Phytoplankton biomass, chlorophyll, nutrients, and physical fields from MIT General Circulation Model (MITgcm) output (PhytoPlankSizeFcn project)

Website: https://www.bco-dmo.org/dataset/676534
Data Type: model results
Version:
Version Date: 2017-01-26

Project
» Size structure and function of phytoplankton communities in a changing ocean (PhytoPlankSizeFcn)

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Dataset Description

MIT General **C**irculation **M**odel (MITgcm) output.

This model and output were utilized in the following publications:

Dutkiewicz, S., A.E. Hickman, and O. Jahn, 2018. Modelling ocean colour derived Chlorophyll-a. Biogeoscience, 15, 613-630, doi:10.5194/bg-15-613-2018.

Dutkiewicz, S., et al. "Capturing optically important constituents and properties in a marine biogeochemical and ecosystem model." (2015). doi:10.5194/bg-12-4447-2015

Model Access:
The MITgcm is available at http://mitgcm.org. The version used for Dutkiewicz et al. 2015 can be downloaded as the .tar file MITgcm_monod_size_radtrans9.tar (1.4 GB).

Newer model code developed as part of this project is in testing phase, and is available at: git://gud.mit.edu/gud1

The investigators' older ecosystem/biogeochemical modules together with example setups ("verification") are available at: http://mitgcm.org/viewvc/MITgcm/MITgcm_contrib/darwin2/

Output files (netcdf):

Results from simulation "run_size163_9spec_radtrans_newwab" files made with Diags_monod_radtrans9/fields.m Matlab m-file available for download here: fields.m

Nutrients	dutkiewiczetal2015_nutrients.zip	(62 MB)
Physics	dutkiewiczetal2015_physics.zip	(87 MB)
Phytoplankton	dutkiewiczetal2015_phytoplankton.zip	(297 MB)

Please contact developers for updates (jahn@mit.edu; stephd@mit.edu) before using.

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Parameters

Parameters for this dataset have not yet been identified

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Project Information

Size structure and function of phytoplankton communities in a changing ocean (PhytoPlankSizeFcn)

Coverage: Global modelling

The proposed work involves theory and simulations, it will not generate any new laboratory or field observations. The size-and-functional trait based model proposed will be part of the MIT general circulation model (MITgcm).

Project description from NSF award abstract:
Phytoplankton form the base of the marine food web and are a crucial component in the global carbon cycle. They are also extremely diverse, with different species ranging widely in size, biochemical functions, and light and temperature requirements. How phytoplankton establish communities (mixtures of the different species living in the same place) and how these vary between regions and with time is poorly known. Community structure is important for the type of food webs they can support and the amount of carbon they sequester in the ocean. The diversity within the community may also be essential for stability of the ecosystems under changing environmental conditions. Computer models, grounded by observations, provide an important tool to explore marine ecosystems. Current models however include very limited diversity of phytoplankton, focusing on either their differences in size or function, but not both. This new modelling effort will incorporate substantially more diversity and therefore be able to address how and why different groups of phytoplankton co-exist in space and time and how their community structures change in altered environments.

This unique global modelling effort plans to incorporate multiple dimensions of trait space: size, biochemical function, and adaptation to light and temperature. The new model will be tested and constrained by compiling existing and new empirical data sets. It will then be used to explore how community structure and biogeochemical impact are controlled by the interplay of both organism functional and size trait. In particular the model will be used to explore how the diverse community structure is significant in regulating the resilience of ecosystem structure and function to global change. The compiled data, model, as well as theoretical frameworks will address the hypotheses: 1) a model with multiple dimensions of traits will provide more realistic complex community structures, with a size range within functional groups, and more co-existence between functional groups; 2) community structure will be driven by grazing control within functional groups, but nutrients supply rates will control functional group ranges; 3) patterns of carbon export will be significantly more complex when both size distribution of overlying communities and ballasting by minerals such as calcium carbonate and opal are taken into account; 4) climate change will lead to regionally varying patterns of size shifts within functional groups or shifts between functional groups, and such changes will lead to varying alterations to carbon export fluxes; and 5) the inclusion of size will lead to more stable ecosystems in terms of productivity and export to climate change perturbations.

Model Access:
The MITgcm is available at http://mitgcm.org

The investigators' older ecosystem/biogeochemical modules together with example setups ("verification") are available at: http://mitgcm.org/viewvc/MITgcm/MITgcm_contrib/darwin2/

Articles containing information and equations on these versions of the ecosystem model are:

Dutkiewicz, S., A.E. Hickman, and O. Jahn, 2018. Modelling ocean colour derived Chlorophyll-a. Biogeoscience, 15, 613-630, doi:10.5194/bg-15-613-2018.

Dutkiewicz, S., A.E. Hickman, O. Jahn, W.W. Gregg, C.B. Mouw, and M.J. Follows, 2015: Capturing optically important constituents and properties in a marine biogeochemical and ecosystem model. Biogeoscience, 12, 4447-4481 doi:10.5194/bg-12-4447-2015 http://www.biogeosciences.net/12/4447/2015/bg-12-4447-2015.html

Ward, B.A., S. Dutkiewicz, O. Jahn, and M.J. Follows, 2012: A size structured food-web model for the global ocean. Limnology and Oceanography, 57, 1877-1891

Dutkiewicz, S., M. J. Follows, and J. G. Bragg, 2009: Modeling the coupling of ocean ecology and biogeochemistry, Global Biogeochem. Cycles , 23, GB4017, doi:10.1029/2008GB003405.

Follows, M.J., S. Dutkiewicz, S. Grant, and S.W. Chisholm, 2007: Emergent biogeography of microbial communities in a model ocean. Science, 315, 1843-1846, doi:10.1126/science.1138544.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1434007

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