Temperature, salinity, dissolved O2, and pH from SeapHOx_Kelp_A, SeapHOx_Kelp_B, SeapHOx_Kelp_C, and SeapHOx_Kelp_D kelp moorings in the La Jolla Kelp Forest, San Diego CA, from 2010-2011 (SeapHOx project)

Website: https://www.bco-dmo.org/dataset/3638
Version: 10 October 2013
Version Date: 2013-10-10

Project
» Macrophyte-induced variability in coastal ocean pH and consequences for invertebrate larvae (SeapHOx)

Program
» Ocean Carbon and Biogeochemistry (OCB)

Contributors	Affiliation	Role
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Dataset Description

These data are from SeapHOx deployments from in and around the La Jolla Kelp Forest and include pH, dissolved oxygen, temperature, and salinity. The data were collected using two "SeapHOx" instrument packages. The SeapHOx consists of a Honeywell Durafet III pH sensor (Martz et al. 2010), an Aanderaa 3835 oxygen optode, and an SBE-37 MicroCAT CTD. The sensors were attached to a mooring line at a given water depth below the surface (e.g. 7 m). There are four moorings utilized in this study and there is one data file which accompanies each mooring.

Related publication: Frieder, C. A., Nam, S. H., Martz, T. R., and Levin, L. A.: High temporal and spatial variability of dissolved oxygen and pH in a nearshore California kelp forest, Biogeosciences., 9, 4099-4132, doi:10.5194/bgd-9-4099-2012, 2012.
Abstract Page
Manuscript

Methods & Sampling

To calibrate the pH sensors, discrete water samples were taken during each SeapHOx deployment for the determination of total alkalinity (TA) and total dissolved inorganic carbon (DIC). The calibration samples were collected via SCUBA next to the sensor with a 5L niskin bottle. The collected seawater was transferred to a 500

ml clean borosilicate glass bottle with a ground glass neck and stopper. The samples were poisoned with a saturated mercuric chloride solution. TA measurements were determined using an open-cell, potentiometric titration (Dickson et al. 2007). DIC measurements were determined by acid extraction and coulometric detection of CO2 (Dickson et al. 2007). pH was calculated from TA and DIC using the Matlab version of CO2SYS (van Heuven et al. 2011) as recommended by Dickson et al. 2007. The calculated pH at in situ temperature from the calibration sample was used to determine the electrode-specific calibration coefficients. The calibration sample produced a pH accuracy of 0.01 units for each SeapHOx instrument. The oxygen sensors were factory calibrated by Aanderaa and before each deployment a two-point (0% and 100% saturation) offset was applied as recommended in the manual.

References:

Martz, T. R., Connery, J. G., and Johnson, K. S.: Testing the Honeywell Durafet® for seawater pH applications, Limnol. Oceanogr. Methods, 8, 172-184, 2010.

Dickson, A. G., Sabine, C. L., and Christian, J. R.: Guide to Best Practices for Ocean CO2 5 Measurements, Vol. 3, 374 PICES Spec. Publ., Sidney, British Columbia, 2007.

van Heuven et al. 2011. Matlab version of CO2SYS.

Data Processing Description

Extreme salinity outliers (= 3 SD) were removed and salinity data was smoothed with a 1-hr moving average. Oxygen was logged with factory settings. This assumes a salinity of 0 and pressure of 0. Salinity corrections (from CTD data) and pressure corrections (water depth) were applied to the oxygen data as suggested by the manufacturer's manual. pH was calculated at in situ temperature (temperature data from CTD) using calibration coefficients as described above.

BCO-DMO Processing Notes
Generated from original files "SeapOHx_Mooring [A-D].txt" contributed by Christina Frieder

BCO-DMO Edits
- Time column spilt into Date and Time and reformatted as YYYYMMDD and HHMM
- Temp, Sal, O2 and pH data values reported to appropriate decimal places
- "NaN" values converted to "nd" (no data)
- Parameter names modified to conform to BCO-DMO convention

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Data Files

File
MOORING_DATA.csv (Comma Separated Values (.csv), 6.91 MB) MD5:105d7464cbc86f32a3e5bb6ff72075cf Primary data file for dataset ID 3638

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Parameters

Parameter	Description	Units
Mooring_Id	Mooring Id	text
Longitude	Mooring Longitude Position (West is negative)	decimal degrees
Latitude	Mooring Latitude Position (South is negative)	decimal degrees
Start_Date	Start Date of Data Collection	YYYYMMDD
End_Date	End Date of Data Collection	YYYYMMDD
Site_Description	Site description of mooring	text
Water_Depth	Depth of water.	meters
Sensor_ID	There are two sensors - SP001 and SP002	text
Deployment_No	The deployment number of the respective sensor	text
Date	Date (UTC)	YYYYMMDD
Time	Time (UTC)	HHMM
Temperature	Temperature from SBE-37 MicroCAT	degrees Celsius
Salinity	Salinity from SBE-37 MicroCAT	PSU
Oxygen	Oxygen	micro mole/kg
pH	pH (total hydrogen scale)	dimensionless

