Large particulate matter concentration, biovolume, and sized distribution in the Pacific Ocean from 2015-04-11 to 2015-06-18 measured by the Underwater Vision Profiler 5 (UVP5) on the P16N Repeat Hydrography cruise aboard the NOAA Ship Ronald H. Brown

Website: https://www.bco-dmo.org/dataset/787432
Data Type: Cruise Results
Version: 2
Version Date: 2021-04-27

Project
» Variability in particle size distributions, sinking velocities, and fluxes in the northern Gulf of Alaska (GoA Particles)

Contributors	Affiliation	Role
McDonnell, Andrew M.P.	University of Alaska Fairbanks (UAF)	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset includes large particulate matter concentration, biovolume, and sized distribution in the Pacific Ocean from 2015-04-11 to 2015-06-18 measured by the Underwater Vision Profiler 5 (UVP5) on the P16N Repeat Hydrography cruise aboard the NOAA Ship Ronald H. Brown.

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Coverage

Spatial Extent: **N**:56.29027 **E**:-149.86171 **S**:-16.95559 **W**:-153.23287
Temporal Extent: 2015-04-11 - 2015-06-18

Dataset Description

The Underwater Vision Profiler (UVP5) is an underwater camera system that was designed to record the vertical distributions of large aggregates and zooplankton (> 102 µm) down to 6000 m. Two units that consist of red-light emitting diodes (LEDs) illuminate (in 100 µsecond flashes) an area of 4 X 20 cm which provides a volume sampling of ~1L per frame. The UVP5 was mounted on the bottom of each CTD rosette and collected data on each CTD cast (data are collected during the down cast). The methodology generally follows Picheral et al., 2010.

Methods & Sampling

The Underwater Vision Profiler 5 (UVP5) was utilized to collect in situ images of particles and plankton across the 2015 P16N repeat hydrography transect from French Polynesia (17°S) to the northern Gulf of Alaska shelf (56.3°N), primarily along the 151°W and 152°W meridians. The UVP5 was integrated within the conductivity temperature depth (CTD) rosette, and several images per second were acquired during the downcasts, resulting in a total of 171 vertical profiles from both legs of the cruise, most spanning from the surface down to near the bottom. The UVP captured in situ images of particles and plankton in a mixed processing mode in which particles were sized, counted, and tabulated in real time during the profile. Subsequent processing bins these particle counts into discrete, pre-defined size bins ranging from 102 µm to >26 mm in equivalent spherical diameter. Particle biovolume was also computed for each size bin. All data contained here is inclusive of both living and non-living particles and plankton.

Supplemental file "file_header_uvp5_sn009_2015_p16n_BCO-DMO_PAR.txt" contains additional metadata from the original file header.

Known Problems:
Some profiles did not extend to the full depth of the CTD cast because of problems with the rechargeable lithium ion battery onboard the UVP.

Data Processing Description

The UVP5 software acquires and processes images in real time. The gain, shutter and LED pulses are controlled and the background image is removed. Images are acquired and processed to get size and grey level for each image. Size information on all detected particles is stored and images of individual particles and plankton larger than 500 µm in equivalent spherical diameter are segmented and saved for later identification. Image post processing and metadata creation is accomplished with the Zooprocess software. Tabulated particle data are used to sum the number and volume of particles within predefined size and depth bins, allowing for the computation of the Datasets. Data and images have been uploaded to the Ecotaxa website (http://ecotaxa.obs-vlfr.fr/) which serves as a tool for particle and zooplankton identification with machine learning and human verification, as well as a repository for all globally collected UVP data. Data files for particle and zooplankton abundances are exported from the Ecotaxa particle module in detailed Ocean Data View (ODV) format, and reformatted for submission to BCO-DMO. The size distribution data is reported in non-differential forms (simply the concentration of particles in each size bin) as well as on a numeric and particle volume basis assuming all particles are spherical. The size bin limits are defined in equivalent spherical diameter (ESD), where ESD = (4 *Sm* π-1)-0.5 where *Sm* is the projected area of each particle in mm² and the particle concentrations are reported for each size bin defined by the log-transformed center of each size bin in µm. The biovolume is computed as the sum of the individual spherical volumes of each particle issued from the calibrated ESD.

This dataset was prepared using the scripts archived in this Github repository: https://github.com/britairving/UVP_submission_formatting. This repo has been forked by BCO-DMO to ensure a copy of the code is available. This can be accessed at https://github.com/BCODMO/UVP_submission_formatting. A .zip file of the code is also attached to this dataset as a Supplemental File.

