Carbonate chemistry in Mission Aransas Estuary from May 2014 to Feb 2017 and Dec 2018 to Feb 2020

Website: https://www.bco-dmo.org/dataset/835227
Data Type: Other Field Results
Version: 1
Version Date: 2021-01-04

Project
» CAREER: The Impact of Hydrologic State on CO2 Flux and Acidification in Subtropical Estuaries (CO2 Flux and Acidification in Subtropical Estuaries)

Contributors	Affiliation	Role
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Abstract
The Ecosystem Science and Modeling lab has been collecting water samples from five stations in the Mission-Aransas Estuary (MAE, Northwest Gulf of Mexico, Texas coast) for carbonate system characterization on a monthly to twice monthly basis since May 2014. This dataset includes temperature, salinity, dissolved inorganic carbon (DIC), total alkalinity (TA), calcium, and pH measurements from surface and bottom water samples in MAE from May 2014 – Feb 2017 and Dec 2018 – Feb 2020. Additional data for this estuary to fill in the Feb 2017 – Dec 2018 gap are also archived with BCO-DMO (http://www.bco-dmo.org/dataset/784673, doi:10.1575/1912/bco-dmo.784673.1).

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Coverage

Spatial Extent: **N**:28.73833 **E**:-96.8283 **S**:27.83806 **W**:-97.2008
Temporal Extent: 2014-05-02 - 2020-02-25

Methods & Sampling

Samples were collected every two weeks (March-October) or monthly (November-February) using Mission-Aransas National Estuarine Research Reserve Small Boat. Water samples from both the surface (~0.5 meters) and the bottom of the water column (within 0.5 m from the sediment-water interface) were obtained using a Van Dorn water sampler.

Data Processing Description

Following the standard ocean acidification operating protocol, unfiltered water samples were collected in 250

mL borosilicate glass bottles for carbonate system characterization. 100 µL saturated mercuric chloride (HgCl2) was added into the sample bottles and bottle stoppers were replaced after the application of Apiezon® L grease and secured with a rubber band and hose clamp. These preserved samples were used for salinity, total alkalinity (TA), total dissolved inorganic carbon (DIC), and pH analyses within two months of sample collection.

In-situ temperatures at both the surface (~0.5 m) and the bottom of the water column (within 0.5 m from the sediment-water interface) were obtained using a calibrated YSI 6920 multisonde. Salinity was measured using a benchtop salinometer (Orion Star™ A12, Thermo Scientific) which was calibrated using MilliQ and known salinity certified reference material (CRM). Total Alkalinity (TA) was analyzed at 22±0.1°C using Gran titration on an automated titration system (AS-Alk2, Apollo Scitech Inc.). DIC was analyzed using infrared detection on an AS-C3 DIC analyzer (Apollo Scitech Inc.). Certified reference material was used to ensure the quality of the analysis and optimal performance of the instruments. Total scale pH for salinity ≥20 samples was measured on a spectrophotometer at 25°C using purified m-cresol purple. The equation in Liu et al. (2011) was used in the calculation of pH values. For low salinity waters (<20) prior to September 28th, 2017, a potentiometric method was used to measure pH. An Orion® Ross™ high precision glass electrode was used and three pH standards (4.01, 7.00, and 10.01) were used to calibrate the electrode. Beginning September 28th, 2017, the low salinity samples were also run on the spectrophotometer, and the Douglas and Byrne (2017) equation was used to calculate pH on total scale. Calcium concentration ([Ca2+]) was measured (from non-preserved water samples) using an automatic titration with an ethylene glycol tetraacetic acid (EGTA) titrant on a Metrohm Titrando. The end-point was detected using a Metrohm calcium ion-selective electrode.

