Phytoplankton diversity along with carbon and nitrogen uptake rates collected along the GO-SHIP IO9 repeat hydrography section of the Indian Ocean from R/V Roger Revelle cruise RR1604 from March to April 2016

Website: https://www.bco-dmo.org/dataset/723191
Data Type: Cruise Results
Version: 2
Version Date: 2018-02-22

Project
» Collaborative Research: Regional variation of phytoplankton diversity and biogeochemical functioning in the subtropical Indian Ocean (IO Phytoplankton)

Contributors	Affiliation	Role
Lomas, Michael W.	Bigelow Laboratory for Ocean Sciences	Principal Investigator
Twining, Benjamin	Bigelow Laboratory for Ocean Sciences	Co-Principal Investigator
Baer, Steven E.	Bigelow Laboratory for Ocean Sciences	Contact
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Phytoplankton diversity along with carbon and nitrogen uptake rates collected along the GO-SHIP IO9 repeat hydrography section of the Indian Ocean from R/V Roger Revelle cruise RR1604 from March to April 2016.

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Coverage

Spatial Extent: **N**:17 **E**:95 **S**:-28.31 **W**:87.07

Dataset Description

Phytoplankton diversity along with carbon and nitrogen uptake rates from cruise RR1604 along the GO-SHIP IO9 repeat hydrography section of the Indian Ocean.

Methods & Sampling

All nutrient and cell count methodology is described in the published work coming out of this data set (see below).

Samples were initially collected with a CTD/Niskin rosette, as supplied by the ship.

Urea and total dissolved phosphorus (for calculation of dissolved organic phosphorus) were determined on a Thermo Scientific Genesys 10UV spectrophotometer. See Lomas et al. (2010) for a description of the latter.

Cell counts for heterotrophic bacteria and nanoplankton (<20 um) cells were performed on a BD FACSJazz flow cytometer, using standard methods and 0.53 um bead stocks for reference material. Visualization of heterotrophic bacteria was performed with SYBR Green stain.

Biomass calculations were derived from flow cytometry data output, as per Casey et al. (2013).

Larger (>20 um) autotrophs were enumerated on a FlowCam (Fluid Imagining Technologies).

Biomass and isotopic enrichment, used to calculate specific and absolute uptake rates, were assessed on a Thermo Finnegan Delta V mass spectrometer, as operated by the Bigelow Analytical Services team.

Sample accuracy was assessed by using certified standards, for those measurements where standards are available. Certified standards were run with each analytical run and compared to long term control charts for respective analyses. For those analyses where there are no standards (e.g., flow cytometric cell counts) data were assessed for reasonableness based upon extensive experience of the PI's.

Data Processing Description

Data processing was performed using mostly Microsoft Excel. Further statistical analyses and graphing were performed with SigmaPlot. All samples collected are included in the report. Any occurences of "nd" in the data mean those samples were not collected.

BCO-DMO Processing:
- modified parameter names to conform with BCO-DMO naming convetions (removed units, replaced spaces with underscores);
- replaced blank cells with "nd" ("no data").

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Data Files

File
IO_Phytoplankton.csv (Comma Separated Values (.csv), 9.99 KB) MD5:184fcb3dcf42c7c339764b0935bf81da Primary data file for dataset ID 723191

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Related Publications

Baer, S. E., Rauschenberg, S., Garcia, C. A., Garcia, N. S., Martiny, A. C., Twining, B. S., & Lomas, M. W. (2019). Carbon and nitrogen productivity during spring in the oligotrophic Indian Ocean along the GO-SHIP IO9N transect. Deep Sea Research Part II: Topical Studies in Oceanography, 161, 81–91. doi:10.1016/j.dsr2.2018.11.008
Results

Casey, J. R., Aucan, J. P., Goldberg, S. R., & Lomas, M. W. (2013). Changes in partitioning of carbon amongst photosynthetic pico- and nano-plankton groups in the Sargasso Sea in response to changes in the North Atlantic Oscillation. Deep Sea Research Part II: Topical Studies in Oceanography, 93, 58–70. doi:10.1016/j.dsr2.2013.02.002
Methods

Garcia, C. A., Baer, S. E., Garcia, N. S., Rauschenberg, S., Twining, B. S., Lomas, M. W., & Martiny, A. C. (2018). Nutrient supply controls particulate elemental concentrations and ratios in the low latitude eastern Indian Ocean. Nature Communications, 9(1). doi:10.1038/s41467-018-06892-w
Results

