Time series data from multiple instruments at 4 sites in Bermuda measured during September 2017

Website: https://www.bco-dmo.org/dataset/756551
Data Type: Other Field Results
Version: 1
Version Date: 2019-02-21

Project
» Carbon Cycling in Carbonate-Dominated Benthic Ecosystems: Eddy Covariance Hydrogen Ion and Oxygen Fluxes (ECHOES Benthic Ecosystems)

Contributors	Affiliation	Role
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Coverage

Spatial Extent: **N**:32.4634 **E**:-64.79802 **S**:32.4002 **W**:-64.83058
Temporal Extent: 2017-09-05 - 2017-09-23

Methods & Sampling

O2 and pH fluxes and the derived rates of net ecosystem calcification are from eddy covariance hydrogen ion and oxygen exchange systems described in Long et al. 2015 (DOI: 10.1002/lom3.10038).

The rest of the time series data from the following instruments:
Odyssey Photosynthetic active radiation logger (irradiance) – Calibrated by methods of Long et al. 2012 (DOI 10.4319/lom.2012.10.416)
ProOceanus ProCV (Co2) – factory calibration with auto-zeroing
Nortek acoustic Doppler velocimeter (mean velocity) – factory calibration

Instruments were deployed using small boats and SCUBA divers. All instruments where deployed for brief periods (~1week) and recovered. All dates and times recorded in the local time zone.

Problem report: Gaps in sampling (represented as NaN) are due to sensor failure or maintenance of the individual sensors.

Data Processing Description

BCO-DMO Processing:

- modified parameter names (replaced spaces with underscores);
- re-formatted month, day, hour, minute, and seconds to two-digits;
- added ISO_DateTime field;
- combine data from the 4 locations/spreadsheets; added in lat/lon and depth from the metadata form.

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Data Files

File
Bermuda_Reefs.csv (Comma Separated Values (.csv), 168.14 KB) MD5:aa0449504ebbd8fea5c6497db0053f7a Primary data file for dataset ID 756551

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Related Publications

Long, M. H., Charette, M. A., Martin, W. R., & McCorkle, D. C. (2015). Oxygen metabolism and pH in coastal ecosystems: Eddy Covariance Hydrogen ion and Oxygen Exchange System (ECHOES). Limnology and Oceanography: Methods, 13(8), 438–450. doi:10.1002/lom3.10038
Methods

Long, M. H., Rheuban, J. E., Berg, P., & Zieman, J. C. (2012). A comparison and correction of light intensity loggers to photosynthetically active radiation sensors. Limnology and Oceanography: Methods, 10(6), 416–424. doi:10.4319/lom.2012.10.416
Methods

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Parameters

Parameter	Description	Units
site	Name of the sampling site	unitless
lat	Latitude of the site; positive values = North	decimal degrees
lon	Longitude of the site; positive values = East	decimal degrees
depth	Sampling depth	meters (m)
year	4-digit year	unitless
month	2-digit month of year	unitless
day	2-digit day of month	unitless
hour	Hour of sampling; 24-hour time	unitless
minute	Minutes portion of sampling time	unitless
second	Seconds portion of sampling time	unitless
ISO_DateTime	Date and time (Local) formatted to ISO8601 standard. Format: yyyy-mm-ddTHH:MM:SS	unitless
O2_flux	O2 flux	mmol m-2 h-1
pH_flux	pH flux	mmol m-2 h-1
Net_ecosystem_calcification	Net ecosystem calcification	mmol m-2 h-1
Irradiance	Irradiance, measured by Odyssey Photosynthetic active radiation logger	mE m-2 s-1
Temp	Temperature, measured by Satlantic SeapHOx	degress Celsius
Salinity	Salinity, measured by Satlantic SeapHOx	PSU
Oxygen	Oxygen, measured by Satlantic SeapHOx	umol L-1
pH	pH, measured by Satlantic SeapHOx	pH units
CO2	CO2, measured by ProOceanus ProCV	ppm
mean_velocity	Mean velocity, measured by Nortek acoustic Doppler velocimeter	m s-1

