Daily optimum interpolation sea surface temperature (OISST) for paired grids from Sapodilla Caye, Belize starting 2010 (OA - Ocean Acidification and Warming Impact on Calcification project)

Website: https://www.bco-dmo.org/dataset/564287
Version: 30 July 2015
Version Date: 2015-07-30

Project
» Investigation of the Effects of CaCO3 Saturation State and Temperature on the Calcification Rate and Skeletal Properties of Benthic Marine Calcifiers (OA - Ocean Acidification and Warming Impact on Calcification)

Program
» Ocean Carbon and Biogeochemistry (OCB)

Contributors	Affiliation	Role
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Dataset Description

Daily OISST for paired grids centered on nearshore, backreef, and forereef environments in southern Belize.

Map showing core extraction sites from Castillo et al. (2011)

Methods & Sampling

We acquired daily, globally gridded SST records from the National Oceanic and Atmospheric Administration (NOAA)'s optimum interpolated SST (OI-SST) database (version 2), which is available from 1982 to present. The OI-SST records were obtained for the interval 1982 to2008 from paired 0.25 degree latitude/longitude sized grids spanning forereef, backreef, and nearshore reef zones from where the coral cores were extracted along the Mesoamerican Barrier Reef System in southern Belize. Paired grids were used to provide more extensive and thus more representative coverage of SSTs within these three reef zones.

Coral cores were extracted at a water depth of 4 to 5m using a pneumatic drill outfitted with a 5-cm-diameter diamond-tipped core bit24. Six-millimetre-thick slabs were sectioned vertically from the centre of each coral core with a water-cooled trim saw. Coral slabs were then air dried and X-rayed. Skeletal extension rates were estimated from the thickness of high-density_low-density annual growth couplets using Coral XDS version 3.0. In the western Caribbean Sea, the coral *S. siderea* deposits lower density skeletal growth bands from December to May and higher density growth bands from June to November. Core chronologies were

established by counting annual growth bands backwards from the 2008 growth band at the top of the core, which corresponds to the last complete year of coral growth before extraction of the core.

The following paper is submitted with the data:
Castillo KD, Ries JB, Weiss JM, Lima FP (2012) Decline of forereef corals in response to recent warming linked to history of thermal exposure. Nature Climate Change 2: 756-760

Data Processing Description

Statistical analyses were carried out using the nlme package of R 2.12.1. We employed random intercept models with residual correlation structures to model the relationships between coral skeletal extension rates and summer SSTs. This approach distinguishes observational units from sampling units and addresses the temporal autocorrelation structure that is inherently present in core data that are chronologically ordered.

BCO-DMO Processing Notes
- Generated from original files OISST-Paired Grids_ Nearshore_Backreef_ Forereef.csv" contributed by Karl Castillo
- Parameter names edited to conform to BCO-DMO naming convention found at Choosing Parameter Name
- Date reformatted to YYYYMMDD

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Data Files

File
OISST_Paired_Grids.csv (Comma Separated Values (.csv), 683.92 KB) MD5:6ece3b7ffe855ebe93ab82cdb63ab589 Primary data file for dataset ID 564287

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Parameters

Parameter	Description	Units
Year	Year of data collection	YYYY
Date	Date of data collection	YYYYMMDD
Grid_NS_North	Average annual summer temperatures for Grid NS North	degs C
Grid_BR_North	Average annual summer temperatures for Grid BR North	degs C
Grid_FR_North	Average annual summer temperatures for Grid FR North	degs C
Grid_NS_South	Average annual summer temperatures for Grid NS South	degs C
Grid_BR_South	Average annual summer temperatures for Grid BR South	degs C
Grid_FR_South	Average annual summer temperatures for Grid FR South	degs C
Nearshore_Avg	Average annual summer temperatures for Nearshore	degs C
Backreef_Avg	Average annual summer temperatures for Backreef	degs C
Forereef_Avg	Average annual summer temperatures for Forereef	degs C

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Instruments

Dataset-specific Instrument Name	pneumatic drill
Generic Instrument Name	Manual Biota Sampler
Dataset-specific Description	Coral cores were extracted at a water depth of 4 to 5m using a pneumatic drill outfitted with a 5-cm-diameter diamond-tipped core bit24.
Generic Instrument Description	"Manual Biota Sampler" indicates that a sample was collected in situ by a person, possibly using a hand-held collection device such as a jar, a net, or their hands. This term could also refer to a simple tool like a hammer, saw, or other hand-held tool.

