Prochlorococcus, Synechococcus, and picoeukaryotic phytoplankton for four future climatic scenarios and five Earth System Models (cell/ml) in a global 1x1 grid for the ocean surface (50m)

Website: https://www.bco-dmo.org/dataset/793847
Data Type: model results
Version: 1
Version Date: 2020-02-19

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

Contributors	Affiliation	Role
Martiny, Adam	University of California-Irvine (UC Irvine)	Principal Investigator
Flombaum, Pedro	Universidad de Buenos Aires	Co-Principal Investigator, Contact
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Coverage

Spatial Extent: **N**:89.5 **E**:180 **S**:-89.5 **W**:-180

Dataset Description

Prochlorococcus, Synechococcus, and picoeukaryotic phytoplankton for four future climatic scenarios and five Earth System Models (cell/ml) in a global 1º×1º-grid for the ocean surface (50m).

Methods & Sampling

We estimated *Prochlorococcus, Synechococcus*, and picoeukaryotic phytoplankton abundance (cell/ml) for four climate scenarios. Cell abundance was obtained using niche models (Flombaum et al. 2013, 2020). Inputs for the niche models were temperature and nitrate from Earth System Models, and light from Ocean Color (oceancolor.gsfc.nasa.gov) which was identical across simulations.

Data columns containing cell concentrations are labeled after lineage, scenario, and Earth System Model.
Lineages: Prochlorococcus, Synechococcus, and picoeukaryotic phytoplankton.
Scenarios: Historic, RCP2.6, RCP4.5, RCP8.5.
Earth System Models: GFDL-ESM2G, HadGEM2-ES, IPSL-CM5A-MR, MPI-ESM-LR, NorESM1-ME (Taylor et al 2012).

Data Processing Description

BCO-DMO Processing:
- renamed columns to conform with BCO-DMO naming convetions;
- replaced NaN with nd ("no data").

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Data Files

File
pro_syn_peuk_CC_surface.csv(Comma Separated Values (.csv), 20.11 MB) MD5:f00d665b40b268a7cc2232aade0bc72c Primary data file for dataset ID 793847

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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

Taylor, K. E., Stouffer, R. J., & Meehl, G. A. (2012). An Overview of CMIP5 and the Experiment Design. Bulletin of the American Meteorological Society, 93(4), 485–498. doi:10.1175/bams-d-11-00094.1
https://doi.org/10.1175/BAMS-D-11-00094.1
Related Research

Visintini, N., Martiny, A. C., & Flombaum, P. (2021). Prochlorococcus , Synechococcus , and picoeukaryotic phytoplankton abundances in the global ocean. Limnology and Oceanography Letters, 6(4), 207–215. doi:10.1002/lol2.10188
Results

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Parameters

Parameter	Description	Units
Latitude	Latitude	degrees
Longitude	Longitude	degrees

Prochlorococcus_for_HISTORIC_scenario_GFDLESM2G_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus Historic GFDL-ESM2G	cells per milliliter (cells/mL)
Prochlorococcus_for_HISTORIC_scenario_HadGEM2ES_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus Historic HadGEM2-ES	cells/mL
Prochlorococcus_for_HISTORIC_scenario_IPSLCM5AMR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus Historic IPSL-CM5A-MR	cells/mL
Prochlorococcus_for_HISTORIC_scenario_MPIESMLR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus Historic MPI-ESM-LR	cells/mL
Prochlorococcus_for_HISTORIC_scenario_NorESM1ME_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus Historic NorESM1-ME	cells/mL
Prochlorococcus_for_RCP2_6_scenario_GFDLESM2G_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP2.6 GFDL-ESM2G	cells/mL
Prochlorococcus_for_RCP2_6_scenario_HadGEM2ES_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP2.6 HadGEM2-ES	cells/mL
Prochlorococcus_for_RCP2_6_scenario_IPSLCM5AMR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP2.6 IPSL-CM5A-MR	cells/mL

Prochlorococccus_for_RCP2_6_scenario_MPIESMLR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP2.6 MPI-ESM-LR	cells/mL
Prochlorococccus_for_RCP2_6_scenario_NorESM1ME_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP2.6 NorESM1-ME	cells/mL
Prochlorococccus_for_RCP4_5_scenario_GFDLESM2G_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP4.5 GFDL-ESM2G	cells/mL
Prochlorococccus_for_RCP4_5_scenario_HadGEM2ES_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP4.5 HadGEM2-ES	cells/mL
Prochlorococccus_for_RCP4_5_scenario_IPSLCM5AMR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP4.5 IPSL-CM5A-MR	cells/mL
Prochlorococccus_for_RCP4_5_scenario_MPIESMLR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP4.5 MPI-ESM-LR	cells/mL
Prochlorococccus_for_RCP4_5_scenario_NorESM1ME_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP4.5 NorESM1-ME	cells/mL
Prochlorococccus_for_RCP8_5_scenario_GFDLESM2G_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP8.5 GFDL-ESM2G	cells/mL