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Data Files

File
carbonate_chem_data.csv (Comma Separated Values (.csv), 56.37 KB) MD5:adfc590a1e0fcddd5690aad7819f426a Primary data file for dataset ID 835227

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Related Publications

Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.) 2007. Guide to Best Practices for Ocean CO2 Measurements. PICES Special Publication 3, 191 pp https://isbnsearch.org/isbn/1-897176-07-4
Methods

Douglas, N. K., & Byrne, R. H. (2017). Spectrophotometric pH measurements from river to sea: Calibration of mCP for 0 ≤S≤ 40 and 278.15 ≤T≤ 308.15 K. Marine Chemistry, 197, 64–69. doi:10.1016/j.marchem.2017.10.001
Methods

Liu, X., Patsavas, M. C., & Byrne, R. H. (2011). Purification and Characterization of meta-Cresol Purple for Spectrophotometric Seawater pH Measurements. Environmental Science & Technology, 45(11), 4862–4868. doi:10.1021/es200665d
Methods

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Parameters

Parameter	Description	Units
ISO_Date	Sampling date in ISO date format	yyyy-mm-dd
Latitude	Latitude of sample collection, South is negative	degrees North
Longitude	Longitude of sample collection, West is negative	degrees East
Station	Station name	unitless
Depth	Sample depth	meters (m)
Temperature	Water temperature	degrees Celsius
Salinity	Salinity	unitless
DIC	Total dissolved inorganic carbon	micromoles per kilogram (umol/kg)
TA	Total titration alkalinity	micromoles per kilogram (umol/kg)
Calcium	Calcium	millimoles per kilogram (mmol/kg)
pH	pH at 25 degrees Celsius	unitless
pH_Label	pH method (1=spectrophotometric, 4=potentiometric)	unitless

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Instruments

Dataset-specific Instrument Name	AS-C3 DIC analyzer, 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 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	Orion Star™ A12, Thermo Scientific
Generic Instrument Name	Conductivity Meter
Dataset-specific Description	Orion Star™ A12, Thermo Scientific
Generic Instrument Description	Conductivity Meter - An electrical conductivity meter (EC meter) measures the electrical conductivity in a solution. Commonly used in hydroponics, aquaculture and freshwater systems to monitor the amount of nutrients, salts or impurities in the water.

Dataset-specific Instrument Name	YSI 6920 multisonde
Generic Instrument Name	Multi Parameter Portable Meter
Dataset-specific Description	YSI 6920 multisonde is a multiparameter water quality instrument for real-time or long-term monitoring and profiling of temperature, conductivity, pH, oxidation-reduction potential, dissolved oxygen, and turbidity.
Generic Instrument Description	An analytical instrument that can measure multiple parameters, such as pH, EC, TDS, DO and temperature with one device and is portable or hand-held.

Dataset-specific Instrument Name	Orion® Ross™ glass electrode, Thermo Scientific
Generic Instrument Name	pH Sensor
Dataset-specific Description	Orion® Ross™ glass electrode, Thermo Scientific
Generic Instrument Description	An instrument that measures the hydrogen ion activity in solutions. The overall concentration of hydrogen ions is inversely related to its pH. The pH scale ranges from 0 to 14 and indicates whether acidic (more H+) or basic (less H+).

Dataset-specific Instrument Name	Agilent 8453 UV-Vis spectrophotometer
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	AS-Alk2 alkalinity titrator, Apollo SciTech Inc
Generic Instrument Name	Titrator
Generic Instrument Description	Titrators are instruments that incrementally add quantified aliquots of a reagent to a sample until the end-point of a chemical reaction is reached.

Dataset-specific Instrument Name	Metrohm Titrando 888, calcium ion-selective Titrode
Generic Instrument Name	Titrator
Generic Instrument Description	Titrators are instruments that incrementally add quantified aliquots of a reagent to a sample until the end-point of a chemical reaction is reached.