BCO-DMO Processing Notes:
-added conventional header with dataset name, PI name, version date;
- added ISO_DateTime_UTC field with times formatted following ISO8601 conventions;
- renamed fields to comply with BCO-DMO naming conventions;
- replaced "-9999.000000" with "nd" to indicate "no data".

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Data Files

File
par.csv (Comma Separated Values (.csv), 46.26 MB) MD5:0005351fc871e61e7d1bec9f426037aa Primary data file for dataset ID 787432

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Supplemental Files

File
file_header_uvp5_sn009_2015_p16n_BCO-DMO_PAR.txt (Octet Stream, 1.66 KB) MD5:a5b7ad00a9811207794b2c5de657e3b1 Original header of the data file "uvp5_sn009_2015_p16n_PAR", containing deployment information (location, date, time), instrument information, and uncertainty equations.
UVP Data Submission Formatting Repo filename: UVP_submission_formatting-1.0.zip (ZIP Archive (ZIP), 80.78 KB) MD5:b3f6c50ec61d75a64dfed6ab0c8cd484 Code used to prepare data for submission to BCO-DMO; associated with datasets 787966 and 787432. PI: Andrew McDonnell. Also available from BCO-DMO Github at https://github.com/BCODMO/UVP_submission_formatting

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Related Publications

Kiko, R., Biastoch, A., Brandt, P., Cravatte, S., Hauss, H., Hummels, R., … Stemmann, L. (2017). Biological and physical influences on marine snowfall at the equator. Nature Geoscience, 10(11), 852–858. doi:10.1038/ngeo3042 https://doi.org/10.1038/NGEO3042
Results

Picheral, M., Guidi, L., Stemmann, L., Karl, D. M., Iddaoud, G., & Gorsky, G. (2010). The Underwater Vision Profiler 5: An advanced instrument for high spatial resolution studies of particle size spectra and zooplankton. Limnology and Oceanography: Methods, 8(9), 462–473. doi:10.4319/lom.2010.8.462
Methods

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Related Datasets

IsPartOf

Kiko, Rainer (2020): The global marine particle size distribution dataset obtained with the Underwater Vision Profiler 5 - version 1. PANGAEA, https://doi.pangaea.de/10.1594/PANGAEA.924375 (dataset in review)

Kiko, Rainer; Brandt, Peter; Cravatte, Sophie; Hauss, Helena; Hummels, Rebecca; Krahmann, Gerd; Marin, Frédéric; McDonnell, Andrew; Picheral, Marc; Vandromme, Pieter; Thurnherr, Andreas M; Stemmann, Lars (2017): Biological and physical influences on marine snowfall at the equator - data collection. PANGAEA, https://doi.org/10.1594/PANGAEA.874873,

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Parameters

Parameter	Description	Units
station	Site	unitless

profile	Profile name	unitless
UVP_rawfilename	Raw file name from UVP	unitless
ISO_DateTime_UTC	Date and time (UTC); formatted to ISO8601 standard: YYYY-MM-DDThh:mm:ssZ	unitless
date	Date	unitless
time	Time (UTC)	unitless
lat	Latitude in decimal degrees (positive values = North)	decimal degrees North
lon	Longitude in decimal degrees (positive values = East)	decimal degrees East
bin_depth	Depth, midpoint of 5m depth bin	meters (m)
volume	Total volume of water sampled within each depth bin	liters (L)
abundance_102_128_um	Abundance of particles with an equivalent spherical diameter between 102-128 micrometers	number/L
abundance_128_161_um	Abundance of particles with an equivalent spherical diameter between 128-161 micrometers	number/L
abundance_161_203_um	Abundance of particles with an equivalent spherical diameter between 161-203 micrometers	number/L
abundance_203_256_um	Abundance of particles with an equivalent spherical diameter between 203-256 micrometers	number/L
abundance_256_323_um	Abundance of particles with an equivalent spherical diameter between 256-323 micrometers	number/L
abundance_323_406_um	Abundance of particles with an equivalent spherical diameter between 323-406 micrometers	number/L
abundance_406_512_um	Abundance of particles with an equivalent spherical diameter between 406-512 micrometers	number/L
abundance_512_645_um	Abundance of particles with an equivalent spherical diameter between 512-645 micrometers	number/L
abundance_645_813_um	Abundance of particles with an equivalent spherical diameter between 645-813 micrometers	number/L
abundance_0p813_1p02_mm	Abundance of particles with an equivalent spherical diameter between 0.813-1.02 millimeters	number/L
abundance_1p02_1p29_mm	Abundance of particles with an equivalent spherical diameter between 1.02-1.29 millimeters	number/L
abundance_1p29_1p63_mm	Abundance of particles with an equivalent spherical diameter between 1.29-1.63 millimeters	number/L
abundance_1p63_2p05_mm	Abundance of particles with an equivalent spherical diameter between 1.63-2.05 millimeters	number/L
abundance_2p05_2p58_mm	Abundance of particles with an equivalent spherical diameter between 2.05-2.58 millimeters	number/L
abundance_2p58_3p25_mm	Abundance of particles with an equivalent spherical diameter between 2.58-3.25 millimeters	number/L
abundance_3p25_4p1_mm	Abundance of particles with an equivalent spherical diameter between 3.25-4.1 millimeters	number/L
abundance_4p1_5p16_mm	Abundance of particles with an equivalent spherical diameter between 4.1-5.16 millimeters	number/L
abundance_5p16_6p5_mm	Abundance of particles with an equivalent spherical diameter between 5.16-6.5 millimeters	number/L