Lomas, M. W., Burke, A. L., Lomas, D. A., Bell, D. W., Shen, C., Dyhrman, S. T., & Ammerman, J. W. (2010). Sargasso Sea phosphorus biogeochemistry: an important role for dissolved organic phosphorus (DOP). Biogeosciences, 7(2), 695–710. doi:10.5194/bg-7-695-2010
Methods

Twining, B. S., Rauschenberg, S., Baer, S. E., Lomas, M. W., Martiny, A. C., & Antipova, O. (2019). A nutrient limitation mosaic in the eastern tropical Indian Ocean. Deep Sea Research Part II: Topical Studies in Oceanography. doi:10.1016/j.dsr2.2019.05.001
Results

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Parameters

Parameter	Description	Units
station	Station number	unitless
latitude	Station latitude; positive values = North	decimal degrees
longitude	Station longitude; positive values = East	decimal degrees
depth	Sample depth	meters (m)
urea	Urea concentration. BD = below detection (the detection limit for the urea method is 0.01 umol L-1).	micromoles per liter (umol L-1)
DOP	Dissolved organic phosphorus concentration	micromoles per liter (umol L-1)
chlorophyll_a	Chlorophyll a	milligrams per cubic meter (mg m-3)
LNA_bacteria	Count of low-nucleic acid heterotrophic bacteria	cells per milliliter (cells ml-1)
HNA_bacteria	Count of high-nucleic acid heterotrophic bacteria	cells per milliliter (cells ml-1)
prochlorococcus	Count of Prochlorococcus cells	cells per milliliter (cells ml-1)
synechococcus	Count of Synechococcus cells	cells per milliliter (cells ml-1)
picoeukaryotes	Count of picoeukaryote (<3 um) cells	cells per milliliter (cells ml-1)
nanoeukaryotes	Count of nanoeukaryote (3-20 um) cells	cells per milliliter (cells ml-1)
bacteria_biomass	Biomass of all bacteria	micrograms carbon per liter (ug C L-1)

prochlorococcus_biomass	Carbon content of Prochlorococcus cells	micrograms carbon per liter (ug C L-1)
synechococcus_biomass	Carbon content of Synechococcus cells	micrograms carbon per liter (ug C L-1)
small_eukaryote_biomass	Carbon content of picoeukaryote and nanoeukaryote cells	micrograms carbon per liter (ug C L-1)
diatom_biomass	Carbon content of diatoms	micrograms carbon per liter (ug C L-1)
dinoflagellate_biomass	Carbon content of dinoflagellates	micrograms carbon per liter (ug C L-1)
ciliate_biomass	Carbon content of ciliates	micrograms carbon per liter (ug C L-1)
other_large_phyto_biomass	Carbon content of >20 um phytoplankton not included in other categories	micrograms carbon per liter (ug C L-1)
NO3_V	Nitrate specific uptake	per hour (h-1)
NO3_V_std_dev	Standard deviation of NO3_V	per hour (h-1)
NO3_rho	Nitrate absolute uptake	nanomoles per liter per hour (nmol N L-1 h-1)
NO3_rho_std_dev	standard deviation of NO3_rho	nanomoles per liter per hour (nmol N L-1 h-1)
NH4_V	Ammonium specific uptake	per hour (h-1)
NH4_V_std_dev	Standard deviation of NH4_V	per hour (h-1)
NH4_rho	Ammonium absolute uptake	nanomoles per liter per hour (nmol N L-1 h-1)
NH4_rho_std_dev	Standard deviation of NH4_rho	nanomoles per liter per hour (nmol N L-1 h-1)
urea_V	Urea specific uptake	per hour (h-1)
urea_V_std_dev	Standard deviation of urea V	per hour (h-1)
urea_rho	Urea absolute uptake	nanomoles per liter per hour (nmol N L-1 h-1)

urea_rho_std_dev	Standard deviation of urea rho	nanomoles per liter per hour (nmol N L-1 h-1)
C_V	Bicarbonate specific uptake	per hour (h-1)
C_V_std_dev	Standard deviation of Bicarbonate specific uptake	per hour (h-1)
C_rho	Bicarbonate absolute uptake	nanomoles per liter per hour (nmol N L-1 h-1)
C_rho_std_dev	Standard deviation of C rho	nanomoles per liter per hour (nmol N L-1 h-1)

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Instruments

Dataset-specific Instrument Name	CTD/Niskin rosette
Generic Instrument Name	CTD - profiler
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column. It permits scientists to observe the physical properties in real-time via a conducting cable, which is typically connected to a CTD to a deck unit and computer on a ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This term applies to profiling CTDs. For fixed CTDs, see https://www.bco-dmo.org/instrument/869934.

