Benthic macroalgal and water column carbon uptake rates in an experimental chamber, Maunalua, O'ahu, Hawai'i, 2015-2016

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Data Type: experimental
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Project
» Collaborative Research: Dissolved organic matter feedbacks in coral reef resilience: The genomic & geochemical basis for microbial modulation of algal phase shifts (Coral DOM2)

Contributors	Affiliation	Role
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Abstract
Benthic macroalgal and water column carbon uptake rates in an experimental chamber, Maunalua, O'ahu, Hawai'i, 2015-2016.

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Coverage

Spatial Extent: **N**:21.275824 **E**:-157.760472 **S**:21.27273 **W**:-157.76335
Temporal Extent: 2015-10-09 - 2016-11-03

Dataset Description

This dataset contains initial experimental condition, and concentrations of dissolved inorganic carbon from experiments conducted at the University of Hawaii, Manoa in 2015.

Experiment CRANE (Coral Reef Acclimation to Nutrient Enrichment) identifies a monthlong mesocosm incubation study designed to understand the response of the coral reef community to long-term nutrient exposure.

Acquisition Description

Parameter
Method

tidal_height
Exact tides at the time of the experiment were retrieved from https://tidesandcurrents.noaa.gov/noaatidepredictions.html?id=1612340

lat
Experimental locations were randomly chosen across a known gradient of submarine groundwater discharge (SGD). The waypoints (latitude and longitude) were inputted in a Garmin GSP 78.

long
Experimental locations were randomly chosen across a known gradient of submarine groundwater discharge (SGD). The waypoints (latitude and longitude) were inputted in a Garmin GSP 78.

incubation_time
Time started when benthic chamber was sealed into position and ended when benthic chamber was taken off the benthos.

temp_avg_inside
A HOBO tidbit temperature logger was placed inside the benthic chamber for the duration of the experiment. Temperature readings were taken every 5 minutes. This time series was averaged, resulting in this value.

sal_avg_inside
An Odyssey temperature and conductivity

ph_amb
A water sample was taken from inside the benthic chamber at the beginning of the experiment (before 13C-sodium carbonate addition). pH was measured using a Thermo Scientific Orion Star A329 portable meter with a pH electrode calibrated against a Tris buffer of known pH from Andrew Dickson's laboratory at the Scripps Institution of Oceanography.

phosphate_pre
A water sample was collected at the beginning of the experiment from inside the benthic chamber. This water were filtered through a 0.2um filter (GF/F) in situ, and refrigerated for 3 weeks. The samples were brought to room temperature, mixed, and analyzed on a Seal Analytical Segmented Flow Injection AutoAnalyzer AA3HR for soluble reactive phosphate (PO43-).

silicate_pre
A water sample was collected at the beginning of the experiment from inside the benthic chamber. This water were filtered through a 0.2um filter (GF/F) in situ, and refrigerated for 3 weeks. The samples were brought to room temperature, mixed, and analyzed on a Seal Analytical Segmented Flow Injection AutoAnalyzer AA3HR for silicate (SiO).

No3_NO2_pre
A water sample was collected at the beginning of the experiment from inside the benthic chamber. This water were filtered through a 0.2um filter (GF/F) in situ, and refrigerated for 3 weeks. The samples were brought to room temperature, mixed, and analyzed on a Seal Analytical Segmented Flow Injection AutoAnalyzer AA3HR for nitrate + nitrite (N + N; NO2- + NO3-).

ammonia_pre
A water sample was collected at the beginning of the experiment from inside the benthic chamber. This water were filtered through a 0.2um filter (GF/F) in situ, and refrigerated for 3 weeks. The samples were brought to room temperature, mixed, and analyzed on a Seal Analytical Segmented Flow Injection AutoAnalyzer AA3HR for ammonium (NH4+).

PAR_avg_outside
An autonomous Odyssey Submersible Photosynthetic Active Radiation Logger was deployed within the benthic chamber. The scan rate was one per minute and the detected wavelength was cosine corrected photosynthetic irradiance (400_700nm).

adv_mean

A Nortek Vector 3D Acoustic Velocimeter was deployed outside the chamber, within 40cm of the benthos. It was set to sample continuously at a sampling rate of 8 Hz, with a nominal velocity range of 0.30 m/s.

DIC_amb
Right before (within 5 minutes) the 13C sodium bicarbonate spike, water samples for DIC analysis (250 ml) were collected from within the benthic chamber and stored in 300 mL borosilicate bottles. Samples were brought back to the lab and fixed with 200 _l HgCl2 per 250 ml seawater. Samples were analyzed for DIC using the UIC Coulometer and Marianda VINDTA 3D at the S-LAB at the University of Hawai'i at M_noa.

DIC_2
Right after (within 2 minutes) the 13C sodium bicarbonate spike, water samples for DIC analysis (250 ml) were collected from within the benthic chamber and stored in 300 mL borosilicate bottles. Samples were brought back to the lab and fixed with 200 _l HgCl2 per 250 ml seawater. Samples were analyzed for DIC using the UIC Coulometer and Marianda VINDTA 3D at the S-LAB at the University of Hawai'i at M_noa.

