Irradiance and estimated light attenuation coefficient, Kd, underwater and onshore in Varadero Reef, 2017

Website: https://www.bco-dmo.org/dataset/786608
Data Type: Other Field Results
Version: 1
Version Date: 2020-01-08

Project
» RAPID: Coral robustness: lessons from an "improbable" reef (Varadero Reef)

Contributors	Affiliation	Role
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Abstract
This dataset contains the primary data of irradiance recorded underwater and onshore and the estimated light attenuation coefficient, Kd, based on these data in Varadero Reef. The irradiance recorded synchronously onshore and underwater were used to estimate the variability of the light attenuation coefficient (Kd) resulting from temporal variation of the optical properties of water.

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Coverage

Spatial Extent: **Lat**:10.3065 **Lon**:-75.5856
Temporal Extent: 2017-08-12 - 2017-11-28

Dataset Description

This dataset contains the primary data of irradiance recorded underwater and onshore and the estimated light attenuation coefficient, Kd, based on these data in Varadero Reef, Colombia, August - November 2017. The irradiance recorded synchronously onshore and underwater were used to estimate the variability of the light attenuation coefficient (Kd) resulting from temporal variation of the optical properties of water.

These data were used in the manuscript “Degradation of the underwater light environment: physiological and ecological consequences for reef corals” submitted to the Journal Nature Communications Biology. [under review, 2019-12-28]

Methods & Sampling

The Varadero Reef is located south-west of the Cartagena Bay close to the southern strait that connects the Bay to the Caribbean Sea in Colombia (10°18’23.3"N, 75°35’08.0"W). The Bay is a receiving estuary from the Magdalena River through the Canal del Dique, a man-made channel whose construction and operation dates back almost a century. The depth of the particular transplant site in Varadero is 3.5m.

Irradiance was monitored for one year (November 2016 - November 2017) at Varadero with cosine-corrected light sensors (Odyssey submersible PAR logger, Dataflow systems, New Zealand), previously cross-calibrated against a manufacturer-calibrated quantum sensor (LI-1400, LI-COR, USA). The light sensors were cleaned and downloaded periodically (every two months or less) to avoid biofouling. Data in which cumulative light signal loss was evident were discarded.

In order to estimate the variation of the optical properties of water resulting from the Dique plume dynamics, light data recorded underwater were compared with data simultaneously recorded by another sensor in a site onshore close to Varadero (Fig. 5). With this array, we were able to isolate the variations of irradiance associated with the plume from variations due to cloud coverage. The irradiance synchronously recorded by onshore and underwater loggers was used to estimate the variability of Kd based on the Lambert-Beer’s law: Kd = ln (Ez / E0) / -Z,

where Ez is the irradiance recorded underwater, E0 is the irradiance recorded onshore, and Z is the depth at which the underwater sensor was deployed in Varadero (3.5 m). Only data recorded between 7:00 and 17:00 were employed.

Odyssey data logging software (Dataflow systems Ltd., Christchurch, New Zealand) was used to manage the logger and data operations.

Problem report: There are some gaps associated with technical failure of the devices.

Data 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
- reformatted date from m/d/yyyy to yyyy-mm-dd
- added ISO_DateTime_UTC column
- blank values were replaced with no data value 'nd'

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Data Files

File
irrad_light.csv (Comma Separated Values (.csv), 381.53 KB) MD5:1e1c472a0b38e021b614414ed13ecfc0 Primary data file for dataset ID 786608

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Related Publications

López-Londoño, T., Galindo-Martínez, C. T., Gómez-Campo, K., González-Guerrero, L. A., Roitman, S., Pollock, F. J., Pizarro, V., López-Victoria, M., Medina, M., & Iglesias-Prieto, R. (2021). Physiological and ecological consequences of the water optical properties degradation on reef corals. Coral Reefs, 40(4), 1243–1256. https://doi.org/10.1007/s00338-021-02133-7
Results

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Parameters

Parameter	Description	Units
Date	sampling date	unitless
Time	sampling time	unitless
DateTimeLocal	sampling date and time	unitless
Irradiance_uw	light intensity underwater	micromol quanta meter^-2 second^-1
Irradiance_onshore	light intensity onshore	micromol quanta meter^-2 second^-1
Kd_est	estimated light attenuation coefficient Kd	meter^-1
ISO_DateTime_UTC	date and time formatted is ISO: yyyy-mm-ddTHH:MM:SSZ	unitless

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Instruments

Dataset-specific Instrument Name	LI-1400 (LI-COR, Nebraska, USA)
Generic Instrument Name	Data Logger
Dataset-specific Description	Data logger connected to a quantum sensor was used to calibrate the Odyssey sensors
Generic Instrument Description	Electronic devices that record data over time or in relation to location either with a built-in instrument or sensor or via external instruments and sensors.

