

Net calcification rates of coral and calcified algae in pCO₂ flume experiments in Moorea, French Polynesia from August to October of 2014 (OA_Coral_adapt project, MCR_LTER project)

Website: <https://www.bco-dmo.org/dataset/683723>

Data Type: experimental

Version:

Version Date: 2017-02-23

Project

» [Collaborative Research: Ocean Acidification and Coral Reefs: Scale Dependence and Adaptive Capacity](#) (OA coral adaptation)

Program

» [Science, Engineering and Education for Sustainability NSF-Wide Investment \(SEES\): Ocean Acidification \(formerly CRI-OA\)](#) (SEES-OA)

Contributors	Affiliation	Role
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Abstract

This dataset contains net calcification rates for coral and coralline algae at three levels; community, reef pavement, and coral or coralline algae. The experiments took place in flumes with various pCO₂ levels at Richard B. Gump South Pacific Research Station in Moorea, French Polynesia between August and October of 2014.

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Coverage

Spatial Extent: Lat:-17.4907 Lon:-149.826

Temporal Extent: 2014-08 - 2014-10

Dataset Description

These data were utilized in the following publication:

Comeau S., Carpenter R.C., Lantz C.A., Edmunds P.J. (2016) Parameterization of the response of calcification to temperature and pCO₂ in the coral *Acropora pulchra* and the alga *Lithophyllum kotschyannum*. Coral Reefs. doi: [10.1007/s00338-016-1425-0](https://doi.org/10.1007/s00338-016-1425-0)

Methods & Sampling

The data is from an experiment performed in Moorea from August-October 2014. Constructed communities of corals (*Pocillopora* spp., massive *Porites* spp., and *Acropora* spp.) and crustose coralline algae (*Porolithon onkodes*) were placed in one of four flumes at either ambient (~400 uatm) or elevated (~1200 uatm) pCO₂ for 7 weeks. Net calcification rates at the community scale in the flumes were measured using the total alkalinity anomaly method (Chisholm & Gattuso, 1991), which assumes that for every two moles of AT consumed, one mole of CaCO₃ is produced. Net calcification (Gn) was determined at three levels of biological organization (whole community, reef pavement, corals and coralline algae) and four flow speeds (2, 4, 8, and 14 cm s⁻¹). Coral and algal samples were acquired at the barrier reef of the north shore of Moorea at ~15–17 m depth (-17.47423,-149.84258). For more details on methodology used, see Comeau et. al. 2015.

Average chemistry in the flumes during the 7-week experiment please see [Carbon Chemistry Table \(PDF\)](#).

Data Processing Description

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 replaced with no data value 'nd'
- * All values were rounded to three decimal places if more than that.
- * latitude and longitude added for experiment location

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Data Files

File
calc_pCO2.csv (Comma Separated Values (.csv), 36.29 KB) MD5:be47dcdd8093c8649ae0541cff900fd6
Primary data file for dataset ID 683723

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Related Publications

Chisholm, J. R. M., & Gattuso, J.-P. (1991). Validation of the alkalinity anomaly technique for investigating calcification of photosynthesis in coral reef communities. *Limnology and Oceanography*, 36(6), 1232–1239. doi:[10.4319/lo.1991.36.6.1232](https://doi.org/10.4319/lo.1991.36.6.1232)

Methods

Comeau, S., Carpenter, R. C., Lantz, C. A., & Edmunds, P. J. (2016). Parameterization of the response of calcification to temperature and pCO₂ in the coral *Acropora pulchra* and the alga *Lithophyllum kotschyannum*. *Coral Reefs*, 35(3), 929–939. doi:[10.1007/s00338-016-1425-0](https://doi.org/10.1007/s00338-016-1425-0)

Results

Comeau, S., Lantz, C. A., Edmunds, P. J., & Carpenter, R. C. (2015). Framework of barrier reefs threatened by ocean acidification. *Global Change Biology*, 22(3), 1225–1234. doi:[10.1111/gcb.13023](https://doi.org/10.1111/gcb.13023)

Related Research

Methods

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Parameters

Parameter	Description	Units
site	Location of flume; MCR is shorthand for Moorea Coral Reef Long-Term Ecological Research site	unitless
lat	Latitude of flume; north is positive	decimal degrees
lon	Longitude of flume; west is negative	decimal degrees
experiment_type	Experiment identifier (community/pavement/flow); see acquisition description for details	unitless
treatment	pCO ₂ treatment in each flume (Amb [ambient] ~400 uatm; OA [ocean acidification] ~1000 uatm)	unitless
flow	Flow speed in the flume	centimeters per second
flume	Flume number	unitless
week	Week number of experiment (1-7)	unitless
day_night	Time sampled (Day/Night)	unitless
incubation_period	Time range of incubation (TAHT - Tahiti Time Zone)	unitless
light	Light level	tbd
gn	Whole community net calcification for a given flume	g CaCO ₃ m ⁻² d ⁻¹
gn_corals	Coral and calcifying algae net calcification for a given flume	g CaCO ₃ m ⁻² d ⁻¹

