Sea surface temperature JPL MUR data, Belize Mesoamerican Barrier Reef System (MBRS), 2003-2015

Website: https://www.bco-dmo.org/dataset/734406
Data Type: Other Field Results
Version: 1
Version Date: 2018-04-16

Project
» Investigating the influence of thermal history on coral growth response to recent and predicted end-of-century ocean warming across a cascade of ecological scales (Thermal History and Coral Growth)

Contributors	Affiliation	Role
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Abstract
This dataset contains sea surface temperature data obtained from daily 1-km horizontal resolution SST estimates acquired from the Jet Propulsion Laboratory's Multi-Scale High Resolution SST (JPL MUR SST) records via the Physical Oceanography Distributed Active Archive Center (PO.DAAC) at the NASA JPL, Pasadena, CA (http://podaac.jpl.nasa.gov). NOTE: Data from 2012 are given twice at each site; only the first set, along with the 2003-2011 data, was used in the original analysis in Baumann et al (2016). The 2012-2015 data were only available following revision in the peer review process. It became useful for making comparisons between the in-situ data and satellite data. These data were used in a coral study in: Baumann JH, Townsend JE, Courtney TA, Aichelman HE, Davies SW, Lima FP, et al. (2016) Temperature Regimes Impact Coral Assemblages along Environmental Gradients on Lagoonal Reefs in Belize. PLoS ONE 11(9): e0162098. https://doi.org/10.1371/journal.pone.0162098.

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Coverage

Spatial Extent: **N**:17.824 **E**:-88.002 **S**:16.13 **W**:-88.629
Temporal Extent: 2003-01-01 - 2015-11-18

Dataset Description

This dataset contains sea surface temperature data obtained from daily 1-km horizontal resolution SST estimates acquired from the Jet Propulsion Laboratory's Multi-Scale High Resolution SST (JPL MUR SST) records via the Physical Oceanography Distributed Active Archive Center (PO.DAAC) at the NASA JPL, Pasadena, CA (http://podaac.jpl.nasa.gov).

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Acquisition Description

Conventional 1-km resolution satellite-derived SST measurements (infrared, IR) are contaminated by clouds, creating data-void areas. Microwave (MW) data sets can penetrate clouds to gain better temporal coverage, but with a much coarser spatial resolution (25 km) [36]. MUR combines these two datasets to present a more comprehensive and complete SST product. It employs multi-resolution variational analysis (MRBA) as an interpolation method to combine high resolution datasets with more conventional datasets, generating a product that contains no cloud contamination [36]. MUR reports estimates of foundation SST, or SST at the base of the diurnal thermocline (~5-10m depth). Comparison of in-situ temperature (recorded

by HOBO® v2 data loggers), MUR, and other SST products revealed that MUR outperforms other products in estimating in-situ temperature, although it also underestimates the temperature corals experience at depth (S1 Fig). However, due to its temporal coverage and temporal resolution, high spatial resolution, lack of cloud contamination, and smaller method error compared to similar products such as Group for High Resolution SST (GHRSST), MUR was determined to be the ideal SST product for use in the current study.

Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- too many columns to serve in BCO-DMO system, so transformed date columns to rows

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Related Publications

Baumann, J. H., Townsend, J. E., Courtney, T. A., Aichelman, H. E., Davies, S. W., Lima, F. P., & Castillo, K. D. (2016). Temperature Regimes Impact Coral Assemblages along Environmental Gradients on Lagoonal Reefs in Belize. PLOS ONE, 11(9), e0162098. doi:10.1371/journal.pone.0162098

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Parameters

Parameter	Description	Units
site	site identifier	unitless
lat	latitude; north is positive	decimal degrees
long	longitude; east is positive	decimal degrees
date	date; formatted as yyyy-mm-dd	unitless
temp	daily 1-km horizontal resolution sea surface temperature estimate from the Jet Propulsion Laboratory's Multi-Scale High Resolution SST (JPL MUR SST)	degrees Celsius
temp_se	temperature standard error	degrees Celsius

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Advanced Very High Resolution Radiometer
Dataset-specific Description	One of several instruments used by NASA to produce sea surface temperature data products.
Generic Instrument Description	"The AVHRR instrument consists of an array of small sensors that record (as digital numbers) the amount of visible and infrared radiation reflected and (or) emitted from the Earth's surface" (more information).