Dataset-specific Instrument Name	BD FACSJazz flow cytometer
Generic Instrument Name	Flow Cytometer
Dataset-specific Description	Cell counts for heterotrophic bacteria smaller (
Generic Instrument Description	Flow cytometers (FC or FCM) are automated instruments that quantitate properties of single cells, one cell at a time. They can measure cell size, cell granularity, the amounts of cell components such as total DNA, newly synthesized DNA, gene expression as the amount messenger RNA for a particular gene, amounts of specific surface receptors, amounts of intracellular proteins, or transient signalling events in living cells. Description from: http://www.bio.umass.edu/micro/immunology/facs542/facswhat.htm

Dataset-specific Instrument Name	Thermo Finnegan Delta V mass spectrometer
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Biomass and isotopic enrichment, used to calculate specific and absolute uptake rates, were assessed on a Thermo Finnegan Delta V mass spectrometer, as operated by the Bigelow Analytical Services team.
Generic Instrument Description	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

Dataset-specific Instrument Name	CTD/Niskin rosette
Generic Instrument Name	Niskin bottle
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	Thermo Scientific Genesys 10UV spectrophotometer
Generic Instrument Name	Spectrophotometer
Dataset-specific Description	Urea and total dissolved phosphorus (for calculation of dissolved organic phosphorus) were determined on a Thermo Scientific Genesys 10UV spectrophotometer.
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

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Deployments

RR1604

Website	https://www.bco-dmo.org/deployment/723194
Platform	R/V Roger Revelle
Start Date	2016-03-21
End Date	2016-04-28

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Project Information

Collaborative Research: Regional variation of phytoplankton diversity and biogeochemical functioning in the subtropical Indian Ocean (IO Phytoplankton)

Coverage: GO-SHIP IO9N transect: 20S 95E to 20N 95E

Description from NSF award abstract:
The Indian Ocean accounts for nearly a fifth of global ocean photosynthesis and is likely a key component in global ocean nutrient and carbon cycles. However, the Indian Ocean may be the least studied major marine body on the planet. Our limited understanding suggests extensive variations in physical and chemical environmental conditions, but how this variation influences biodiversity, nutrient stress, and more broadly regional differences in the functioning of phytoplankton is unknown. To help address these gaps, the investigators will conduct a study by joining an already-funded major research cruise to this region. It will cover a northern region with some of the highest temperatures recorded in open ocean waters, an area around 10°S of predicted (but not tested in situ) iron stress, and a southern subtropical gyre with unique nitrogen to phosphorous(or N:P) ratios. The focus of this project is to quantify and synthesize the interconnectedness of environmental conditions, phytoplankton diversity and genome content, and nutrient biogeochemistry, with the goal of understanding how these may lead to unique biogeochemical regions in Indian Ocean. The research will have broader impacts on many levels. First, it will increase public awareness of the role of phytoplankton on ocean functioning, climate, and people's lives through a new partnership with the Aquarium of the Pacific (AOP), which is the fourth most-attended aquarium in the nation. Secondly, the project will train a postdoctoral scholar as well as a graduate and undergraduate students. Third, the research will dramatically increase our basic knowledge ocean biogeochemistry and in many cases will be the first measurements of their kind made in the Indian Ocean.

This project will address two major questions: How do environmental conditions, phytoplankton diversity, phytoplankton physiology, and biogeochemistry vary across the central Indian Ocean? Are there distinct biogeochemical regimes in the central IO? The researchers hypothesize that environmental conditions, including the relative availability of nitrogen (N) and iron (Fe), lead to three distinct phytoplankton communities and biogeochemical regimes. They will employ a series of advanced analytical tools including high sensitivity measurements of dissolved and particulate nutrients (nitrogen, phosphorus, and iron), genomics, bioassays to test for nutrient stress, and cell-sorting of specific taxa followed by measures of nutrient content and uptake. A focus of this project is to quantify and synthesize the interconnectedness of environmental conditions, phytoplankton diversity and genome content, and nutrient biogeochemistry, and how these lead to unique biogeochemical regions in Indian Ocean. This extensive set of observations can ultimately be linked to ocean models and satellite data to provide a comprehensive view of regional differences in chemistry, biodiversity and phytoplankton biogeochemical functioning in the Indian Ocean.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1559021

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