Dataset-specific Instrument Name	Van Dorn Beta™ Horizontal Bottle, Aquatic Biotechnology
Generic Instrument Name	Van Dorn water sampler
Generic Instrument Description	A free-flushing water sample bottle comprising a cylinder (polycarbonate, acrylic or PVC) with a stopper at each end. The bottle is closed by means of a messenger from the surface releasing the tension on a latex band and thus pulling the two stoppers firmly into place. A thermometer can be mounted inside the bottle. One or more bottles can be lowered on a line to allow sampling at a single or multiple depth levels. Van Dorn samplers are suitable for for physical (temperature), chemical and biological sampling in shallow to very deep water. Bottles are typically lowered vertically through the water column although a horizontal version is available for sampling near the seabed or at thermoclines or chemoclines. Because of the lack of metal parts the bottles are suitable for trace metal sampling, although the blue polyurethane seal used in the Alpha version may leach mercury. The Beta version uses white ASA plastic seals that do not leach mercury but are less durable.

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Project Information

CAREER: The Impact of Hydrologic State on CO2 Flux and Acidification in Subtropical Estuaries (CO2 Flux and Acidification in Subtropical Estuaries)

Website: http://hulab.tamucc.edu/research.htm

Coverage: Gulf of Mexico

NSF Award Abstract:

This project is a CAREER award to Xinping Hu at Texas A&M University-Corpus Christi. Hu proposes to integrate research and education in an investigation of carbon cycling and ocean acidification in the Mission-Aransas Estuary in South Texas. This coastal system is strongly affected by changes in river flow between seasons and from year to year. The relationship of changing river flows to carbon cycling in estuaries is not well understood. This lack of understanding in turn contributes to uncertainty in estimating global estuarine carbon budgets. In addition, climate change and other human activities heavily influence riverine input into estuaries and the coastal ocean, which then affect biogeochemistry and metabolism in these environments. Despite the need for this information, long-term records that can help to address the change in the strength and directions of CO2 fluxes in these ecosystems are very rare. Using high-intensity field sampling and analysis of historical data, this project aims to improve understanding of carbon cycling in this estuary and in the coastal ocean in general. The results obtained from this study will also provide key information about the biogeochemical response of estuaries to changing hydrologic conditions, as the southwestern U.S. grows drier with overall declining precipitation.

The research objectives of this project include 1) investigating the relationship between hydrologic state and estuarine CO2 partial pressure (pCO2) in a case study of the Mission-Aransas Estuary, a subtropical semiarid estuary, 2) understanding the extent of CO2 flux and its hydrologic control in one of the world's largest lagoonal estuarine systems along the northwestern Gulf of Mexico, and 3) elucidating the mechanisms that lead to estuarine acidification and its feedback to CO2 fluxes. Intensive field campaigns for high-temporal resolution pCO2 and water carbonate chemistry sampling as well as sediment incubation will be carried out; analysis of multidecadal carbonate chemistry parameters that have been collected by Texas Commission on Environmental Quality will be used to obtain temporal trends of estuarine water pCO2 against the backdrop of increasing freshwater scarcity in this region. The education component of this CAREER award includes 1) creating an ocean and estuarine acidification research course and redesigning two existing courses for both undergraduate and graduate students, 2) collaborating with Foy Moody High School on their Aquatic Science education to engage high school students predominantly from underrepresented and economically challenged backgrounds in field and lab experiences. The ultimate educational goal is to encourage high school students to follow a STEM path for their college education, and undergraduate STEM students to pursue graduate degrees. This will be a part of the concerted effort to enhance diversity in the future workforce by increasing the number of underrepresented graduates with bachelor's or higher degrees in the STEM fields. This project will train one Ph.D. student. High school students and undergraduate interns from underrepresented and economically challenged backgrounds will also be supported to participate in summer research. Broader dissemination of the project findings will include undergraduate student presentations at symposiums organized by both TAMU-CC and the Texas A&M University System, public seminars by both the graduate students and the principal investigator at various meetings organized by regional estuarine programs, presentations at national and international meetings, and publications in peer-reviewed journals.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1654232

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