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Deployments

lab_Ries_Sapodilla_Caye

Website	https://www.bco-dmo.org/deployment/58722
Platform	Ries
Report	http://www.unc.edu/~jries/field_sites.html
Start Date	2010-09-01
End Date	2099-01-01
Description	The Ries Lab - Sapodilla Caye, Belize

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Project Information

Investigation of the Effects of CaCO3 Saturation State and Temperature on the Calcification Rate and Skeletal Properties of Benthic Marine Calcifiers (OA - Ocean Acidification and Warming Impact on Calcification)

Website: http://www.unc.edu/~jries/index.html

Coverage: Chapel Hill, North Carolina (lab) and Mesoamerican Barrier Reef System - Sapodilla Caye, Belize (16.2 N 88.5 W)

Description from NSF award abstract:
Anthropogenic elevation of atmospheric pCO2 is increasing the acidity of the oceans, thereby reducing the saturation state of seawater with respect to calcium carbonate (CaCO3). Of mounting concern is the potential impact of these changes on the ability of calcifying organisms to form their shells and skeletons. Recent studies, including pilot work conducted by investigator Ries and his colleagues on a suite of benthic marine calcifiers spanning broad taxonomic, mineralogical, and ecological ranges, have revealed that marine organisms exhibit a wide range of calcification responses to CO2-induced ocean acidification, including positive, negative, parabolic, threshold, and neutral responses. Marine calcifiers build their shells and skeletons from various forms (polymorphs) of CaCO3, most commonly aragonite, high-Mg calcite, and low-Mg calcite. These polymorphs differ greatly in their solubility in seawater and, therefore, in their potential response to CO2-induced ocean acidification. X-ray diffraction analysis of shells secreted by the organisms investigated in the pilot study reveals that the proportion of calcite (the less soluble form of CaCO3) to aragonite (the more soluble form) within their shells increases under elevated pCO2, while the Mg:Ca ratio of their calcite declines.

These observations suggested that some marine calcifiers may partially adapt to a declining CaCO3 saturation state by accreting a greater proportion of the less-soluble form of CaCO3 (low-Mg calcite) at the expense of the more soluble forms (aragonite, high-Mg calcite). However, it is likely that such mineralogical and compositional changes in the shells and skeletons of marine organisms would alter their structural and biomechanical properties.

The project seeks to build upon the results of a pilot study by rearing a suite of benthic marine calcifiers under past (280 ppm), present (385 ppm), and predicted future (540, 840 ppm) pCO2 and under three distinct temperatures to investigate changes in: (1) their rates of calcification and linear extension; (2) the relative abundance and micron-scale distribution of the various CaCO3 polymorphs within their shells/skeletons; (3) the ultrastructure and crystal morphology of their shells/skeletons; and (4) their biomechanical properties. The research also builds upon the pilot experiments by utilizing a more thoroughly replicated study design, by more precisely constraining the chemical parameters of the experimental seawater treatments, by investigating calcification responses under 3 different temperature regimes, and by employing a "pre-industrial" pCO2 level (280 ppm). The results of the proposed research should advance our understanding of how benthic marine calcifiers shall respond to future CO2-induced changes in seawater temperature and CaCO3 saturation state. By investigating the response of organisms over the range of atmospheric pCO2 that has occurred since late Paleozoic time, this research should inform our understanding of the putative links between atmospheric pCO2, mass extinction events, and secular variation in the polymorph mineralogy of marine calcifiers throughout geologic time. Finally, comparison of the observed biological responses to variable pCO2-T scenarios with that already established for abiogenic carbonates will advance our understanding of the very mechanisms by which marine calcifiers build their shells and skeletons.

Results of this research project will inform the decisions of policy makers and legislators working to mitigate the impacts of CO2-induced warming and ocean acidification by establishing pCO2-T tolerances for a range of marine calcifiers.

Note (02 Oct 2014): Funding for this project has transferred from award OCE-1031995 to OCE-1357665, coincident with Principal Investigator's affiliation change from University of North Carolina at Chapel Hill to Northeastern University.

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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-1031995
NSF Division of Ocean Sciences (NSF OCE)	OCE-1357665
National Oceanic and Atmospheric Administration (NOAA)	NA11OAR431016
National Oceanic and Atmospheric Administration (NOAA)	NA13OAR4310186

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