

Spatial surveys of carbonate chemistry conducted in Kaneohe Bay, Hawaii from small boats during 2015 to 2017

Website: <https://www.bco-dmo.org/dataset/765037>

Data Type: Cruise Results

Version: 1

Version Date: 2019-04-15

Project

» [CAREER: Biogeochemical Modification of Seawater CO₂ Chemistry in Near-Shore Environments: Effect of Ocean Acidification](#) (Nearshore CO₂)

Contributors	Affiliation	Role
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Abstract

General study design: In this study, seawater carbonate chemistry samples were collected across a spatial array of stations across the barrier reef flat of Kāneʻohe Bay, Hawaiʻi. The study was designed to assess spatial variability in carbonate chemistry across the barrier reef flat during the 2015 fall coral bleaching event and during a year of recovery following the coral bleaching.

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Coverage

Spatial Extent: N:21.5138 E:-157.777267 S:21.44921 W:-157.83487

Temporal Extent: 2015-10-31 - 2017-02-26

Dataset Description

General study design:

In this study, seawater carbonate chemistry samples were collected across a spatial array of stations across the barrier reef flat of Kāneʻohe Bay, Hawaiʻi. The study was designed to assess spatial variability in carbonate chemistry across the barrier reef flat during the 2015 fall coral bleaching event and during a year of recovery following the coral bleaching.

Methods & Sampling

Methods description:

Total alkalinity (TA) and dissolved inorganic carbon (DIC) spatial surveys were conducted across the entire Kāneʻohe Bay barrier reef flat including samples offshore from the reef flat boundary on 31 October 2015, 31 June 2016, 12 November 2016, and 26 February 2017. At each station, surface temperature and salinity were

measured with handheld YSI multiprobes and seawater samples were collected by hand at the surface following standard protocols for analysis of TA and DIC.

Analytical Methods:

Surface seawater samples were collected by hand at ~0.25 m depth using 250 ml Pyrex glass bottles and immediately fixed with 100 μ L HgCl₂ as per standard protocols (Dickson et al. 2007). Handheld YSI multiprobes (October 2015: YSI 6600 V2; June 2016, November 2016: YSI Professional Plus; February 2017: YSI 556) were calibrated and used to measure temperature and salinity at the time of sampling. All seawater samples were transported to the Scripps Coastal and Open Ocean Biogeochemistry lab and analyzed for TA via an open-cell potentiometric acid titration system developed at Scripps Institution of Oceanography (SIO) by A. Dickson (Dickson et al. 2007) and DIC via an automated infra-red inorganic carbon analyzer (AIRICA, Marianda Inc).

Quality Control:

Standard protocols were followed for sampling and analysis of seawater TA and DIC. YSI multiprobes were calibrated prior to each sampling with an accuracy of $\pm 0.2^{\circ}\text{C}$ for temperature and $\pm 0.3 \text{ g kg}^{-1}$ for salinity. The mean accuracy (TA $\pm 1.3 \mu\text{mol kg}^{-1}$, DIC $\pm 1.6 \mu\text{mol kg}^{-1}$) and precision (TA $\pm 1.3 \mu\text{mol kg}^{-1}$, DIC $\pm 1.4 \mu\text{mol kg}^{-1}$) of TA and DIC measurements were evaluated using certified reference materials (CRM) provided by the laboratory of A. Dickson at SIO and analyzed every 5 samples for DIC and ~10-15 samples for TA.

Data Processing Description

BCO-DMO Processing:

- formatted time to HH:MM;
- created ISO_DateTime_Local column from date and time fields provided.

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Data Files

File
carbonate_chem_Kaneohe.csv (Comma Separated Values (.csv), 15.52 KB) MD5:e85d8d23f941e11452e62af964587015
Primary data file for dataset ID 765037

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Related Publications

Courtney, T. A., De Carlo, E. H., Page, H. N., Bahr, K. D., Barro, A., Howins, N., ... Andersson, A. J. (2017). Recovery of reef-scale calcification following a bleaching event in Kāneʻohe Bay, Hawaiʻi. *Limnology and Oceanography Letters*, 3(1), 1–9. doi:[10.1002/lol2.10056](https://doi.org/10.1002/lol2.10056)
Results

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. ISBN: 1-897176-07-4. URL: https://www.nodc.noaa.gov/ocads/oceans/Handbook_2007.html <https://hdl.handle.net/11329/249>
Methods

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Parameters

Parameter	Description	Units
sample	Sample bottle number for table reference	unitless
reefstatus	Reef status is either observed as 'bleached' or 'recovery' at the time of the survey	unitless
date	Date of the survey in DD-Month-YYYY	unitless
time	Time of survey in local time (GMT -10); 24-hour; formatted as HH:MM	unitless
lat	Latitude of survey station	decimal degrees
long	Longitude of survey station	decimal degrees
temp	Temperature of seawater	degrees Celsius
sal	Salinity of seawater	psu
ta	Total alkalinity of seawater	micromoles per kilogram (umol/kg)
dic	Dissolved inorganic carbon of seawater	micromoles per kilogram (umol/kg)
ISO_DateTime_Local	Date and time of survey formatted to ISO8601 standard: yyyy-mm-ddThh:mm:ss	unitless

