Antarctic Peninsula ROMS model Palmer Deep area drifter data

Website: https://www.bco-dmo.org/dataset/867442
Data Type: model results
Version: 2
Version Date: 2022-09-19

Project
» Collaborative Research: Physical Mechanisms Driving Food Web Focusing in Antarctic Biological Hotspots (Project SWARM)

Contributors	Affiliation	Role
Dinniman, Michael	Old Dominion University (ODU)	Principal Investigator, Contact
Klinck, John M.	Old Dominion University (ODU)	Co-Principal Investigator
Kohut, Joshua	Rutgers University	Co-Principal Investigator
Oliver, Matthew	University of Delaware	Co-Principal Investigator
Hudson, Katherine	University of Delaware	Scientist
Soenen, Karen	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
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Coverage

Spatial Extent: **N**:32 **E**:208 **S**:-35 **W**:155
Temporal Extent: 2009-01 - 2009-03

Dataset Description

Details on the model simulation and the passive tracers are given in: Hudson et al. (2021).
Details on the tracers with simulated diel vertical migration are given in: Hudson et al. (2022).
Besides the paper listed above, more detail on the WAP model is in: Graham et al. (2016).

Methods & Sampling

Model results are from a 1.5 km horizontal resolution Regional Ocean Modeling System (v3.6) circulation model, including dynamic sea-ice and static ice shelves (including mechanical and thermodynamic interactions between the floating ice shelves and the water underneath), for the west Antarctic Peninsula coastal ocean.

The model simulation covers the period November 2008 –December 2009, and is forced by atmospheric output from the Antarctic Mesoscale Prediction System and lateral forcing from several sources including tidal information from the CATS2008 regional Antarctic tidal model.

The results here are model velocities and cross sections of density over the nearshore Palmer Deep submarine canyon averaged over late summer (January to March) 2009. The other files are model outputs of the position and environmental variables of passive neutrally-buoyant particles that are released on a grid with approximately 4 km horizontal spacing around Palmer Deep canyon. The particles were advected by the model circulation at every model time step. Particles were released every 2 days starting on 1 November 2008 and tracked for several months. Each drifter file contains all the drifters that were released at a given depth (either surface, 10, 20, 50, 120, 150, or 300 m) and there were a total of 64,800 particles in every release.

More details on these data are in Hudson et al. (2021), but the simulation is similar to the 1.5 km model run (other than the tidal forcing, updated bathymetry around Palmer Deep, and the release of drifters) described in Graham et al. (2016).

This dataset includes three sets of data files:

1) NetCDF model output of the velocity vectors averaged over January to March 2009 for the area around Palmer Deep. The vectors are interpolated onto a common horizontal grid and there are separate files (vectors.surface.d1064.d1153.nc, vectors.50m.d1064.d1153.nc, etc.) for each of the five fixed depths (surface, 50 m, 100 m, 150 m, 300 m). This is the data for Figure 2 of Hudson et al. (2021).

2) NetCDF model output cross sections of density averaged over January to March 2009 along specific transect lines. The three files (dcross.along.ROMS.nc, dcross.over.out.ROMS.nc, dcross.deep.across.ROMS.nc) are the three cross sections in Figure 3 of Hudson et al. (2021).

3) NetCDF model output of the position and environmental variables for each of the 64800 drifters released in the model in the vicinity of Palmer Deep. The information for each drifter is saved every simulated hour. These files are quite large and there is a separate file for the different initial release depths.

4) NetCDF model output of the position and environmental variables for each of the 64800 drifters with simulated diel vertical behavior released in the model in the vicinity of Palmer Deep. The information for each drifter is saved every simulated hour. These files are quite large and there is a separate file for each different simulated diel vertical behavior.

Data Processing Description

Version 1

BCO-DMO Data Manager Processed notes:
* Bundled and compressed the dcross.along.ROMS.nc, dcross.deep.across.ROMS.nc, dcross.over.out.ROMS.nc into 'dcross_ROMS.tar.gz' and added to the Data Files section.