DIC_postexp
At the end of the 1 hour incubation, water samples for DIC analysis (250 ml) were collected from within the benthic chamber and stored in 300 mL borosilicate bottles. Samples were brought back to the lab and fixed with 200 _l HgCl2 per 250 ml seawater. Samples were analyzed for DIC using the UIC Coulometer and Marianda VINDTA 3D at the S-LAB at the University of Hawai'i at M_noa.

del_13C_DIC_amb
Right before (within 5 minutes) the 13C sodium bicarbonate spike, water samples were collected from within the benthic chamber and stored in 30 mL borosilicate bottles. Samples were brought back to the lab and fixed with 200 _l HgCl2 per 250 ml seawater. Water samples were sent to the Biogeochemical Stable Isotope Facility at the University of Hawai'i at M_noa for _13C analysis of dissolved inorganic carbon (Torres et al. 2005).

del_13C_DIC_2
Right after (within 2 minutes) the 13C sodium bicarbonate spike, water samples were collected from within the benthic chamber and stored in 30 mL borosilicate bottles. Samples were brought back to the lab and fixed with 200 _l HgCl2 per 250 ml seawater. Water samples were sent to the Biogeochemical Stable Isotope Facility at the University of Hawai'i at M_noa for _13C analysis of dissolved inorganic carbon (Torres et al. 2005).

del_13C_DIC_postexp
At the end of the 1 hour incubation, water samples were collected from within the benthic chamber and stored in 30 mL borosilicate bottles. Samples were brought back to the lab and fixed with 200 _l HgCl2 per 250 ml seawater. Water samples were sent to the Biogeochemical Stable Isotope Facility at the University of Hawai'i at M_noa for _13C analysis of dissolved inorganic carbon (Torres et al. 2005).

Processing Description

BCO-DMO Processing:
- modified parameter names to conform with BCO-DMO naming conventions
- converted date format from d-Mon-yy to yyyy-mm-dd
- reduced precision of ammonia_pre and PAR_avg_outside to 2 digits
- reduced precision of adv_mean to 6 digits
- reduced precision of DIC_amb, DIC_2 and DIC_postexp to 1 digit

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Parameters

Parameter	Description	Units
Exp_ID	Identification for experiment	unitless
tidal_height	Tidal height at MLLW (mean lower low water). MLLW is defined as the average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch. For stations with shorter series - comparison of simultaneous observations with a control tide station is made in order to derive the equivalent datum of the National Tidal Datum Epoch.	meters (m)
lat	Latitude of experimental location; north is positive	decimal degrees
long	Longitude of experimental location; east is positive	decimal degrees
date	Date the experiment was conducted (beginning and end date as experiments were about one hour long).	day-month-year
incubation_time	Duration of experiment	minutes (min)
temp_avg_inside	Average temperature inside the benthic chamber during the experiment	degree Celsius (°C)
sal_avg_inside	Average salinity inside the benthic chamber during the experiment	PSU? No unit salinity
ph_amb	pH of water inside the benthic chamber at the beginning of the experiment.	pH units on the total scale
phosphate_pre	Phosphate concentration of water inside the benthic chamber at the beginning of the experiment.	micromol per liter (umol/L)
silicate_pre	Silicate concentration of water inside the benthic chamber at the beginning of the experiment.	micromol per liter (umol/L)
No3_NO2_pre	Nitrate and nitrite concentration of water inside the benthic chamber at the beginning of the experiment.	micromol per liter (umol/L)
ammonia_pre	Ammonia concentration of water inside the benthic chamber at the beginning of the experiment.	micromol per liter (umol/L)
PAR_avg_outside	Average photosynthetic active radiation inside the benthic chamber during the experiment	micromol per meter squared per second (umol m-2 s-1)
adv_mean	Mean flow velocity during the experiment.	centimeters per second (cm s-1)

DIC_amb	Dissolved inorganic carbon concentration inside the benthic chamber right before the 13C sodium bicarbonate spike.	micromole per kilogram of sea water (umol kg-1 sw)
DIC_2	Dissolved inorganic carbon concentration inside the benthic chamber right after the 13C sodium bicarbonate spike.	micromole per kilogram of sea water (umol kg-1 sw)
DIC_postexp	Dissolved inorganic carbon concentration inside the benthic chamber at the end of the one hour incubation (end of experiment).	micromole per kilogram of sea water (umol kg-1 sw)
del_13C_DIC_amb	delta 13C of dissolved inorganic carbon concentration inside the benthic chamber right before the 13C sodium bicarbonate spike; parts per thousand (‰ vs. V-PDB)	unitless
del_13C_DIC_2	delta 13C dissolved inorganic carbon concentration inside the benthic chamber right after the 13C sodium bicarbonate spike; parts per thousand (‰ vs. V-PDB)	unitless
del_13C_DIC_postexp	delta 13C dissolved inorganic carbon concentration inside the benthic chamber at the end of the one hour incubation (end of experiment); parts per thousand (‰ vs. V-PDB)	unitless

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Instruments

Dataset-specific Instrument Name	Seal Analytical Segmented Flow Injection AutoAnalyzer AA3HR
Generic Instrument Name	Flow Injection Analyzer
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	Thermo Scientific Orion Star A329 portable meter
Generic Instrument Name	pH Sensor
Dataset-specific Description	Used to measure pH in the experimental chamber.
Generic Instrument Description	General term for an instrument that measures the pH or how acidic or basic a solution is.

