis. DO_spec samples were measured spectrophotometrically using Genesis 30 (Thomas Scientific) spectrophotometer at 466 nm.
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	DIC and TA were measured using the instruments from Apollo Scitech Inc.
Generic Instrument Name	Apollo SciTech AS-C3 Dissolved Inorganic Carbon (DIC) 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 Nagion 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.

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Deployments

PE17-12

Website	https://www.bco-dmo.org/deployment/831651
Platform	R/V Pelican
Start Date	2017-02-26
End Date	2017-02-28

PE17-18

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

PE17-21

Website	https://www.bco-dmo.org/deployment/831653
Platform	R/V Pelican
Start Date	2017-05-14
End Date	2017-05-16

PE18-11

Website	https://www.bco-dmo.org/deployment/789096
Platform	R/V Pelican
Start Date	2017-09-28
End Date	2017-10-11

PE18-02

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

PE18-19

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

PE18-24

Website	https://www.bco-dmo.org/deployment/831663
Platform	R/V Pelican
Start Date	2018-04-24
End Date	2018-04-26

PE18-33

Website	https://www.bco-dmo.org/deployment/831666
Platform	R/V Pelican
Start Date	2018-06-26
End Date	2018-06-28

PE19-06

Website	https://www.bco-dmo.org/deployment/831670
Platform	R/V Pelican
Start Date	2018-08-14
End Date	2018-08-22

PE20-03

Website	https://www.bco-dmo.org/deployment/831673
Platform	R/V Pelican
Start Date	2019-07-15
End Date	2019-07-22

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Project Information

Collaborative Research: pH Dynamics and Interactive Effects of Multiple Processes in a River-Dominated Eutrophic Coastal Ocean (nGOMx acidification)

Coverage: northern Gulf of Mexico, 27.5 N, 30 N, 88 W, 94 W

NSF Award Abstract:

Ocean acidification (OA) refers to the lowering of ocean pH (or increasing acidity) due to uptake of atmospheric carbon dioxide (CO2). A great deal of research has been done to understand how the open ocean is influenced by OA, but coastal systems have received little attention. In the northern Gulf of Mexico (nGOM) shelf region, pH in bottom waters can measure up to 0.45 units less than the pH of the pre-industrial surface ocean, in comparison to the 0.1 overall pH decrease across the entire ocean. Carbonate chemistry in the ocean is greatly influenced by even small changes in pH, so these seemingly minor changes lead to much greater impacts on the biology and chemistry of the ocean. The researchers

plan to study coastal OA in the nGOM, a region subject to high inputs of nutrients from the Mississippi River. These inputs of anthropogenic nitrogen mostly derived from fertilizers leads to increased respiration rates which decreases oxygen concentrations in the water column to the point of hypoxia in the summer. This study will inform us how OA in coastal waters subject to eutrophication and hypoxia will impact the chemistry and biology of the region. The researchers are dedicated to outreach programs in the Gulf and east coast regions, interacting with K-12 students and teachers, undergraduate/graduate student training, and various outreach efforts (family workshops on OA, lectures for the public and federal, state, and local representatives). Also, a project website will be created to disseminate the research results to a wider audience.

Increased uptakes of atmospheric carbon dioxide (CO2) by the ocean has led to a 0.1 unit decrease in seawater pH and carbonate mineral saturation state, a process known as Ocean Acidification (OA), which threatens the heath of marine organisms, alters marine ecosystems, and biogeochemical processes. Considerable attention has been focused on understanding the impact of OA on the open ocean but less attention has been given to coastal regions. Recent studies indicate that pH in bottom waters of the northern Gulf of Mexico (nGOM) shelf can be as much as 0.45 units lower relative to pre-industrial values. This occurs because the acidification resulting from increased CO2 inputs (both atmospheric inputs and in-situ respiration) decreases the buffering capacity of seawater. This interactive effect will increase with time, decreasing summertime nGOM bottom-water pH by an estimated 0.85 units and driving carbonate minerals to undersaturation by the end of this century. Researchers from the University of Delaware and the Louisiana Universities Marine Consortium will carry out a combined field, laboratory, and modeling program to address the following questions. (1) What are the physical, chemical, and biological controls on acidification in coastal waters impacted by the large, nutrient-laden Mississippi River?; (2) What is the link between coastal-water acidification, eutrophication, and hypoxia; (3) How do low pH and high CO2 concentrations in bottom waters affect CO2 out-gassing during fall and winter and storm periods when the water column is mixed?; and (4) What are the influences of changing river inputs under anthropogenic forcing on coastal water acidification? Results from this research aim to further our understanding of the processes influencing ocean acidification in coastal waters subject to eutrophication and hypoxia both in the GOM and river-dominated shelf ecosystems globally.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1559279

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