Acoustic data from two subsurface moorings deployed near Palmer Deep Canyon from January to March 2020

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Data Type: Other Field Results
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Project
» Collaborative Research: Physical Mechanisms Driving Food Web Focusing in Antarctic Biological Hotspots (Project SWARM)

Contributors	Affiliation	Role
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Abstract
This dataset contains acoustic data from two subsurface moorings deployed near Palmer Deep Canyon from January to March 2020.

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Coverage

Spatial Extent: **N**:-64.8124 **E**:-64.0376 **S**:-64.864 **W**:-64.2119
Temporal Extent: 2020-01-06 - 2020-03-07

Dataset Description

Each mooring has three data files associated with it:
1) an "_Sv" file containing the processed acoustic return from the mooring in volume backscattering strength in decibels (dB) from the 120 kHz narrowband echosounder in a matrix where rows represent single pings and columns indicate depth bins;
2) a "_dp" file representing the depth (in meters) of the depth bins for each return with the same dimensions as the "_Sv" file; and
3) a "_tm" file containing a vector of timestamps corresponding to each ping in seconds since Jan 1 1970 (POSIX), where the length of the vector is equivalent to the number of rows in each matrix.

These files are all available in the attached "all_moorings_files.tar.gz" file.

Acquisition Description

One mooring was deployed to the eastern (AMLR2) and western (AMLR1) sides of Palmer Deep Canyon to 400 and 345 m, respectively. AMLR1 was deployed at -64.2119, -64.8124 (longitude/latitude) and AMLR2 was deployed at -64.0376, -64.864.

Both moorings were deployed on 6 January 2020. The western mooring was recovered on 3 February and the eastern mooring was recovered on 7 March 2020. The upward facing echosounders pinged at 6 s intervals and had 1168 vertical bins representing 0.375 m in range. These datasets include the 120 kHz returns.

Processing Description

Data Processing:
Raw data were processed using the methods outlined in Cutter et al., 2022. Individual .mat files that resulted from processing procedures were concatenated in R by row using rbind to produce single acoustic return (Sv), time, and depth files for each mooring. Time was transformed from Julian day to POSIX time in R. Data processing methods can be found in Cutter, et al. (2022).

BCO-DMO Processing:
- saved the csv files in a single .tar.gz file

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Data Files

File	Version
all_moorings_files.tar.gz (GZIP (.gz), 10.08 GB) MD5:c994903679d89f43f5c5169965599315 *This package contains 6 .csv files.* *Those named starting with "AMLR1" are from the AMLR1 mooring, located on the western (AMLR1) side of Palmer Deep Canyon at 345 meters. AMLR1 was deployed at -64.2119, -64.8124 (longitude/latitude).* *Those named starting with "AMLR2" are from the AMLR2 mooring, located on the eastern (AMLR1) side of Palmer Deep Canyon at 400 meters. AMLR2 was deployed at -64.0376, -64.864 (longitude/latitude).* *Each mooring has three data files associated with it:* *1) an "_Sv" file containing the processed acoustic return from the mooring in volume backscattering strength in decibels (dB) from the 120 kHz narrowband echosounder in a matrix where rows represent single pings and columns indicate depth bins;* *2) a "_dp" file representing the depth (in meters) of the depth bins for each return with the same dimensions as the "_Sv" file; and* *3) a "_tm" file containing a vector of timestamps corresponding to each ping in seconds since Jan 1 1970 (POSIX), where the length of the vector is equivalent to the number of rows in each matrix.*	1

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Related Publications

Cutter, G. R., Reiss, C. S., Nylund, S., & Watters, G. M. (2022). Antarctic Krill Biomass and Flux Measured Using Wideband Echosounders and Acoustic Doppler Current Profilers on Submerged Moorings. Frontiers in Marine Science, 9. https://doi.org/10.3389/fmars.2022.784469
Methods

Hudson, K., Oliver, M. J., Kohut, J., Cohen, J. H., Dinniman, M. S., Klinck, J., et al. (2021). Subsurface Eddy Facilitates Retention of Simulated Diel Vertical Migrators in a Biological Hotspot. In review, Journal of Geophysical Research: Oceans.
Results

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Parameters

Parameters for this dataset have not yet been identified

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Instruments

Dataset-specific Instrument Name	Nortek Signature 100 Acoustic Doppler Current Profiler
Generic Instrument Name	Nortek Signature 100 Acoustic Doppler Current Profiler
Dataset-specific Description	Nortek Signature 100 echosounders SNs 101132 and 101134
Generic Instrument Description	A long-range current profiler designed for combined current profile and biomass measurements. The Signature100 combines a four-beam current profiler operating at 100 kHz with an optional scientific echosounder. Applications include providing insight into the dynamics of zooplankton, krill or schools of fish; current profiling; providing insight into small-scale physical processes; and upwelling and downwelling studies. The instrument is suitable for buoy mounting with internal attitude and heading reference system (AHRS). Optional centre beam with 70-120 kHz Both the current profiler and the biomass measurements have an effective range of 300-400 m. The echosounder has a velocity resolution of 0.1 cm/s, a maximum sampling rate of 1 Hz (1/2 Hz at max output power), and a standard range of 0-1500 m.

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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
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1745018
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1745023
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1745081

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