abundance_6p5_8p19_mm	Abundance of particles with an equivalent spherical diameter between 6.5-8.19 millimeters	number/L
abundance_8p19_10p3_mm	Abundance of particles with an equivalent spherical diameter between 8.19-10.3 millimeters	number/L
abundance_10p3_13_mm	Abundance of particles with an equivalent spherical diameter between 10.3-13 millimeters	number/L
abundance_13_16p4_mm	Abundance of particles with an equivalent spherical diameter between 13-16.4 millimeters	number/L
abundance_16p4_20p6_mm	Abundance of particles with an equivalent spherical diameter between 16.4-20.6 millimeters	number/L
abundance_20p6_26_mm	Abundance of particles with an equivalent spherical diameter between 20.6-26 millimeters	number/L
abundance_gt26_mm	Abundance of particles with an equivalent spherical diameter greater than 26 millimeters	number/L
biovolume_102_128_um	Biovolume of particles with an equivalent spherical diameter between 102-128 micrometers	mm^3/L
biovolume_128_161_um	Biovolume of particles with an equivalent spherical diameter between 128-161 micrometers	mm^3/L
biovolume_161_203_um	Biovolume of particles with an equivalent spherical diameter between 161-203 micrometers	mm^3/L
biovolume_203_256_um	Biovolume of particles with an equivalent spherical diameter between 203-256 micrometers	mm^3/L
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biovolume_645_813_um	Biovolume of particles with an equivalent spherical diameter between 645-813 micrometers	mm^3/L
biovolume_0p813_1p02_mm	Biovolume of particles with an equivalent spherical diameter between 0.813-1.02 millimeters	mm^3/L
biovolume_1p02_1p29_mm	Biovolume of particles with an equivalent spherical diameter between 1.02-1.29 millimeters	mm^3/L
biovolume_1p29_1p63_mm	Biovolume of particles with an equivalent spherical diameter between 1.29-1.63 millimeters	mm^3/L
biovolume_1p63_2p05_mm	Biovolume of particles with an equivalent spherical diameter between 1.63-2.05 millimeters	mm^3/L
biovolume_2p05_2p58_mm	Biovolume of particles with an equivalent spherical diameter between 2.05-2.58 millimeters	mm^3/L
biovolume_2p58_3p25_mm	Biovolume of particles with an equivalent spherical diameter between 2.58-3.25 millimeters	mm^3/L
biovolume_3p25_4p1_mm	Biovolume of particles with an equivalent spherical diameter between 3.25-4.1 millimeters	mm^3/L
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biovolume_6p5_8p19_mm	Biovolume of particles with an equivalent spherical diameter between 6.5-8.19 millimeters	mm^3/L
biovolume_8p19_10p3_mm	Biovolume of particles with an equivalent spherical diameter between 8.19-10.3 millimeters	mm^3/L
biovolume_10p3_13_mm	Biovolume of particles with an equivalent spherical diameter between 10.3-13 millimeters	mm^3/L
biovolume_13_16p4_mm	Biovolume of particles with an equivalent spherical diameter between 13-16.4 millimeters	mm^3/L
biovolume_16p4_20p6_mm	Biovolume of particles with an equivalent spherical diameter between 16.4-20.6 millimeters	mm^3/L
biovolume_20p6_26_mm	Biovolume of particles with an equivalent spherical diameter between 20.6-26 millimeters	mm^3/L
biovolume_gt26_mm	Biovolume of particles with an equivalent spherical diameter greater than 26 millimeters	mm^3/L

