Net carbonate production rates for Palau and Yap coral reefs from kriging

Website: https://www.bco-dmo.org/dataset/736016
Data Type: Other Field Results
Version: 1
Version Date: 2018-05-23

Project
» Adjustment of western Pacific Ocean coral reefs to sea-level rise and ocean warming (Coral Reef Adjustment)

Contributors	Affiliation	Role
van Woesik, Robert	Florida Institute of Technology (FIT)	Principal Investigator, Contact
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
As part of the reef-composition survey of Palau (7°30' N, 134°30' E) and Yap (9°32' N, 138°7' E), the rates of carbonate flux were estimated using rates of accretion and biological erosion. The initial model output containing estimates of carbonate production and erosion was used in subsequent R scripts and models.

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Coverage

Spatial Extent: **N**:9.6568 **E**:138.2088 **S**:7.1878 **W**:134.229

Dataset Description

This model and results were published in van Woesik and Cacciapaglia, 2018. The model package model.zip contains model inputs, R-language scripts, shapefiles, and model documentation files. model.zip (2.8 MB) Model output is available by clicking the "Get Data" link on this page. The "Parameters" section of this page documents the model output column names, descriptions, and units. The input for this model is fully described and accessible from the following dataset landing pages. The original version of these input data as submitted to BCO-DMO are included in the model.zip package provided here. Please refer to the "Processing" section on each dataset landing page below to view the changes made from the original to the final version served. Related Datasets (Palau and Yap reef data 2017): * Parrotfish surveys: https://www.bco-dmo.org/dataset/734979 * Parrotfish species information: https://www.bco-dmo.org/dataset/735679 * Coral species information: https://www.bco-dmo.org/dataset/736007 * Site list: https://www.bco-dmo.org/dataset/735714 * Urchins: https://www.bco-dmo.org/dataset/737514 * Coral surveys: https://www.bco-dmo.org/dataset/737508 * Coral density: https://www.bco-dmo.org/dataset/737520 * Coral extension rates: https://www.bco-dmo.org/dataset/737526

Methods & Sampling

All of the estimates are outputs from the carbonate-production model, these methods can be found within the manuscript along with the equations required to produce the output (van Woesik & Cacciapaglia, 2018).

Data Processing Description

Data Manager Processing Notes: * Input filenames did not match the names called in the model code. Data submitter provided a list of filenames called in the R scripts and the names the files were submitted to BCO-DMO as. Code modified to call filenames as submitted to BCO-DMO. * code modified to relative paths from full hard-coded paths. * file dependencies (shapefiles, etc) provided by data submitter were added to model.zip package. * model output values rounded (lat, lon to five decimal places; NP, GP to three decimal places and BFj, BUj to six decimal places). * Model output for Yap and Palau combined into one dataset with added column "Country" containing values Yap or Palau.

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Data Files

File
model_output.csv (Comma Separated Values (.csv), 2.63 KB) MD5:cbd4923207c4c4851d268b83b1eb356c Primary data file for dataset ID 736016

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Related Publications

Van Woesik, R., & Cacciapaglia, C. W. (2018). Keeping up with sea-level rise: Carbonate production rates in Palau and Yap, western Pacific Ocean. PLOS ONE, 13(5), e0197077. doi:10.1371/journal.pone.0197077
Results

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Parameters

Parameter	Description	Units
Country	Country (Palau | Yap) of site	unitless
locat	Reef habitats stratified as either ‘outer’, ‘inner’, or ‘patch’ reef	Unitless
NP	Net carbonate production including all erosion, sedimentation, and production of carbonate at each site	kilograms calcium carbonate per year (kg CaCO3 yr-1)
GP	Gross carbonate production, excluding all sedimentation and erosional forces, at each site	kilograms calcium carbonate per year (kg CaCO3 yr-1)
BFj	Biological erosion caused by parrotfishes at each site	kilograms calcium carbonate per year (kg CaCO3 yr-1)
BUj	Biological erosion caused by sea urchins at each site	kilograms calcium carbonate per year (kg CaCO3 yr-1)
lon	Longitude of site	Decimal degrees
lat	Latitude of site	Decimal degrees