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Instruments

Dataset-specific Instrument Name	Open-cell potentiometric acid titration system
Generic Instrument Name	Automatic titrator
Dataset-specific Description	The open-cell potentiometric acid titration system was developed by the laboratory of A.G. Dickson. Briefly, a known amount of seawater is added to an open cell temperature controlled beaker. Hydrochloric acid is added using a Methrom Dosimat to a pH of 3.5-4.0 and allowed to stabilize to remove CO ₂ gas formed by the addition of acid. Small aliquots of hydrochloric acid are then added to pH of ~3.0. The titration is monitored by a glass electrode and the total alkalinity of the sample is calculated using a non-linear least-squares method following Dickson et al. (2007).
Generic Instrument Description	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	Automated Infra Red Inorganic Carbon Analyzer (AIRICA)
Generic Instrument Name	Inorganic Carbon Analyzer
Dataset-specific Description	The Automated Infra Red Inorganic Carbon Analyzer (AIRICA) utilizes infrared detection of CO ₂ gas purged from an acidified seawater sample. A high-precision syringe pump extracts the seawater sample, acidifies the sample with phosphoric acid, and analyzes the gas released with an infrared light analyzer (LICOR). The CO ₂ signal is integrated for each sample to quantify the total inorganic carbon for a given aliquot of seawater analyzed. Three aliquots and peak integrations are performed for each seawater sample and averaged to determine the dissolved inorganic carbon for each sample. Precision was typically $\pm 1-2 \mu\text{mol/kg}$ for TA. Please see http://marianda.com/index.php?site=products&subsite=airica for a complete instrument description.
Generic Instrument Description	Instruments measuring carbonate in sediments and inorganic carbon (including DIC) in the water column.

Dataset-specific Instrument Name	Handheld YSI multi probes
Generic Instrument Name	Water Quality Multiprobe
Dataset-specific Description	YSI Handheld Multiparameter Instruments were used to measure in situ temperature (accuracy $\pm 0.15^\circ\text{C}$), salinity (accuracy $\pm 1\%$), DO _{mg} (accuracy $\pm 2\%$), and DO _% (accuracy $\pm 2\%$). Instrument models used: October 2015: YSI 6600 V2; June 2016, November 2016: YSI Professional Plus; February 2017: YSI 556.
Generic Instrument Description	An instrument which measures multiple water quality parameters based on the sensor configuration.

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Deployments

Kaneohe Bay CO2

Website	https://www.bco-dmo.org/deployment/765047
Platform	R/V HIMB_Small_Boat
Start Date	2015-10-31
End Date	2017-02-26
Description	Seawater carbonate chemistry sampling conducted from small boats at a spatial array of stations across the barrier reef flat of Kāneʻohe Bay, Hawaiʻi, during 2015, 2016, and 2017.

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Project Information

CAREER: Biogeochemical Modification of Seawater CO2 Chemistry in Near-Shore Environments: Effect of Ocean Acidification (Nearshore CO2)

Coverage: San Diego, California; Bermuda; Oahu, Hawaii

NSF Award Abstract:

Because of well-known chemical principles, changes in the CO₂ chemistry of seawater in the open ocean as a result of rising atmospheric CO₂ can be predicted very accurately. On the other hand, in near-shore environments, these projections are much more difficult because the CO₂ chemistry is largely modified by biogeochemical processes operating on timescales of hours to months. To make predictions on how near-shore seawater CO₂ chemistry will change in response to ocean acidification (OA), it is critical to consider the relative influence of net ecosystem production (NEP) and net ecosystem calcification (NEC), and how these processes might change in response to this major perturbation. Understanding how future OA will alter near-shore seawater CO₂ chemistry and variability was identified as a major critical knowledge gap at the recent IPCC WG II/WG I workshop on impacts of ocean acidification on marine biology and ecosystems in January of 2011, and also at the International Ocean Acidification Network workshop in Seattle in June of 2012.

With funding from this CAREER award, a researcher at the Scripps Institute of Oceanography and his students will study how biogeochemical processes and the relative contributions from NEP and NEC modify seawater CO₂ chemistry in near-shore environments influenced by different benthic communities under well-characterized environmental and physical conditions, and how these processes might change in response to OA. The team will investigate a limited number of contrasting habitats in subtropical (reef crest, back/patch reef, lagoon, seagrass bed, algal mat) and temperate (kelp bed, inter- and sub-tidal, marsh) environments during summer and winter, employing a method that evaluates the function and performance of the carbon cycle of a system using a stoichiometric vector approach based on changes in total dissolved inorganic carbon (DIC) and total alkalinity (TA). These field studies will be complemented by controlled mesocosm experiments with contrasting and mixed benthic communities under different OA scenarios.

The project has two educational components: (1) developing a research-driven OA and biogeochemistry course based on inquiry-, experience-, and collaborative-based learning; and (2) working with the Ocean Discovery Institute (ODI) to engage individuals from a local underrepresented minority community in science through educational activities focused on OA, and also providing a moderate number of internships for high school and college students to engage in this research project.

Broader Impacts: This project will directly support one PhD student, one junior research technician, and two high school and college interns from underrepresented minorities (URM) each summer of the project. It will contribute to the education of 80 undergraduate and graduate students participating in the research based ocean acidification/biogeochemistry course offered four times throughout the duration of the project at SIO/UCSD. Education and curricular material on the topics of OA, including hands-on laboratories, classroom and field-based activities will be developed through the collaboration with the ODI and brought to hundreds of URM students and their teachers in the City Heights area, a community with the highest poverty and ethnic diversity in the San Diego region. This collaboration will enable URM students to directly engage in a rapidly evolving field of research that has high relevance at both the local and global scales. To ensure broad dissemination of this project and the topic of OA, the research team will work with the Google Ocean team to

incorporate information and educational material in the Google Ocean Explorer.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1255042

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