NetCDF model output of 4 circum-Antartic model simulations covering the Antarctic Continental Shelf.

Website: https://www.bco-dmo.org/dataset/887777
Data Type: model results
Version: 1
Version Date: 2023-02-07

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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Abstract
NetCDF model output of 4 circum-Antartic model simulations covering the Antarctic Continental Shelf.

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Coverage

Spatial Extent: **N**:-53.823 **E**:180 **S**:-90 **W**:-180

Dataset Description

NetCDF model output of the entire state of the surface layer, including simulated dFe dyes, of the portions of the circum-Antarctic model domain over and near the Antarctic continental shelf. Each file contains two five day temporal averages of the model state for the last two years of the model simulation (the portion analyzed in Dinniman et al., submitted). There are four simulations:

* 115: Base simulation (Base atmospheric forcing)
* 133: Winds simulation (Strengthened and poleward shifted winds)
* 137: Winds + Precip simulation (133 plus increased precipitation)
* 139: All simulation (137 plus increased atmospheric temperatures)

The previous grid file (so_grd.rtopo2.2.5km.nc.try16) is still valid for these simulations. (see related dataset: https://www.bco-dmo.org/dataset/782848).

Methods & Sampling

The 5 km horizontal resolution circum-Antarctic circulation model used in this study is an implementation of the Regional Ocean Modeling System. The model includes a dynamic sea-ice model and static ice shelves (including mechanical and thermodynamic interactions between the floating ice shelves and the water underneath). The domain extends northward from the continent across Drake Passage to South America and is north of the maximum winter sea ice extent. In depth descriptions of the model can be found in Dinniman et al., 2015 and Dinniman et al., 2020.

The results in this dataset only examine results over a portion of the model domain (including the entire Antarctic continental shelf), so the results are a spatial cutout of the entire domain. There are 4 simulations: Base simulation (Base atmospheric forcing), Winds simulation (Strengthened and poleward shifted winds), Winds + Precip simulation (winds simulation plus increased precipitation), (winds + precip simulation plus increased atmospheric temperatures). Additionally, the simulation are shorter in time that the related dataset (https://www.bco-dmo.org/dataset/782848). Further description of these model outputs can be found in Dinniman et al., 2022.

Each of the four model run datasets has 76 netCDF files that are 636MB each for a total of (4 * 76 * 636/1024) 189GB of storage.

Data Processing Description

BCO-DMO Processing notes:
* Added the model results as .zip data file to this dataset

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Data Files

File
Antarctic dFe model dyes for Antarctic Continental Shelf filename: Antarctic_dFe_model_dyes.zip (ZIP Archive (ZIP), 88.30 GB) MD5:202e60a69650f09200ad3e8d707fad82 Zip folder contains 304 files in total: 4 model runs in total, where each model run outputs 76 netcdf files. The model used in this study is the circum-Antarctic circulation model which is an implementation of the Regional Ocean Modeling System (ROMS).

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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
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
Methods

Dinniman, M., St-Laurent, P., Arrigo, K., Hofmann, E., & van Dijken, G. (2022). Sensitivity of the relationship between Antarctic ice shelves and iron supply to projected changes in the atmospheric forcing. https://doi.org/10.5194/egusphere-egu22-3041
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.
Methods

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Related Datasets

IsRelatedTo

Arrigo, K., Dinniman, M., Hofmann, E. (2020) **NetCDF model output of the entire state of the surface layer, including simulated dFe dyes, of the circum-Antarctic.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2019-11-25 doi:10.26008/1912/bco-dmo.782848.1 [view at BCO-DMO]
Relationship Description: Model simulations using same input model.

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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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