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Instruments

Dataset-specific Instrument Name	Vectrino
Generic Instrument Name	Acoustic Doppler Velocimeter
Dataset-specific Description	Acoustic Doppler Velocimeter: Vectrino, NortekUSA
Generic Instrument Description	ADV is the acronym for acoustic doppler velocimeter. The ADV is a remote-sensing, three-dimensional velocity sensor. Its operation is based on the Doppler shift effect. The sensor can be deployed either as a moored instrument or attached to a still structure near the seabed. Reference: G. Voulgaris and J. H. Trowbridge, 1998. Evaluation of the Acoustic Doppler Velocimeter (ADV) for Turbulence Measurements. J. Atmos. Oceanic Technol., 15, 272-289. doi: http://dx.doi.org/10.1175/1520-0426(1998)0152.0.CO;2

Dataset-specific Instrument Name	Titrator: T50
Generic Instrument Name	Automatic titrator
Dataset-specific Description	Automatic Titrator: T50, Mettler-Toledo, Switzerland
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	Orion 3-stars, Thermo Scientific
Generic Instrument Name	pH Sensor
Dataset-specific Description	pH Sensor: Orion 3-stars, Thermo Scientific, USA, mounted with a combination pH probe (Orion Ross Ultra, Thermo Scientific, USA)
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+).

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Deployments

MCR_Emunds

Website	https://www.bco-dmo.org/deployment/640059
Platform	Richard B Gump Research Station - Moorea LTER
Start Date	2010-01-01
End Date	2016-12-31
Description	Ongoing studies on corals

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Project Information

Collaborative Research: Ocean Acidification and Coral Reefs: Scale Dependence and Adaptive Capacity (OA coral adaptation)

Website: <http://mcr.lternet.edu>

Coverage: Moorea, French Polynesia

Extracted from the NSF award abstract:

This project focuses on the most serious threat to marine ecosystems, Ocean Acidification (OA), and addresses the problem in the most diverse and beautiful ecosystem on the planet, coral reefs. The research utilizes Moorea, French Polynesia as a model system, and builds from the NSF investment in the Moorea Coral Reef Long Term Ecological Research Site (LTER) to exploit physical and biological monitoring of coral reefs as a context for a program of studies focused on the ways in which OA will affect corals, calcified algae, and coral reef ecosystems. The project builds on a four-year NSF award with research in five new directions: (1) experiments of year-long duration, (2) studies of coral reefs to 20-m depth, (3) experiments in which carbon dioxide will be administered to plots of coral reef underwater, (4) measurements of the capacity of coral reef organisms to change through evolutionary and induced responses to improve their resistance to OA, and (5) application of emerging theories to couple studies of individual organisms to studies of whole coral reefs. Broader impacts will accrue through a better understanding of the ways in which OA will affect coral reefs that are the poster child for demonstrating climate change effects in the marine environment, and which provide income, food, and coastal protection to millions of people living in coastal areas, including in the United States.

This project focuses on the effects of Ocean Acidification on tropical coral reefs and builds on a program of research results from an existing 4-year award, and closely interfaces with the technical, hardware, and information infrastructure provided through the Moorea Coral Reef (MCR) LTER. The MCR-LTER, provides an unparalleled opportunity to partner with a study of OA effects on a coral reef with a location that arguably is better instrumented and studied in more ecological detail than any other coral reef in the world. Therefore, the results can be both contextualized by a high degree of ecological and physical relevance, and readily integrated into emerging theory seeking to predict the structure and function of coral reefs in warmer and more acidic future oceans. The existing award has involved a program of study in Moorea that has focused mostly on short-term organismic and ecological responses of corals and calcified algae, experiments conducted in mesocosms and flumes, and measurements of reef-scale calcification. This new award involves three new technical advances: for the first time, experiments will be conducted of year-long duration in replicate outdoor flumes; CO₂ treatments will be administered to fully intact reef ecosystems in situ using replicated underwater flumes; and replicated common garden cultivation techniques will be used to explore within-species genetic variation in the response to OA conditions. Together, these tools will be used to support research on corals and calcified algae in three thematic areas: (1) tests for long-term (1 year) effects of OA on growth, performance, and fitness, (2) tests for depth-dependent effects of OA on reef communities at 20-m depth where light regimes are attenuated compared to shallow water, and (3) tests for beneficial responses to OA through intrinsic, within-species genetic variability and phenotypic plasticity. Some of the key experiments in these thematic areas will be designed to exploit integral projection models (IPMs) to couple organism with community responses, and to support the use of the metabolic theory of ecology (MTE) to address scale-dependence of OA effects on coral reef organisms and the function of the communities they build.

