Underway pCO2 from the R/V Pelican cruise GOM_UW_1704 conducted in the Northern Gulf of Mexico in April 2017.

Website: https://www.bco-dmo.org/dataset/770864
Data Type: Cruise Results
Version: 1
Version Date: 2019-07-01

Project

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

Contributors	Affiliation	Role
Cai, Wei-Jun	University of Delaware	Principal Investigator
Fennel, Katja	Dalhousie University	Co-Principal Investigator
Rabalais, Nancy	Louisiana State University (LSU)	Co-Principal Investigator
Soenen, Karen	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

Underway pCO2 from R/V Pelican cruise conducted in the northern Gulf of Mexico (27.5 N, 30 N, 88 W, 94 W) from April 5th to 16th in 2017. The precision of pCO2 is ±2 µatm.

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Coverage

Spatial Extent: **N**:29.6455 **E**:-88.7984 **S**:27.4902 **W**:-93.4223
Temporal Extent: 2017-04-06 - 2017-04-16

Dataset Description

Underway pCO2 from R/V Pelican cruise GOM_UW_1704 conducted in northern Gulf of Mexico in April 2017.

Acquisition Description

Underway sea surface temperature, salinity, and pCO2 data were collected continuously along the cruise track. Surface seawater was collected from an intake on the port side of the ship at about 4m depth. SST and SSS were measured by an SBE45 (Sea-Bird Electronics) Thermosalino graph installed in the sea chest. Seawater was pumped to the ship's labs. There, underway pCO2 was measured inline by an automated system (Apollo Scitech) with a Li-7000 (LICOR, Inc.) non-dispersive infrared detector at a water flow rate of 3-4L/min; The sampling interval was 2 min. This autonomous system was twice daily against three certified CO2 gas standards (150.62, 404.72, and 992.54 ppm) obtained from NOAA's Earth System Research Laboratory (ESRL), Global Monitoring Division in Boulder, CO. These gas standards are directly traceable to the World Meteorological Organization (WMO) scale. The precision of underway pCO2 measurements of this system is 0.1 µatm, and the overall accuracy is estimated at 2 µatm, as documented by Pierrot et al. (2009). The underway system uses a shower head type equilibrator with ~0.5L headspace volume.

Instruments:
Underway pCO2 was measured inline by an automated system (Apollo Scitech) with a Li-7000 (LICOR, Inc.) non-dispersive infrared detector .

The pCO2 measurement was calibrated twice daily against 3 certified CO2 gas standards (150.62, 404.72, and 992.54 ppm)

Processing Description

1) Read the data into Excel.
2) Get the data log book and delete any questionable data such as those during instrument failure. Note: data during calibration should be cut and pasted into another worksheet.
3) Correct the CO2 data directly from Li-Cor using the calibration results. Specifically, first get the linear relationship between the known xCO2 from gas cylinders and the Li-Cor reading; then use the correlated equation to correct the raw xCO2 to calibrated xCO2.
4) Calculate the surface water pCO2 at the temperature of equilibration (it will be corrected to in-situ temperature later) [pCO2 (eq), units: µatm][Weiss and Price, 1980].
5) Calculate in-situ pCO2 [pCO2@SST, units: µatm] (Takahashi et al. 1993)

Data Manager processing notes:
- Converted longitude range from 0-360 to -180 - 180
- Added "Z" to end the datetime stamp to indicate it was in UTC time

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Related Publications

Feely, R. A., Wanninkhof, R., Milburn, H. B., Cosca, C. E., Stapp, M., & P. Murphy, P. (1998). A new automated underway system for making high precision pCO2 measurements onboard research ships. Analytica Chimica Acta, 377(2-3), 185–191. doi:10.1016/S0003-2670(98)00388-2

Ho, D.T., Wanninkhof, R., Masters, J., Feely, R. A., and Cosca, C. E. (1997). Measurement of underway fCO2 in the Eastern Equatorial Pacific on NOAA ships BALDRIGE and DISCOVERER, NOAA data report ERL AOML-30, 52 pp., NTIS Springfield.