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Instruments

Dataset-specific Instrument Name	Nortek acoustic Doppler velocimeter
Generic Instrument Name	Acoustic Doppler Velocimeter
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	ProOceanus ProCV
Generic Instrument Name	pCO2 Sensor
Generic Instrument Description	A sensor that measures the partial pressure of CO2 in water (pCO2)

Dataset-specific Instrument Name	Odyssey Photosynthetic active radiation logger
Generic Instrument Name	Photosynthetically Available Radiation Sensor
Generic Instrument Description	A PAR sensor measures photosynthetically available (or active) radiation. The sensor measures photon flux density (photons per second per square meter) within the visible wavelength range (typically 400 to 700 nanometers). PAR gives an indication of the total energy available to plants for photosynthesis. This instrument name is used when specific type, make and model are not known.

Dataset-specific Instrument Name	Satlantic SeapHOx
Generic Instrument Name	SeapHOx/SeaFET
Generic Instrument Description	The SeapHOx and SeaFET are autonomous sensors originally designed and developed by the Todd Martz Lab at Scripps Institution of Oceanography. The SeaFET was designed to measure pH and temperature. The SeapHOx, designed later, combined the SeaFET with additional integrated sensors for dissolved oxygen and conductivity. Refer to Martz et al. 2010 (doi:10.4319/lom.2010.8.172). The SeapHOx package is now produced by Sea-Bird Scientific and allows for integrated data collection of pH, temperature, salinity, and oxygen. Refer to Sea-Bird for specific model information.

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Project Information

Carbon Cycling in Carbonate-Dominated Benthic Ecosystems: Eddy Covariance Hydrogen Ion and Oxygen Fluxes (ECHOES Benthic Ecosystems)

Website: https://www2.whoi.edu/staff/mlong/projects/project-4/

Coverage: Bermuda

NSF Award Abstract:

Chemical and biological processes that occur in and on the seafloor can create chemical exchange of elements with seawater and make significant contributions to carbon and nutrient cycling in shallow coastal systems. However, these processes are exceedingly difficult to measure directly in the ocean, with no satisfactory methods currently available to quantify their full impact. The researchers undertaking this project have developed a unique, field instrument referred to as the Eddy Covariance H+ and O2 Exchange System (ECHOES). These novel measurements of hydrogen ion (H+) and oxygen (O2) exchange between the seafloor and the overlying seawater will allow unique, direct evaluation of the important linked biological and chemical reactions. Data from ECHOES will transform understanding of the potentially critical contribution of seafloor processes to the resilience of coastal ecosystems experiencing rapid changes in seawater chemistry. Results

from this project will provide critical data for improved models of the consequences of coastal acidification. Additionally, this project will fund an early career scientist and the mentorship of undergraduate students in ocean science research through the Woods Hole Oceanographic Institute's Summer Student Fellowship Program.

Laboratory experiments have successfully examined the benthic response of individual organisms and chemical reactions to stress related to changing seawater chemistry but the integrated response of intact ecosystems has been very difficult to quantify due to unsatisfactory methods for in situ measurements of the required suite of biogeochemical fluxes. This deployment of ECHOES at a variety of carbonate-dominated seafloor sites in Bermuda is a pioneering effort to simultaneously measure net community production (NCP) and net community calcification (NCC). The study will focus on traditionally difficult-to-study systems including complex reefs, vertical seagrass canopies, and bare permeable sediments, evaluating diel variability, patchiness, and the impact of upstream fluxes on downstream ecosystems. Important biogeochemical parameters (e.g. pH, CO2, O2, alkalinity, etc.) in these productive shallow environments can experience daily fluctuations over a greater dynamic range than 100-year model projections for the open ocean due to increasing atmospheric CO2. Therefore, the novel field data generated by this research will help define the potentially critical and heretofore ill-defined role for shallow, productive carbonate sediments in predictive models of ecosystem response to ocean acidification.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1657727

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