The following publications and data resulted from this project:

Comeau S, Carpenter RC, Lantz CA, Edmunds PJ. (2016) Parameterization of the response of calcification to temperature and pCO₂ in the coral *Acropora pulchra* and the alga *Lithophyllum kotschyianum*. *Coral Reefs* 2016. DOI [10.1007/s00338-016-1425-0](https://doi.org/10.1007/s00338-016-1425-0).
[calcification rates](#) (2014)
[calcification rates](#) (2010)

Comeau, S., Carpenter, R.C., Edmunds, P.J. (2016) Effects of pCO₂ on photosynthesis and respiration of tropical scleractinian corals and calcified algae. *ICES Journal of Marine Science* doi:[10.1093/icesjms/fsv267](https://doi.org/10.1093/icesjms/fsv267).
[respiration and photosynthesis I](#)
[respiration and photosynthesis II](#)

Evensen, N.R. & Edmunds P. J. (2016) Interactive effects of ocean acidification and neighboring corals on the growth of *Pocillopora verrucosa*. *Marine Biology*, 163:148. doi: [10.1007/s00227-016-2921-z](https://doi.org/10.1007/s00227-016-2921-z)
[coral growth](#)
[seawater chemistry](#)
[coral colony interactions](#)

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Program Information

Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)

Website: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503477

Coverage: global

NSF Climate Research Investment (CRI) activities that were initiated in 2010 are now included under Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES). SEES is a portfolio of activities that highlights NSF's unique role in helping society address the challenge(s) of achieving sustainability. Detailed information about the SEES program is available from NSF (https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504707).

In recognition of the need for basic research concerning the nature, extent and impact of ocean acidification on oceanic environments in the past, present and future, the goal of the SEES: OA program is to understand (a) the chemistry and physical chemistry of ocean acidification; (b) how ocean acidification interacts with processes at the organismal level; and (c) how the earth system history informs our understanding of the effects of ocean acidification on the present day and future ocean.

Solicitations issued under this program:

[NSF 10-530](#), FY 2010-FY2011

[NSF 12-500](#), FY 2012

[NSF 12-600](#), FY 2013

[NSF 13-586](#), FY 2014

NSF 13-586 was the final solicitation that will be released for this program.

PI Meetings:

[1st U.S. Ocean Acidification PI Meeting](#) (March 22-24, 2011, Woods Hole, MA)

[2nd U.S. Ocean Acidification PI Meeting](#) (Sept. 18-20, 2013, Washington, DC)

3rd U.S. Ocean Acidification PI Meeting (June 9-11, 2015, Woods Hole, MA - Tentative)

NSF media releases for the Ocean Acidification Program:

[Press Release 10-186 NSF Awards Grants to Study Effects of Ocean Acidification](#)

[Discovery Blue Mussels "Hang On" Along Rocky Shores: For How Long?](#)

[Discovery nsf.gov - National Science Foundation \(NSF\) Discoveries - Trouble in Paradise: Ocean Acidification This Way Comes - US National Science Foundation \(NSF\)](#)

[Press Release 12-179 nsf.gov - National Science Foundation \(NSF\) News - Ocean Acidification: Finding New Answers Through National Science Foundation Research Grants - US National Science Foundation \(NSF\)](#)

[Press Release 13-102 World Oceans Month Brings Mixed News for Oysters](#)

[Press Release 13-108 nsf.gov - National Science Foundation \(NSF\) News - Natural Underwater Springs Show How Coral Reefs Respond to Ocean Acidification - US National Science Foundation \(NSF\)](#)

[Press Release 13-148 Ocean acidification: Making new discoveries through National Science Foundation research grants](#)

[Press Release 13-148 - Video nsf.gov - News - Video - NSF Ocean Sciences Division Director David Conover answers questions about ocean acidification. - US National Science Foundation \(NSF\)](#)

[Press Release 14-010 nsf.gov - National Science Foundation \(NSF\) News - Palau's coral reefs surprisingly resistant to ocean acidification - US National Science Foundation \(NSF\)](#)

[Press Release 14-116 nsf.gov - National Science Foundation \(NSF\) News - Ocean Acidification: NSF awards \\$11.4 million in new grants to study effects on marine ecosystems - US National Science Foundation \(NSF\)](#)

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1415300
NSF Division of Ocean Sciences (NSF OCE)	OCE-1415268

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