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Deployments

vanWoesik_Yap_2017

Website	https://www.bco-dmo.org/deployment/744604
Platform	shoreside Yap
Start Date	2017-06-25
End Date	2017-07-06

vanWoesik_Palau_2017

Website	https://www.bco-dmo.org/deployment/744578
Platform	shoreside Palau
Start Date	2017-06-02
End Date	2017-06-24

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Project Information

Adjustment of western Pacific Ocean coral reefs to sea-level rise and ocean warming (Coral Reef Adjustment)

Coverage: Western Pacific: Palau, Yap, Pohnpei, Kosrae, Republic of the Marshall Islands, Kiribati

NSF Award Abstract:
Increases in ocean temperatures and sea-level rise are threatening coral reef ecosystems worldwide. Indeed, some island nations are no more than 1 m above modern sea level. Yet, building sea walls on tropical coasts, to keep out the ocean, as they do in the Netherlands, is a substantial economic burden on small-island nations. Healthy coral reefs, however, have the capacity to lay down sufficient calcium carbonate to grow vertically and keep up with sea-level rise, as they did in the geological past. By contrast, damaged coral reefs do not have the capacity to keep up with sea-level rise, making the coastal communities vulnerable, and inflicting a large economic burden on the coastal societies to build sea walls. In addition, and very recently, coral reefs are being subjected to high water temperatures that are causing considerable damage to corals. This study will ask some critical questions: Are coral reefs in the western Pacific Ocean keeping up with sea-level rise? Where are reefs keeping up with sea-level rise, and what is preventing reefs in some localities from keeping up? This study will also examine whether geographical differences in ocean temperatures influence the capacity of reefs to keep up with sea-level rise. Where coral reefs cannot keep up with sea-level rise, these natural storm barriers will disappear, resulting in the loss of habitable land for millions of people worldwide. The broader impacts of the study will focus on training a post-doctoral researcher, and developing and running one-week training workshops in the proposed study locations in Palau, Yap, Chuuk, Pohnpei, Kosrae, Majuro, and Kiribati. The investigators will work with local stakeholders on the various islands, focusing on connecting science to management practices to reduce local stressors to coral reefs.

Coral reefs are one of the world's most diverse and valuable marine ecosystems. Since the mid-Holocene, some 5000 years ago, coral reefs in the Pacific Ocean have been vertically constrained by sea level. Contemporary sea-level rise is releasing these constraints, providing accommodation space for vertical reef expansion. Yet recently corals have been repeatedly subjected to thermal-stress events, and we know little about whether modern coral reefs can "keep up" with projected future sea-level rise as the ocean temperatures continue to increase. This study will examine whether and where coral reefs are keeping up with sea-level rise across a temperature gradient in the Pacific Ocean, from Palau in the west to Kiribati in the east. The spatial differences in the capacity to keep up with sea level will be explored, and it is hypothesized that differential rates of coral growth and capacity to keep up with sea-level rise will be a function of regional temperatures, local water-flow rates, and land-use. One of the major tasks of this study is to determine the

contribution of the various components of each reef to potential carbonate production, across the geographical temperature gradient. The investigators will quantify the rates of carbonate production, by corals and calcareous algae, and the rates of carbonate destruction, by reef eroders, by measuring the space occupied by each benthic component at each study site. The team will then sum that information to interpret the overall capacity of the reef to produce carbonate. At each study site mobile benthic eroders will be estimated, as counts and size measurements of echinoids and herbivorous fishes. The investigators will measure the densities of the different coral species, from different habitats, and develop models that relate the coral morphologies with the potential rate of carbonate deposition. This study will assess the contribution of sea surface temperature, flow rates, and land-use practice to the capacity of reefs to keep up with sea-level rise. Two different approaches will be used to predict the relationship between carbonate production and sea-level rise. The first model will assume that the capacity of vertical reef accretion is directly related to the extension of Porites microatolls at the various island locations. The second model will take a hierarchical Bayesian approach to examine reef growth, which depends on the presence and density of calcifying organisms, and on physical, chemical, and biological erosional processes.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1657633

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