Dataset-specific Instrument Name	Odyssey submersible PAR logger (Dataflow systems Ltda, Christchurch, New Zealand)
Generic Instrument Name	Light Meter
Dataset-specific Description	Used to monitor the light intensity at each site.
Generic Instrument Description	Light meters are instruments that measure light intensity. Common units of measure for light intensity are umol/m2/s or uE/m2/s (micromoles per meter squared per second or microEinsteins per meter squared per second). (example: LI-COR 250A)

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Project Information

RAPID: Coral robustness: lessons from an "improbable" reef (Varadero Reef)

Coverage: Caribbean Sea (10°18’10”N, 75°34’ 55”W)

NSF Award Abstract:
Coral reefs provide invaluable services to coastal communities, but coral populations worldwide are in a state of unprecedented decline. Studying resilient reefs is of primary importance for coral conservation and restoration efforts. A unique natural experiment in coral resilience to stress has been playing out in Cartagena Bay, Colombia since the Spanish conquistadors diverted the Magadalena River into the Bay in 1582. Varadero Reef at the southern mouth of the Bay has survived centuries of environmental insults and changing conditions with up to 80% coral cover. This reef provides an ideal system to test biological robustness theory. Given that Varadero is a highly perturbed system, we hypothesize that while likely more robust to perturbation than nearby pristine reefs, it will be less physiologically efficient. Some of the large star coral colonies (Orbicella faveolata) at this site have existed since before the construction of the Canal del Dique. These coral specimens contain invaluable information regarding the conditions of the Magdalena River wathershed and its construction in the XIV century. Changes in turbidity of the plume associated with the urban industrial and agricultural development of Colombia can be documented as variations in calcification rates and changes in the microstructure of the skeleton. The Colombian government has announced the approval for the construction of a shipping channel that will go right over this reef, with the goal to start dredging as early as Fall 2016 or early 2017. The RAPID funding mechanism would enable immediate collection of data and information of why this reef has survived centuries of environmental stress that can shed light on what genotype combinations of coral and its microbial constituents will fare better in similar conditions at other reef locations around the world. Coral reef conservation biology will benefit from this study by generating data for the development of stress diagnostic tools to identify resilient corals. This project will help broaden participation in science by training a diverse cohort of students to work effectively in the global arena while fostering productive collaborations with several Colombian researchers and educational institutions. Students will also gain cultural empathy and sensitivity through direct engagement with the members of society who are most directly impacted by coral reef degradation (e.g. fishermen). Student researchers from Penn State University will work alongside their Colombian counterparts to develop a series of bilingual blog posts to record the cultural and scientific aspects of this project's research expeditions. The blog postings will be submitted for wide dissemination to the Smithsonian's Ocean Portal where Penn State students have published in the past. An educational coral kit developed by the Medina Lab and extensively tested in schools in the US has been translated into Spanish and will be used in local schools in Cartagena and vicinities. All expedition data and metadata will be incorporated into the Global Coral Microbiome Project's interactive web portal, a responsive outreach tool allows researchers, students and/or teachers to access a wealth of information about every coral colony we sample and to virtually explore coral reefs around the world from any internet-enabled device.

This research will generate information to understand functional traits related to symbioses stability under different perturbation regimes. Comparative analyses of microbiome modifications generated during the reciprocal transplantation will allow us to document possible differential responses of the holobionts to acute and chronic stressors relative to corals not exposed to significant levels of perturbation. The development of local bio-optical models of coral calcification and the characterization of the coral holobiont will permit the distinction between the effects in calcification attributed to local turbidity from those that can be ;attributed to differences in host genotype and/or microbial community composition and function. The information recorded in coral skeletons can be used to reconstruct the rates of agricultural, industrial and urban development of Colombia through the last 5 centuries as changes in the turbidity of the effluent of the Magdalena River.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1642311

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