* Bundled and compressed vectors.100m.d1064.d1153.nc, vectors.150m.d1064.d1153.nc, vectors.300m.d1064.d1153.nc, vectors.50m.d1064.d1153.nc, vectors.surface.d1064.d1153.nc into 'vectors_d1064_d1153.tar.gz' and added to the Data Files section

* Bundled and compressed WAP_1k_flt.r042.nc, WAP_1k_flt.r043.ext.2.nc, WAP_1k_flt.r046A.nc, WAP_1k_flt.r046B.nc, WAP_1k_flt.r046C.ext.2.nc, WAP_1k_flt.r046.ext.2.nc, WAP_1k_flt.r060.nc into 'WAP_1k_flt.tar.gz' and added to Datta Files

Version 2

* Added fourth set of data files. Bundled and compressed:
WAP_1k_flt.r039A.nc, WAP_1k_flt.r038B.nc, WAP_1k_flt.r038A.nc, WAP_1k_flt.r037.nc, WAP_1k_flt.r037B.nc, WAP_1k_flt.r036.nc

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Data Files

File
NetCDF model output of the position and environmental variables for each of the 64800 drifters with simulated diel vertical behavior released in the model in the vicinity of Palmer Deep. filename: WAP_1k_flt_DielVertical.zip (ZIP Archive (ZIP), 40.62 GB) MD5:103367f738d1c66f2cb8b413223f53fa NetCDF model output of the position and environmental variables for each of the 64800 drifters with simulated diel vertical behavior released in the model in the vicinity of Palmer Deep. The information for each drifter is saved every simulated hour. These files are quite large and there is a separate file for each different simulated diel vertical behavior. 10-300m and 0.016 m/s: WAP_1k_flt.r039A.nc (~15 GB) 10-150m and 0.016 m/s: WAP_1k_flt.r038B.nc (~15 GB) 10-50m and 0.016 m/s: WAP_1k_flt.r038A.nc (~15 GB) 10-300m and 0.03 m/s: WAP_1k_flt.r037.nc (~15 GB) 10-150m and 0.03 m/s: WAP_1k_flt.r037B.nc (~15 GB) 10-50m and 0.03 m/s: WAP_1k_flt.r036.nc (~15 GB)
NetCDF model output: averaged velocity vectors around Palmer Deep from January to March 2009 filename: vectors_d1064_d1153.tar.gz (GZIP (.gz), 16.70 MB) MD5:3423fc6f1aac5aa2741d97d1217510d0 NetCDF model output of the velocity vectors averaged over January to March 2009 for the area around Palmer Deep. The vectors are interpolated onto a common horizontal grid and there are separate files (vectors.surface.d1064.d1153.nc, vectors.50m.d1064.d1153.nc, etc.) for each of the five fixed depths (surface, 50 m, 100 m, 150 m, 300 m). This is the data for Figure 2 of Hudson et al. (2021). parameter name, description, units,type lat_rho,"latitude of RHO-points",degree_north,float u_east,"subsetted u/east-velocity on rho-grid",cm second-1,float,missing_value = 1.e+10f v_north,"subsetted v/north-velocity on rho-grid",cm second-1, float,missing_value = 1.e+10f
NetCDF model output: cross sections of density averaged over January to March 2009 along specific transect lines filename: dcross_ROMS.tar.gz (GZIP (.gz), 195.67 KB) MD5:e028c47bbdaf6feb0b97cdd1841a0b82 NetCDF model output cross sections of density averaged over January to March 2009 along specific transect lines. The three files (dcross.along.ROMS.nc, dcross.over.out.ROMS.nc, dcross.deep.across.ROMS.nc) are the three cross sections in Figure 3 of Hudson et al. (2021). parameter name, description, units,type in the.nc files: x, distance along x-axis, km, float depth, epth of cross section data points, meters, float rho, model section density anomaly, kg meter-3, float, missing_value = 999
NetCDF model output: position and environmental variables of 64800 drifters released in the model in the vicinity of Palmer Deep filename: WAP_1k_flt.tar.gz (GZIP (.gz), 58.29 GB) MD5:c046a1c8f77497c688829640e63f664a NetCDF model output of the position and environmental variables for each of the 64800 drifters released in the model in the vicinity of Palmer Deep. The information for each drifter is saved every simulated hour. These files are quite large and there is a separate file for the different initial release depths

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Related Publications

Graham, J. A., Dinniman, M. S., & Klinck, J. M. (2016). Impact of model resolution for on-shelf heat transport along the West Antarctic Peninsula. Journal of Geophysical Research: Oceans, 121(10), 7880–7897. doi:10.1002/2016jc011875 https://doi.org/10.1002/2016JC011875
Methods