Dataset-specific Instrument Name	Odyssey Conductivity and Temperature recorder
Generic Instrument Name	Salinity Sensor
Dataset-specific Description	Used to measure salinity in the experimental chamber.
Generic Instrument Description	Category of instrument that simultaneously measures electrical conductivity and temperature in the water column to provide temperature and salinity data.

Dataset-specific Instrument Name	Nortek Vector 3D Acoustic Velocimeter
Generic Instrument Name	Acoustic Doppler Velocimeter
Dataset-specific Description	Used to measure flow velocity during the experiment.
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	HOBO tidbit temperature logger
Generic Instrument Name	Temperature Logger
Dataset-specific Description	Used to measure temperature inside expermental chamber.
Generic Instrument Description	Records temperature data over a period of time.

Dataset-specific Instrument Name	Garmin GSP 78
Generic Instrument Name	GPS receiver
Dataset-specific Description	Used to determine experimental sites.
Generic Instrument Description	Acquires satellite signals and tracks your location.

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Project Information

Collaborative Research: Dissolved organic matter feedbacks in coral reef resilience: The genomic & geochemical basis for microbial modulation of algal phase shifts (Coral DOM2)

Coverage: Pacific Coral Reefs

NSF award abstract: Coral reef degradation, whether driven by overfishing, nutrient pollution, declining water quality, or other anthropogenic factors, is associated with a phase shift towards a reefs dominated by fleshy algae. In many cases managing and ameliorating these stressors does not lead to a return to coral dominance, and reefs languish in an algal-dominated state for years. Nearly a decade of research has demonstrated that trajectories toward increasing algal dominance are restructuring microbial community composition and metabolism; the investigators hypothesize that microbial processes facilitate the maintenance of algal dominance by metabolizing organic compounds released by algae thereby stressing corals through hypoxia and disease. The resilience of reefs to these phase shifts is a critical question in coral reef ecology, and managing reefs undergoing these community shifts requires developing an understanding of the role of microbial interactions in facilitating algal overgrowth and altering reef ecosystem function. The research proposed here will investigate the organics produced by algae, the microbes that metabolize the organics, and the impacts of these processes on coral health and growth. This research has implications for managing reef resilience to algal phase shifts by testing the differential resistance of coral-associated microbial communities to algae and defining thresholds of algal species cover which alter ecosystem biogeochemistry. This project provides mentoring across multiple career levels, linking underrepresented undergraduates, two graduate students, a postdoctoral researcher, and a beginning and established investigators. This project will integrate dissolved organic matter (DOM) geochemistry, microbial genomics and ecosystem process measurements at ecologically-relevant spatial and temporal scales to test hypothetical mechanisms by which microbially-mediated feedbacks may facilitate the spread of fleshy algae on Pacific reef ecosystems. A key product of this research will be understanding how the composition of corals and algae on reefs interact synergistically with complex microbial communities to influence reef ecosystem resilience to algal phase shifts. Emerging molecular and biogeochemical methods will be use to investigate mechanisms of microbial-DOM interactions at multiple spatial and temporal scales. This project will leverage the background environmental data, laboratory facilities and field logistical resources of the Mo'orea Coral Reef Long Term Ecological Research Project in French Polynesia and contribute to the mission of that program of investigating coral reef resilience in the face of global change. The investigators will quantify bulk diel patterns of DOM production and characterize the composition of chromophoric components and both free and acid-hydrolyzable neutral monosaccharides and amino acids from varying benthic algae sources. The team will also characterize planktonic and coral-associated microbial community changes in taxonomic composition and gene expression caused by algal DOM amendments in on-site controlled environmental chambers using phylogenetics and metatranscriptomics, including tracking algal exudate utilization by specific microbial lineages. Field-deployed 100 liter tent mesocosms will be used to examine in situ diel patterns of coupled DOM production and consumption, microbial community genomics and ecosystem metabolism over representative benthic communities comprising combinations of algal and coral species. Together these experimental results will guide interpretation of field surveys of centimeter-scale spatial dynamics of planktonic and coral-associated microbial genomics and metabolism at zones of coral-algal interaction, including boundary layer dynamics of oxygen, bacteria and DOM using planar optodes, high-throughput flow cytometry and fluorescence spectroscopy.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1538393

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