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Project Information

Investigating the influence of thermal history on coral growth response to recent and predicted end-of-century ocean warming across a cascade of ecological scales (Thermal History and Coral Growth)

Website: http://www.unc.edu/~kdcastil/research.html

Coverage: Western Caribbean

Description from NSF award abstract: Rising global ocean surface temperatures have reduced coral growth rates, thereby negatively impacting the health of coral reef ecosystems worldwide. Recent studies on tropical reef building corals reveal that corals' growth in response to ocean warming may be influenced by their previous seawater temperature exposure - their thermal history. Although these recent findings highlight significant variability in coral growth in response to climate change, uncertainty remains as to the spatial scale at which corals' thermal history influences how they have responded to ocean warming and how they will likely respond to predicted future increases in ocean temperature. This study investigates the influence of thermal history on coral growth in response to recent and predicted seawater temperatures increases across four ecologically relevant spatial scales ranging from reef ecosystems, to reef communities, to reef populations, to an individual coral colony. By understanding how corals have responded in the past across a range of ecological scales, the Principal Investigator will be able to improve the ability to predict their susceptibility and resilience, which could then be applied to coral reef conservation in the face of climate change. This research project will broaden the participation of undergraduates from underrepresented groups and educate public radio listeners using minority voices and narratives. The scientist will leverage current and new partnerships to recruit and train minority undergraduates, thus allowing them to engage high school students near field sites in Florida, Belize, and Panama. Through peer advising, undergraduates will document this research on a digital news site for dissemination to the public. The voice of the undergraduates and scientist will ground the production of a public radio feature exploring the topic of acclimatization and resilience - a capacity for stress tolerance within coral reef ecosystems. This project will provide a postdoctoral researcher and several graduate students with opportunities for field and laboratory research training, teaching and mentoring, and professional development. The results will allow policy makers from Florida, the Mesoamerican Barrier Reef System countries, and several Central American countries to benefit from Caribbean-scale inferences that incorporate corals' physiological abilities, thereby improving coral reef management for the region. Coral reefs are at significant risk due to a variety of local and global scale anthropogenic stressors. Although various stressors contribute to the observed decline in coral reef health, recent studies highlight rising seawater temperatures due to increasing atmospheric carbon dioxide concentration as one of the most significant stressors influencing coral growth rates. However, there is increasing recognition of problems of scale since a coral's

growth response to an environmental stressor may be conditional on the scale of description. This research will investigate the following research questions: (1) How has seawater temperature on reef ecosystems (Florida Keys Reef Tract, USA; Belize Barrier Reef System, Belize; and Bocas Del Toro Reef Complex, Panama), reef communities (inshore and offshore reefs), reef populations (individual reefs), and near reef colonies (individual colonies), varied in the past? (2) How has seawater temperature influenced rates of coral growth and how does the seawater temperature-coral growth relationship vary across these four ecological spatial scales? (3) Does the seawater temperature-coral growth relationship forecast rates of coral growth under predicted end-of-century ocean warming at the four ecological spatial scales? Long term sea surface temperature records and small-scale high-resolution in situ seawater temperature measurements will be compared with growth chronologies for the reef building corals Siderastrea siderea and Orbicella faveolata, two keystone species ubiquitously distributed throughout the Caribbean Sea. Nutrients and irradiance will be quantified via satellite-derived observations, in situ measurements, and established colorimetric protocols. Field and laboratory experiments will be combined to examine seawater temperature-coral growth relationships under recent and predicted end-of-century ocean warming at four ecologically relevant spatial scales. The findings of this study will help us bridge the temperature-coral growth response gap across ecologically relevant spatial scales and thus improve our understanding of how corals have responded to recent warming. This will lead to more meaningful predictions about future coral growth response to climate change.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1459522

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