Pierrot, D., Neill, C., Sullivan, K., Castle, R., Wanninkhof, R., Lüger, H., … Cosca, C. E. (2009). Recommendations for autonomous underway pCO2 measuring systems and data-reduction routines. Deep Sea Research Part II: Topical Studies in Oceanography, 56(8-10), 512–522. doi:10.1016/j.dsr2.2008.12.005

Takahashi, T., Olafsson, J., Goddard, J. G., Chipman, D. W., & Sutherland, S. C. (1993). Seasonal variation of CO2and nutrients in the high-latitude surface oceans: A comparative study. Global Biogeochemical Cycles, 7(4), 843–878. doi:10.1029/93GB02263

Wanninkhof, R., & Thoning, K. (1993). Measurement of fugacity of CO2 in surface water using continuous and discrete sampling methods. Marine Chemistry, 44(2-4), 189–204. doi:10.1016/0304-4203(93)90202-Y

Weiss, R. F. (1970). The solubility of nitrogen, oxygen and argon in water and seawater. Deep Sea Research and Oceanographic Abstracts, 17(4), 721–735. doi:10.1016/0011-7471(70)90037-9

Weiss, R. F. (1974). Carbon dioxide in water and seawater: the solubility of a non-ideal gas. Marine Chemistry, 2(3), 203–215. doi:10.1016/0304-4203(74)90015-2

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Parameters

Parameter	Description	Units
Region	Study area: MisPlume (west), MisPlume (east), AtchCoast or AtchPlume	unitless
Cruise	Cruise name	unitless
GPS_DateTime_UTC	Date time in format yyyy-mm-ddTHH:MM:SS (UTC)	unitless
Longitude	Longitude, west is negative	decimal degrees
Latitude	Latitude, south is negative	decimal degrees
Temperature	Sea surface tempearture, measured with SBE45	degrees Celsius (°C)
Salinity	Sea surface salinity, measured with SBE45	PSU
pCO2	pCO2 at SST (+-2 uatm)	microatmosphere (uatm)
Flag_pCO2	Flag of pCO2 at SST. A flag indicated as 2 is good, it means the precision is less than +- 2 uatm	unitless

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Instruments

Dataset-specific Instrument Name	a Li-7000 (LICOR, Inc.) non-dispersive infrared detector
Generic Instrument Name	LI-COR LI-7000 Gas Analyzer
Dataset-specific Description	Underway pCO2 was measured inline by an automated system (Apollo Scitech) with a Li-7000 (LICOR, Inc.) non-dispersive infrared detector .
Generic Instrument Description	The LI-7000 CO2/H2O Gas Analyzer is a high performance, dual cell, differential gas analyzer. It was designed to expand on the capabilities of the LI-6262 CO2/ H2O Gas Analyzer. A dichroic beam splitter at the end of the optical path provides radiation to two separate detectors, one filtered to detect radiation absorption of CO2 and the other to detect absorption by H2O. The two separate detectors measure infrared absorption by CO2 and H2O in the same gas stream. The LI-7000 CO2/ H2O Gas Analyzer is a differential analyzer, in which a known concentration (which can be zero) gas is put in the reference cell, and an unknown gas is put in the sample cell.

Dataset-specific Instrument Name	
Generic Instrument Name	pCO2 Sensor
Dataset-specific Description	Underway pCO2 was measured inline by an automated system (Apollo Scitech) with a Li-7000 (LICOR, Inc.) non-dispersive infrared detector .
Generic Instrument Description	A sensor that measures the partial pressure of CO2 in water (pCO2)

Dataset-specific Instrument Name	SBE45 (Sea-Bird Electronics) Thermosalino graph
Generic Instrument Name	Sea-Bird SBE 45 MicroTSG Thermosalinograph
Generic Instrument Description	A small externally powered, high-accuracy instrument, designed for shipboard determination of sea surface (pumped-water) conductivity and temperature. It is constructed of plastic and titanium to ensure long life with minimum maintenance. It may optionally be interfaced to an external SBE 38 hull temperature sensor. Sea Bird SBE 45 MicroTSG (Thermosalinograph)

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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

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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