NetCDF model output of the entire state of the surface layer, including simulated dFe dyes, of the circum-Antarctic

Website: https://www.bco-dmo.org/dataset/782848
Data Type: model results
Version: 1
Version Date: 2019-11-25

Project
» Collaborative Research: Elucidating Environmental Controls of Productivity in Polynas and the Western Antarctic Peninsula (Western Antarctic Polynas)

Contributors	Affiliation	Role
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Dataset Description

NetCDF model output of the entire state of the surface layer of the circum-Antarctic model, including ocean and sea ice physical variables, heat and freshwater (negative salt) fluxes

between the ice shelves and the ocean, and simulated dFe dyes. Each of the 255 NetCDF (.nc) files contain two five day temporal averages of the model state for the seven years of the model simulation. The additional file "so_grd.rtopo2.2.5km.nc.try16" contains the model grid data (See "Data Files" section).

Acquisition Description

Model results are from a 5 km horizontal resolution circum-Antarctic Regional Ocean Modeling System circulation model including dynamic sea-ice and static ice shelves (including mechanical and thermodynamic interactions between the floating ice shelves and the water underneath). The results here are just from the surface layer (of 32) of the model, but include all the model state variables (ocean and sea ice), especially the 14 dyes used to represent the different sources of dissolved Fe to the surface waters over the Antarctic continental shelf. Model results are from a seven year period (after a six year spin-up) using repeated 2010 atmospheric forcing. The different dyes are allowed to build up over the continental shelf for the first five years of the simulation and then simulated biological uptake (upper part of water column) and iron scavenging (entire water column) are used during the austral summers to reduce dye concentrations.

More detail on the circum-Antarctic model is in Dinniman et al. (2015) and Dinniman et al. (2020).

Information on how to visualize ROMS model output is available at: https://www.myroms.org/wiki/Tools

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Data Files

File	Version
Model grid data (NetCDF, 995.96 MB) MD5:c3db64eb70813e24960fd13d3be13af6 *Model grid data for dataset "Antarctic dFe model dyes" in a netCDF file.*	original
NetCDF model output (GZIP (.gz), 350.08 GB) MD5:0e290cc40c7b6a13586b4926090915db *Compressed and bundled tar.gz file containing 225 netCDF (.nc) files contain two five day temporal averages of the model state for the seven years of the model simulation.* *NetCDF model output of the entire state of the surface layer, including simulated dFe dyes, of the circum-Antarctic.* *The number in the netCDF filenames represents the number of model days / 10 from the beginning of the six year model spinup. Thus, the first file ends at model day 2200 (10 days plus 2190 day spinup) and is numbered 0220.*	original

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Related Publications

Dinniman, M. S., Klinck, J. M., Bai, L.-S., Bromwich, D. H., Hines, K. M., & Holland, D. M. (2015). The Effect of Atmospheric Forcing Resolution on Delivery of Ocean Heat to the Antarctic Floating Ice Shelves. Journal of Climate, 28(15), 6067–6085. doi:10.1175/jcli-d-14-00374.1 https://doi.org/10.1175/JCLI-D-14-00374.1 [details],
Methods

Dinniman, M. S., St-Laurent, P., Arrigo, K. R., Hofmann, E. E., & Dijken, G. L. (2020). Analysis of iron sources in Antarctic continental shelf waters. Journal of Geophysical Research: Oceans. doi:10.1029/2019jc015736 https://doi.org/10.1029/2019JC015736 [details],
Results

Robertson, D. (Ed.). (2006, December 8). WikiROMS. Tools. Retrieved November 26, 2019, from https://www.myroms.org/wiki/index.php?title=Tools&oldid=2018. [details],
Methods

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Parameters

Parameters for this dataset have not yet been identified

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Project Information

Collaborative Research: Elucidating Environmental Controls of Productivity in Polynas and the Western Antarctic Peninsula (Western Antarctic Polynas)

NSF Award Abstract: Coastal waters surrounding Antarctica represent some of the most biologically rich and most untouched ecosystems on Earth. In large part, this biological richness is concentrated within the numerous openings that riddle the expansive sea ice (these openings are known as polynyas) near the Antarctic continent. These polynyas represent regions of enhanced production known as hot-spots and support the highest animal densities in the Southern Ocean. Many of them are also located adjacent to floating extensions of the vast Antarctic Ice Sheet and receive a substantial amount of meltwater runoff each year during the summer. However, little is known about the specific processes that make these ecosystems so biologically productive. Of the 46 Antarctic coastal polynyas that are presently known, only a handful have been investigated in detail. This project will develop ecosystem models for the Ross Sea polynya, Amundsen polynya, and Pine Island polynya; three of the most productive Antarctic coastal polynyas. The primary goal is to use these models to better understand the fundamental physical, chemical, and biological interacting processes and differences in these processes that make these systems so biologically productive yet different in some respects (e.g. size and productivity) during the present day settings. Modeling efforts will also be extended to potentially assess how these ecosystems may have functioned in the past and how they might change in the future under different physical and chemical and climatic settings. The project will advance the education of underrepresented minorities through Stanford's Summer Undergraduate Research in Geoscience and Engineering (SURGE) Program. SURGE will provide undergraduates the opportunity to gain mentored research experiences at Stanford University in engineering and the geosciences. Old Dominion University also will utilize an outreach programs for local public and private schools as well as an ongoing program supporting the Boy Scout Oceanography merit badge program to create outreach and education impacts. Polynyas (areas of open water surrounded by sea ice) are disproportionately productive regions of polar ecosystems, yet controls on their high rates of production are not well understood. This project will provide quantitative assessments of the physical and chemical processes that control phytoplankton abundance and productivity within polynyas, how these differ for different polynyas, and how polynyas may change in the future. Of particular interest are the interactions among processes within the polynyas and the summertime melting of nearby ice sheets, including the Thwaites and Pine Island glaciers. In this proposed study, we will develop a set of comprehensive, high resolution coupled physical-biological models and implement these for three major, but diverse, Antarctic polynyas. These polynyas, the Ross Sea polynya, the Amundsen polynya, and Pine Island polynya, account for >50% of the total Antarctic polynya production. The research questions to be addressed are: 1)

What environmental factors exert the greatest control of primary production in polynyas around Antarctica? 2) What are the controlling physics that leads to the heterogeneity of dissolved iron (dFe) supply to the euphotic zone in polynyas around the Antarctic continental shelf? What effect does this have on local rates of primary production? 3) What are the likely changes in the supply of dFe to the euphotic zone in the next several decades due to climate-induced changes in the physics (winds, sea-ice, ice shelf basal melt, cross-shelf exchange, stratification and vertical mixing) and how will this affect primary productivity around the continent? The Ross Sea, Amundsen, and Pine Island polynyas are some of the best-sampled polynyas in Antarctica, facilitating model parameterization and validation. Furthermore, these polynyas differ widely in their size, location, sea ice dynamics, relationship to melting ice shelves, and distance from the continental shelf break, making them ideal case studies. For comparison, the western Antarctic Peninsula (wAP), a productive continental shelf where polynyas are a relatively minor contributor to biological production, will also be modeled. Investigating specific processes within different types Antarctic coastal waters will provide a better understand of how these important biological oases function and how they might change under different environmental conditions.

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Funding

Funding Source	Award
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1643652
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1643618

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