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Instruments

Dataset-specific Instrument Name	Aanderaa 3835 Oxygen Optode
Generic Instrument Name	Aanderaa Oxygen Optodes
Dataset-specific Description	The SeapHOx consists of a Honeywell Durafet III pH sensor (Martz et al. 2010), an Aanderaa 3835 oxygen optode, and an SBE-37 MicroCAT CTD. The sensors were attached to a mooring line at a given water depth below the surface (e.g. 7 m).
Generic Instrument Description	Aanderaa Oxygen Optodes are instrument for monitoring oxygen in the environment. For instrument information see the Aanderaa Oxygen Optodes Product Brochure.

Dataset-specific Instrument Name	CTD Sea-Bird MicroCAT 37
Generic Instrument Name	CTD Sea-Bird MicroCAT 37
Dataset-specific Description	The SeapHOx consists of a Honeywell Durafet III pH sensor (Martz et al. 2010), an Aanderaa 3835 oxygen optode, and an SBE-37 MicroCAT CTD. The sensors were attached to a mooring line at a given water depth below the surface (e.g. 7 m).
Generic Instrument Description	The Sea-Bird MicroCAT CTD unit is a high-accuracy conductivity and temperature recorder based on the Sea-Bird SBE 37 MicroCAT series of products. It can be configured with optional pressure sensor, internal batteries, memory, built-in Inductive Modem, integral Pump, and/or SBE-43 Integrated Dissolved Oxygen sensor. Constructed of titanium and other non-corroding materials for long life with minimal maintenance, the MicroCAT is designed for long duration on moorings. In a typical mooring, a modem module housed in the buoy communicates with underwater instruments and is interfaced to a computer or data logger via serial port. The computer or data logger is programmed to poll each instrument on the mooring for its data, and send the data to a telemetry transmitter (satellite link, cell phone, RF modem, etc.). The MicroCAT saves data in memory for upload after recovery, providing a data backup if real-time telemetry is interrupted.

Dataset-specific Instrument Name	Honeywell Durafet III pH sensor
Generic Instrument Name	pH Sensor
Dataset-specific Description	The SeapHOx consists of a Honeywell Durafet III pH sensor (Martz et al. 2010), an Aanderaa 3835 oxygen optode, and an SBE-37 MicroCAT CTD. The sensors were attached to a mooring line at a given water depth below the surface (e.g. 7 m). Honeywell Durafet III pH sensor
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

SeapHOx_Kelp_A

Website	https://www.bco-dmo.org/deployment/58117
Platform	SeapHOx Kelp Mooring
Start Date	2010-07-29
End Date	2011-10-20
Description	The SeapHOx Kelp A Mooring is one of two moorings (mooring A is located inside the La Jolla kelp forest off San Diego, California, and B is offshore from the kelp forest) deployed in July 2010 for a project studying Macrophyte-induced variability in coastal ocean pH and consequences for invertebrate larvae. Two additional moorings were deployed at a later date. Funding is provided by NSF award OCE-0927445. Mooring locations: A 32.80861° N 117.28891° W (Mooring M1) B 32.80807° N 117.30521° W (Mooring M2) C 32.80917° N 117.28423° W (Mooring M3) D 32.85192° N 117.28456° W (Mooring M4) Mooring Locations

SeapHOx_Kelp_B

Website	https://www.bco-dmo.org/deployment/58118
Platform	SeapHOx Kelp Mooring
Start Date	2010-07-10
End Date	2010-11-10
Description	The SeapHOx Kelp B Mooring is one of two moorings (mooring A is located inside the La Jolla kelp forest off San Diego, California, and M2 is offshore from the kelp forest) deployed in July 2010 for a project studying Macrophyte-induced variability in coastal ocean pH and consequences for invertebrate larvae. Two additional moorings were deployed at a later date. Funding is provided by NSF award OCE-0927445. Mooring locations: A 32.80861° N 117.28891° W (Mooring M1) B 32.80807° N 117.30521° W (Mooring M2) C 32.80917° N 117.28423° W (Mooring M3) D 32.85192° N 117.28456° W (Mooring M4) Mooring Locations