Hudson, K., Oliver, M. J., Kohut, J., Cohen, J. H., Dinniman, M. S., Klinck, J. M., Reiss, C. S., Cutter, G. R., Statscewich, H., Bernard, K. S., & Fraser, W. (2022). Subsurface Eddy Facilitates Retention of Simulated Diel Vertical Migrators in a Biological Hotspot. Journal of Geophysical Research: Oceans, 127(5). Portico. https://doi.org/10.1029/2021jc017482 https://doi.org/10.1029/2021JC017482
Results

Hudson, K., Oliver, M. J., Kohut, J., Dinniman, M. S., Klinck, J. M., Moffat, C., ... Fraser, W. (2021). A Recirculating Eddy Promotes Subsurface Particle Retention in an Antarctic Biological Hotspot. Journal of Geophysical Research: Oceans, 126(11). doi:10.1029/2021jc017304 https://doi.org/10.1029/2021JC017304
Results

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Parameters

Parameters for this dataset have not yet been identified

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Project Information

Collaborative Research: Physical Mechanisms Driving Food Web Focusing in Antarctic Biological Hotspots (Project SWARM)

Coverage: West Antarctic Peninsula

NSF Award Abstract:
Undersea canyons play disproportionately important roles as oceanic biological hotspots and are critical for our understanding of many coastal ecosystems. Canyon-associated biological hotspots have persisted for thousands of years Along the Western Antarctic Peninsula, despite significant climate variability. Observations of currents over Palmer Deep canyon, a representative hotspot along the Western Antarctic Peninsula, indicate that surface phytoplankton blooms enter and exit the local hotspot on scales of ~1-2 days. This time of residence is in conflict with the prevailing idea that canyon associated hotspots are primarily maintained by phytoplankton that are locally grown in association with these features by the upwelling of deep waters rich with nutrients that fuel the phytoplankton growth. Instead, the implication is that horizontal ocean circulation is likely more important to maintaining these biological hotspots than local upwelling through its physical concentrating effects. This project seeks to better resolve the factors that create and maintain focused areas of biological activity at canyons along the Western Antarctic Peninsula and create local foraging areas for marine mammals and birds. The project focus is in the analysis of the ocean transport and concentration mechanisms that sustain these biological hotspots, connecting oceanography to phytoplankton and krill, up through the food web to one of the resident predators, penguins. In addition, the research will engage with teachers from school districts serving underrepresented and underserved students by integrating the instructors and their students completely with the science team. Students will conduct their own research with the same data over the same time as researchers on the project. Revealing the fundamental mechanisms that sustain these known hotspots will significantly advance our understanding of the observed connection between submarine canyons and persistent penguin population hotspots over ecological time, and provide a new model for how Antarctic hotspots function.

To understand the physical mechanisms that support persistent hotspots along the Western Antarctic Peninsula (WAP), this project will integrate a modeling and field program that will target the processes responsible for transporting and concentrating phytoplankton and krill biomass to known penguin foraging locations. Within the Palmer Deep canyon, a representative hotspot, the team will deploy a High Frequency Radar (HFR) coastal surface current mapping network, uniquely equipped to identify the eddies and frontal regions that concentrate phytoplankton and krill. The field program, centered on surface features identified by the HFR, will include (i) a coordinated fleet of gliders to survey hydrography, chlorophyll fluorescence, optical backscatter, and active acoustics at the scale of the targeted convergent features; (ii) precise penguin tracking with GPS-linked satellite telemetry and time-depth recorders (TDRs); (iii) and weekly small boat surveys that adaptively target and track convergent features to measure phytoplankton, krill, and hydrography. A high resolution physical model will generalize our field measurements to other known hotspots along the WAP through simulation and determine which physical mechanisms lead to the maintenance of these hotspots. The project will also engage educators, students, and members of the general public in Antarctic research and data analysis with an education program that will advance teaching and learning as well as broadening participation of under-represented groups. This engagement includes professional development workshops, live connections to the public and classrooms, student research symposia, and program evaluation. Together the integrated research and engagement will advance our understanding of the role regional transport pathways and local depth dependent concentrating physical mechanisms play in sustaining these biological hotspots.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1745009
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1744884
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1745011

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