Prochlorococcus, Synechococcus and picoeukaryotic phytoplankton abundance climatology in the global ocean from quantitative niche models.

Website: https://www.bco-dmo.org/dataset/811147
Data Type: model results
Version: 1
Version Date: 2020-05-11

Project
» Convergence: RAISE: Linking the adaptive dynamics of plankton with emergent global ocean biogeochemistry (Ocean_Stoichiometry)

Contributors	Affiliation	Role
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Abstract
Prochlorococcus, Synechococcus and picoeukaryotic phytoplankton estimated mean cell abundance (cells/ml) in 1-degree grids for 25 layers from 0m to 200 m depth. Cell abundance was estimated with quantitative niche models for each lineage (Flombaum et al., 2013; Flombaum et al., 2020), inputs from the monthly mean of temperature and nitrate from the World Ocean Atlas, and PAR from MODIS-Aqua Level-3 Mapped Photosynthetically Available Radiation Data Version 2018.

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Coverage

Dataset Description

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For annual climatology, the annual mean represents the average of the 12 months for each grid cell.

Processing Description

BCO-DMO Processing Notes:
- renamed directory DATA+METADATA annual/ to annual/
- packaged the .csv files using zip and added as data files.

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Data Files

File	Version
Phytoplankton Climatology filename: picophytoplankton_climatology.zip (ZIP Archive (ZIP), 32.49 MB) MD5:a2ebaaa9abcbfb47c2c1cdcc3bae3f9e *Zip package containing annual and monthly global phytoplankton cell abundance (cells/milliliter) climatology in 1-degree grids for 25 layers from 0m to 200m depth. The monthly climatology are found in the respective directory for picoeukaryotic phytoplankton (PEUK), Prochlorococcus (PRO), and Synechococcus (SYN). The annual climatology are found in the annual directory with each data file having the appropriate naming convention for the picophytoplankton type (PEUK, PRO, SYN).*	1

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Related Publications

Flombaum, P., Gallegos, J. L., Gordillo, R. A., Rincon, J., Zabala, L. L., Jiao, N., … Martiny, A. C. (2013). Present and future global distributions of the marine Cyanobacteria Prochlorococcus and Synechococcus. Proceedings of the National Academy of Sciences, 110(24), 9824–9829. doi:10.1073/pnas.1307701110
Related Research

Flombaum, P., Wang, W.-L., Primeau, F. W., & Martiny, A. C. (2020). Global picophytoplankton niche partitioning predicts overall positive response to ocean warming. Nature Geoscience, 13(2), 116–120. doi:10.1038/s41561-019-0524-2
Related Research

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Related Datasets

IsDerivedFrom

NASA Ocean Biology Processing Group. (2017). *MODIS-Aqua Level 3 Mapped Photosynthetically Available Radiation Data Version R2018.0* [Data set]. NASA Ocean Biology DAAC. https://doi.org/10.5067/AQUA/MODIS/L3M/PAR/2018 https://doi.org/10.5067/aqua/modis/l3m/par/2018

Boyer, T. P., Antonov, J. I., Baranova, O. K., Garcia, H. E., Johnson, D. R., Mishonov, A. V., O'Brien, T. D., Seidov, D., Smolyar, I. (Igor), Zweng, M. M., Paver, C. R., Locarnini, R. A., Reagan, J. R., Coleman, C., & Grodsky, A. World ocean database 2013. *U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service, National Oceanographic Data Center, Ocean Climate Laboratory.* https://doi.org/10.7289/V5NZ85MT

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Parameters

Parameters for this dataset have not yet been identified

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Project Information

Convergence: RAISE: Linking the adaptive dynamics of plankton with emergent global ocean biogeochemistry (Ocean_Stoichiometry)

NSF Award Abstract: Due to their sheer abundance and high activity, microorganisms have the potential to greatly influence how ecosystems are affected by changes in their environment. However, descriptions of microbial physiology and diversity are local and highly complex and thus rarely considered in Earth System Models. Thus, the researchers focus on a convergence research framework that can qualitatively and quantitatively integrate eco-evolutionary changes in microorganisms with global biogeochemistry. Here, the investigators will develop an approach that integrates the knowledge and tools of biologists, mathematicians, engineers, and geoscientists to understand the link between the ocean nutrient and carbon cycles. The integration of data and knowledge from diverse fields will provide a robust, biologically rich, and computationally efficient prediction for the variation in plankton resource requirements and the biogeochemical implications, addressing a fundamental challenge in ocean science. In addition, the project can serve as a road map for many other research groups facing a similar lack of convergence between biology and geoscience. Traditionally, the cellular elemental ratios of Carbon, Nitrogen, and Phosphorus (C:N:P) of marine communities have been considered static at Redfield proportions but recent studies have demonstrated strong latitudinal variation. Such regional variation may have large - but poorly constrained - implications for marine biodiversity, biogeochemical functioning, and atmospheric carbon dioxide levels. As such, variations in ocean community C:N:P may represent an important biological feedback. Here, the investigators propose a convergence research framework integrating cellular and ecological processes controlling microbial resource allocations with an Earth System model. The approach combines culture experiments and omics measurements to provide a molecular understanding of cellular resource allocations. Using a mathematical framework of increasing complexity describing communicating, moving demes, the team will quantify the extent to which local mixing, environmental heterogeneity and evolution lead to systematic deviations in plankton resource allocations and C:N:P. Optimization tools from engineering science will be used to facilitate the quantitative integration of models and observations across a range of scales and complexity levels. Finally, global ocean modeling will enable understanding of how plankton resource use impacts Earth System processes. By integrating data and knowledge across fields, scales and complexity, the investigators will develop a robust link between variation in plankton C:N:P and global biogeochemical cycles.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1848576
Agencia Nacional de Promoción Científica y Tecnológica	PICT-2017-3020
Universidad de Buenos Aires	UBACyT 20020170100620BA

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