SeapHOx_Kelp_C

Website	https://www.bco-dmo.org/deployment/58789
Platform	SeapHOx Kelp Mooring
Start Date	2011-09-16
End Date	2011-10-18
Description	The SeapHOx Kelp C Mooring is one of four moorings deployed in the vicinity of the La Jolla kelp forest off San Diego, California for a project studying Macrophyte-induced variability in coastal ocean pH and consequences for invertebrate larvae. Funding is provided by NSF award OCE-0927445. Mooring locations: A 32.80861° N 117.28891° W (Mooring M1) B 32.80807° N 117.30521° W (Mooring M2) C 32.80917° N 117.28423° W (Mooring M3) D 32.85192° N 117.28456° W (Mooring M4) Mooring Locations

SeapHOx_Kelp_D

Website	https://www.bco-dmo.org/deployment/58790
Platform	SeapHOx Kelp Mooring
Start Date	2011-04-18
End Date	2011-08-11
Description	The SeapHOx Kelp D Mooring is one of four moorings deployed in the vicinity of the La Jolla kelp forest off San Diego, California for a project studying Macrophyte-induced variability in coastal ocean pH and consequences for invertebrate larvae. Funding is provided by NSF award OCE-0927445. Mooring locations: A 32.80861° N 117.28891° W (Mooring M1) B 32.80807° N 117.30521° W (Mooring M2) C 32.80917° N 117.28423° W (Mooring M3) D 32.85192° N 117.28456° W (Mooring M4) Mooring Locations

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Project Information

Macrophyte-induced variability in coastal ocean pH and consequences for invertebrate larvae (SeapHOx)

Coverage: Coastal CA; San Diego La Jolla Kelp Forest; 32.8 N; 117.3 W

Increased concentrations of atmospheric carbon dioxide are acidifying the marine environment at

unprecedented rates. However, relative to the open ocean, predictions of ocean acidification for the coastal ocean are confounded by the greater inherent variability of carbonate chemistry which includes macrophyte photosynthesis and respiration. This proposal addresses the interplay between anthropogenically driven pH changes and the inherently variable coastal ocean carbonate chemistry, and will directly test the implications for a potentially sensitive life form, invertebrate larvae.

The objectives of this study are to measure the impact of key coastal habitats on natural pH variance, and to evaluate the implications these pH regimes have for developing invertebrate larvae. To achieve these objectives the investigators will characterize temporal and spatial carbonate chemistry variability inside and outside kelp forests in San Diego, California. With discrete water samples for the determination of total alkalinity and dissolved inorganic carbon, and continuous autonomous instruments which measure pH, dissolved oxygen, salinity, and temperature, a statistical characterization of carbonate chemistry variability will identify diurnal, seasonal and spatial trends as well as frequencies of maximum variation, rates of change, lowest potential pH (extreme statistics), and biologically-significant thresholds. Subsequently, prominent macrophyte-induced pH regimes will be mimicked in laboratory experiments and incorporated with ocean acidification predictions to test effects of (a) decreased pH, (b) varying pH about the mean, (c) changing variance about mean pH, and (c) pulsed exposure to extreme low pH, on larval survivorship, growth, and calcification responses of multiple species. Together, these laboratory and field studies will offer a mechanistic understanding of the effects of natural variance of carbonate chemistry in the context of ocean acidification for marine invertebrate larvae.

Four moorings identified as SeapHOx Moorings have been deployed in the San Diego La Jolla Kelp Forest in the vicinity of 32.8 N 117.3 W.

Mooring Locations

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Program Information

Ocean Carbon and Biogeochemistry (OCB)

Website: http://us-ocb.org/

Coverage: Global

The Ocean Carbon and Biogeochemistry (OCB) program focuses on the ocean's role as a component of the global Earth system, bringing together research in geochemistry, ocean physics, and ecology that inform on and advance our understanding of ocean biogeochemistry. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by U.S. federal agencies including NASA, NOAA, and NSF.

The scientific mission of OCB is to study the evolving role of the ocean in the global carbon cycle, in the face of environmental variability and change through studies of marine biogeochemical cycles and associated ecosystems.

The overarching OCB science themes include improved understanding and prediction of: 1) oceanic uptake and release of atmospheric CO2 and other greenhouse gases and 2) environmental sensitivities of biogeochemical cycles, marine ecosystems, and interactions between the two.

The OCB Research Priorities (updated January 2012) include: ocean acidification; terrestrial/coastal carbon fluxes and exchanges; climate sensitivities of and change in ecosystem structure and associated impacts on biogeochemical cycles; mesopelagic ecological and biogeochemical interactions; benthic-pelagic feedbacks on biogeochemical cycles; ocean carbon uptake and storage; and expanding low-oxygen conditions in the coastal and open oceans.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0927445

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