Water temperature, salinity, and optical properties from an Acrobat towed vehicle from bi-weekly grids conducted at Palmer Station, Antarctica in 2020

Website: https://www.bco-dmo.org/dataset/916046
Version: 1
Version Date: 2023-12-01

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

Contributors	Affiliation	Role
Statscewich, Hank	University of Alaska Fairbanks (UAF)	Principal Investigator
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Abstract
This data is from a towed instrument called an ACROBAT. The Acrobat is a winged instrument platform that cycles between the surface and 60 m as it is towed behind a ship traveling at speeds of 5 to 8 knots. It is equipped with a SeaBird 49 FastCAT CTD (temperature, conductivity, and pressure) and a Wetlabs EcoPUCK optical sensor (chlorophyll a, colored dissolved organic matter (CDOM), and backscatter). The ACROBAT system has been used to map submesoscale features (fronts, eddies and filaments) and provides a real-time data feed via a faired Kevlar cable to the vehicle operator. The ACROBAT enables adaptive sampling of features of interest and detailed mapping of the upper ocean without aliasing due to tides. Bi-Weekly sampling survey grids were conducted out of Palmer Station through the use of the USAP RHIB platform.

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Coverage

Spatial Extent: **N**:-63.77 **E**:-64.7354 **S**:-64.285 **W**:-64.9104
Temporal Extent: 2020-01-01 - 2020-05-01

Methods & Sampling

Data from the CTD, EcoPUCK, and GPS were combined and vertical profiles were constructed from dives using MATLAB. Data were written to a .mat file that was then combined with metadata to create a netCDF file.

Location: Ocean waters south of Palmer Station, located between 63 - 62.3 S latitude and 64-65 W longitude in depths less than 60 m.

Deployment information:
Palmer RHIB (small boat) operated by United States Antarctic Program operated during the months of Jan -

April, 2020 with Principal Investigators: Jackie Veatch, Hank Statscewich, and Josh Kohut.

Data Processing Description

The CTD data were corrected for thermistor thermal response, time lag due to the physical separation of the temperature and conductivity sensors, and conductivity sensor thermal lag following Johnson et al. [2007]. The EcoPUCK did not have a pressure sensor, so depth was added to the data via interpolation using time stamps generated by the data acquisition computer. Position information was collected from the shipboard GPS system and logged at 1 HZ intervals.

Related software:
* initial release of the ACROBAT code developed by the Dr. Seth Danielson's physical oceanography lab ("isreister/ACROBAT: v1.0.0_UAFOceansACROBAT", doi:10.5281/ZENODO.7768458)

BCO-DMO Processing Description

* No additional processing performed

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Related Publications

Martini, K. I., Stabeno, P. J., Ladd, C., Winsor, P., Weingartner, T. J., Mordy, C. W., & Eisner, L. B. (2016). Dependence of subsurface chlorophyll on seasonal water masses in the Chukchi Sea. Journal of Geophysical Research: Oceans, 121(3), 1755–1770. Portico. https://doi.org/10.1002/2015jc011359
https://doi.org/10.1002/2015JC011359
Methods

Reister, I. (2023). *isreister/ACROBAT: v1.0.0_UAFOceansACROBAT* (Version v1.0.0UAF_ACROBAT) [Computer software]. Zenodo. https://doi.org/10.5281/ZENODO.7768458
https://doi.org/https://doi.org/10.5281/zenodo.7768458
Software

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Related Datasets

IsRelatedTo

Danielson, S., & Statscewich, H. (2020). *Water temperature, salinity, and optical properties from an Acrobat towed vehicle during cruises for the Northern Gulf of Alaska LTER site, 2018 and 2019* (Version 1) [Data set]. Axiom Data Science. https://doi.org/10.24431/RW1K471 https://doi.org/10.24431/rw1k471

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Parameters

Parameters for this dataset have not yet been identified

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Sea-Bird SBE 49 FastCAT CTD Sensor
Dataset-specific Description	Observational data collected using a Seabird SBE49 FastCAT CTD
Generic Instrument Description	The SBE 49 FastCAT is a CTD sensor for use in autonomous platforms. It contains a SBE 3P temperature sensor, a SBE 4C conductivity sensor and a strain-gauge pressure sensor as standard. It can operate in autonomus (16 Hz per sec) or polled mode (transmits each sample). The sensor is depth-rated to 350 m (plastic housing) or 7000 m (titanium housing). Accuracy: +/- 0.002 deg C (temperature), +/- 0.0003 S/m (conductivity), 0.1% of full scale range (pressure).

Dataset-specific Instrument Name	ACROBAT
Generic Instrument Name	towed undulating vehicle
Dataset-specific Description	The Acrobat is a winged instrument platform that cycles between the surface and 60 m as it is towed behind a ship traveling at speeds of 5 to 8 knots. It is equipped with a SeaBird 49 FastCAT CTD (temperature, conductivity, and pressure) and a Wetlabs EcoPUCK optical sensor (chlorophyll a, colored dissolved organic matter (CDOM), and backscatter). The ACROBAT system has been used to map submesoscale features (fronts, eddies and filaments) and provides a real-time data feed via a faired Kevlar cable to the vehicle operator. The ACROBAT enables adaptive sampling of features of interest and detailed mapping of the upper ocean without aliasing due to tides.
Generic Instrument Description	A towed undulating vehicle is a generic class of instruments. See the data set specific information for a detailed description. These are often prototype instrument packages designed to make very specific measurements.

Dataset-specific Instrument Name	Wetlabs three-channel flbbcd EcoPUCK
Generic Instrument Name	WETLabs ECO FLBB scattering fluorescence sensor
Dataset-specific Description	Wetlabs three-channel flbbcd EcoPUCK mounted on an Acrobat vehicle.
Generic Instrument Description	A dual-optical-sensor that carries a single-wavelength chlorophyll fluorometer (470nm ex/695nm em) and backscattering sensor (700 nm) that measures phytoplankton and particle concentration. It operates by using blue (470nm) and red (700 nm) LEDs that alternately flash. The blue LED stimulates chlorophyll fluorescence in plants while the red light illuminates the total particle field. The backscattering sensor has an in-water centroid angle of 142 degrees and can be calibrated to measure turbidity. The fluorometer can typically measure phytoplankton concentrations in the range 0-30 ug/l, with a sensitivity of 0.015 ug/l. The backscattering sensor can measure within the range 0-3 m-1, with a sensitivity of 0.0015 m-1. The instrument output in the standard version is digital and uses a low power mode and stores data. Other variants are used. The instrument is rated to a depth of 600m as standard, with the options of deeper instruments rated up to 6000m and instruments with bio-wipers, rated to 300 m. This instrument comes in the following optional models: FLbb(RT), FLbb(RT)D, FLbbB, FLbbS, FLbbBS, FLbb2k. Refer to the datasheet from the manufacturer: https://www.seabird.com/asset-get.download.jsa?id=55460873804

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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-1745023

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