Prochlorococcus_for_RCP8_5_scenario_HadGEM2ES_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP8.5 HadGEM2-ES	cells/mL
Prochlorococcus_for_RCP8_5_scenario_IPSLCM5AMR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP8.5 IPSL-CM5A-MR	cells/mL
Prochlorococcus_for_RCP8_5_scenario_MPIESMLR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP8.5 MPI-ESM-LR	cells/mL
Prochlorococcus_for_RCP8_5_scenario_NorESM1ME_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Prochlorococcus RCP8.5 NorESM1-ME	cells/mL
Synechococcus_for_HISTORIC_scenario_GFDLESM2G_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus Historic GFDL-ESM2G	cells/mL
Synechococcus_for_HISTORIC_scenario_HadGEM2ES_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus Historic HadGEM2-ES	cells/mL
Synechococcus_for_HISTORIC_scenario_IPSLCM5AMR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus Historic IPSL-CM5A-MR	cells/mL
Synechococcus_for_HISTORIC_scenario_MPIESMLR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus Historic MPI-ESM-LR	cells/mL

Synechococcus_for_HISTORIC_scenario_NorESM1ME_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus Historic NorESM1-ME	cells/mL
Synechococcus_for_RCP2_6_scenario_GFDLESM2G_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP2.6 GFDL-ESM2G	cells/mL
Synechococcus_for_RCP2_6_scenario_HadGEM2ES_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP2.6 HadGEM2-ES	cells/mL
Synechococcus_for_RCP2_6_scenario_IPSLCM5AMR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP2.6 IPSL-CM5A-MR	cells/mL
Synechococcus_for_RCP2_6_scenario_MPIESMLR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP2.6 MPI-ESM-LR	cells/mL
Synechococcus_for_RCP2_6_scenario_NorESM1ME_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP2.6 NorESM1-ME	cells/mL
Synechococcus_for_RCP4_5_scenario_GFDLESM2G_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP4.5 GFDL-ESM2G	cells/mL
Synechococcus_for_RCP4_5_scenario_HadGEM2ES_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP4.5 HadGEM2-ES	cells/mL

Synechococcus_for_RCP4_5_scenario_IPSLCM5AMR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP4.5 IPSL-CM5A-MR	cells/mL
Synechococcus_for_RCP4_5_scenario_MPIESMLR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP4.5 MPI-ESM-LR	cells/mL
Synechococcus_for_RCP4_5_scenario_NorESM1ME_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP4.5 NorESM1-ME	cells/mL
Synechococcus_for_RCP8_5_scenario_GFDLESM2G_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP8.5 GFDL-ESM2G	cells/mL
Synechococcus_for_RCP8_5_scenario_HadGEM2ES_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP8.5 HadGEM2-ES	cells/mL
Synechococcus_for_RCP8_5_scenario_IPSLCM5AMR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP8.5 IPSL-CM5A-MR	cells/mL
Synechococcus_for_RCP8_5_scenario_MPIESMLR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP8.5 MPI-ESM-LR	cells/mL
Synechococcus_for_RCP8_5_scenario_NorESM1ME_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Synechococcus RCP8.5 NorESM1-ME	cells/mL

Eukaryotic_phytoplankton_for_HISTORIC_scenario_GFDLESM2G_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Picoeukaryotic phytoplankton Historic GFDL-ESM2G	cells/mL
Eukaryotic_phytoplankton_for_HISTORIC_scenario_HadGEM2ES_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Picoeukaryotic phytoplankton Historic HadGEM2-ES	cells/mL
Eukaryotic_phytoplankton_for_HISTORIC_scenario_IPSLCM5AMR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Picoeukaryotic phytoplankton Historic IPSL-CM5A-MR	cells/mL
Eukaryotic_phytoplankton_for_HISTORIC_scenario_MPIESMLR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Picoeukaryotic phytoplankton Historic MPI-ESM-LR	cells/mL
Eukaryotic_phytoplankton_for_HISTORIC_scenario_NorESM1ME_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Picoeukaryotic phytoplankton Historic NorESM1-ME	cells/mL
Eukaryotic_phytoplankton_for_RCP2_6_scenario_GFDLESM2G_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Picoeukaryotic phytoplankton RCP2.6 GFDL-ESM2G	cells/mL
Eukaryotic_phytoplankton_for_RCP2_6_scenario_HadGEM2ES_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Picoeukaryotic phytoplankton RCP2.6 HadGEM2-ES	cells/mL

Eukaryotic_phytoplankton_for_RCP2_6_scenario_IPSLCM5AMR_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Picoeukaryotic phytoplankton RCP2.6 IPSL-CM5A-MR	cells/mL
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Eukaryotic_phytoplankton_for_RCP4_5_scenario_GFDLESM2G_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Picoeukaryotic phytoplankton RCP4.5 GFDL-ESM2G	cells/mL
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Eukaryotic_phytoplankton_for_RCP4_5_scenario_NorESM1ME_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Picoeukaryotic phytoplankton RCP4.5 NorESM1-ME	cells/mL
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Eukaryotic_phytoplankton_for_RCP8_5_scenario_NorESM1ME_Model	Cell concentration; labeled after lineage, scenario, and Earth System Model: Picoeukaryotic phytoplankton RCP8.5 NorESM1-ME	cells/mL

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.

Funding