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Instruments

Dataset-specific Instrument Name	Underwater Vision Profiler 5 (UVP5)
Generic Instrument Name	Underwater Vision Profiler
Dataset-specific Description	Underwater Vision Profiler 5 (UVP5), Manufactured by Hydroptic serial number sn009
Generic Instrument Description	A description of the UVP instrument can be found in the following publication: Picheral, M., L. Guidi, L. Stemmann, D. M. Karl, G. Iddaoud, and G. Gorsky. 2010. The Underwater Vision Profiler 5: An advanced instrument for high spatial resolution studies of particle size spectra and zooplankton. Limnol. Oceanogr. Meth. 8: 462-473. (access the PDF at URL: http://cmore.soest.hawaii.edu/cmoredata/LMO/Guidi/Picheral_2010.pdf)

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Deployments

RB1503_leg1

Website	https://www.bco-dmo.org/deployment/787503
Platform	NOAA Ship Ronald H. Brown
Report	http://dx.doi.org/10.7942/C2WC7C
Start Date	2015-04-10
End Date	2015-05-12
Description	2015 P16N, Climate Variability and Predictability (CLIVAR), R/V Ronald H Brown, RB1503, leg 1. Cruise aboard the National Oceanic and Atmospheric Administration (NOAA) vessel the Ronald H. Brown (the Brown) acting under the auspices of the Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP). Expocode: 33RO20150525. The Cruise Report and additional data from the cruise are available from CCHDO: Cross, J. and Siedlecki, S. (2015). Hydrographic Cruise 33RO20150410, exchange version. Accessed from CCHDO https://cchdo.ucsd.edu/cruise/33RO20150410. Access date 2021-05-21. CCHDO cruise DOI: 10.7942/C2WC7C Cruise information is also available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/RB1503

RB1503_leg2

Website	https://www.bco-dmo.org/deployment/852236
Platform	NOAA Ship Ronald H. Brown
Report	http://dx.doi.org/10.7942/C2RP43
Start Date	2015-05-25
End Date	2015-06-27
Description	2015 P16N, Climate Variability and Predictability (CLIVAR), R/V Ronald H Brown, RB1503, leg 2. The Cruise Report and additional data from the cruise are available from CCHDO: Macdonald, A. and Mecking, S. (2015). Hydrographic Cruise 33RO20150525, exchange version. Accessed from CCHDO https://cchdo.ucsd.edu/cruise/33RO20150525. Access date 2021-05-21. CCHDO cruise DOI: 10.7942/C2RP43. Cruise information is also available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/RB1503

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Project Information

Variability in particle size distributions, sinking velocities, and fluxes in the northern Gulf of Alaska (GoA Particles)

Coverage: Pacific Ocean, Gulf of Alaska

NSF abstract:
The sinking of particles from the sunlit zone of the ocean into the ocean interior constitutes a dominant component of the sequestering of carbon into the deep ocean, otherwise known as the ocean's biological carbon pump. The quantities of particulate matter being exported out of the sunlit zone, as well as the tapering-off of these fluxes with respect to depth, have a substantial impact on the distribution of carbon and other important elements throughout the oceans and control the concentration of carbon dioxide in the atmosphere. For these reasons, it is critical that we gain a comprehensive understanding of the magnitude of these elemental fluxes, their variability in space and time, and the processes that control them. The focus of the of this project is to make new, broadly informative discoveries with regard to the function of the ocean's biological carbon pump and the ability to quantify and monitor its strength and efficiency at high spatial and temporal resolutions. In addition, this project will provide the first quantitative and mechanistic study of sinking particle fluxes in the northern Gulf of Alaska by working in conjunction with the ongoing Seward Line Long-term Observational Program. The project will be carried out under the direction of an early career faculty

member and provide a training opportunity for a postdoctoral researcher. Results from the study will be shared with the broader public through a variety of print and digital platforms.

The fluxes of carbon out of the euphotic zone and through subsurface waters are poorly quantified and understood, especially relative to other dominant oceanic carbon flows such as the air-sea gas exchange of carbon dioxide or rates of primary production in surface waters. The inability to differentiate between variability in particle concentration and sinking velocities as the drivers of flux variability is a critical gap in our understanding of the biological carbon pump. The Gulf of Alaska is an optimal site for investigating these processes as the cycling of carbon and other elements in waters above continental shelves, such as the Gulf of Alaska, is highly complex due to the dynamic interplay of chemical, physical, biological, and anthropogenic processes. Using a creative application of short-term sediment trap deployments combined with the use of a unique pair of in situ optical instruments, the researchers will aim to accomplish two specific goals: 1) Quantify the average sinking velocities of small particles and their contribution to the total carbon flux from particles of all sizes; and 2) Determine the relative variability in particle abundances and sinking velocities and assess how it translates into variable patterns of particle flux in the northern Gulf of Alaska.

Affiliated Programs:
Seward Line LTOP, NGA-LTER, US GO-SHIP

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1459835

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