Particle abundances and characteristics from the video plankton profiler with matching CTD data, from casts on RVIB Nathaniel B. Palmer NBP1302, Feb/Mar 2013 (TRACERS project)

Website: https://www.bco-dmo.org/dataset/683064
Data Type: Cruise Results
Version: 1
Version Date: 2017-02-28

Project
» TRacing the fate of Algal Carbon Export in the Ross Sea (TRACERS)

Contributors	Affiliation	Role
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Abstract
Ocean Data View (ODV) and conductivity, temperature and depth (CTD) casts from NBP13-2 in the Ross Sea in February and March 2013. Data include temperature, salinity, density, fluorescence, light transmission, oxygen concentration, particle number, size, roundness, roughness, calculations of patchiness and index of aggregation.

Table of Contents

Coverage

Spatial Extent: **N**:-66 **E**:-135 **S**:-79 **W**:178
Temporal Extent: 2013-02-14

Acquisition Description

Video particle profiler (VPP): (from Bochdansky,et al (2017) JMS)

The VPP was similar to that published in Bochdansky et al. (2010). However, instead of 45° angle lighting from both sides, side lighting with two white high-intensity LED lights was used ~7 cm in front of the lens. Some backscatter from transparent exopolymers (TEP), or from small particles embedded in that matrix,

was possible using high-intensity light. The light beams were restricted using a slit width of 1 cm; however, as the light intensity dropped exponentially in the front and back of the image beam, only the brightest lit image plane was used for analysis. This method reduced bias caused by overlapping particles, removed motion blur streaks, and provided more accurate particle size estimates. At the focal plane, the field of view was 3.5 cm tall and 4.7 cm wide. The analysis program for the VPP was expanded from that in Bochdansky et al. (2010) to include more variables for particle characterization (including perimeter, volume and porosity). The VPP can record 30 images per second, with image analysis by a Linux-based image analysis program (an adapted Avidemux video editing software) at high speeds (approximately in real time after retrieval). The images were later aligned with depth from the CTD using time as the common variable and by filming a clock displaying UTC at the beginning and the end of each video sequence. In Matlab, CTD data were matched at one-second resolution with the particle data. The raw data consisted of millions of particles with associated CTD data. These raw data allow us to resample particle metrics at all scales. Particle volumes were calculated as shown in Fig. 2. Instead of assuming a specific geometric shape, the projected area of the particle on the screen (sum of white and black pixels within the perimeter of the particle) was converted into a circle that was then converted to volume. This method reduces error in volume calculations greatly because 2-dimensional information rather than 1-dimensional information is used to reconstruct volumes, thus avoiding the bias of assigning disproportionally large volumes to elongated objects. This approach is widely used in image analysis of ocean particles (e.g., Iversen et al., 2010). Total particle volume (pixel3 frame-1) was approximated by multiplying the mean volume of particles with the mean particle number.

Processing Description

A moving average with an unweighted 100 m window served as a low-pass filter for the particle data before they were matched with depths.

The degree of overdispersion (i.e., patchiness) in the system was assessed using two indices. One, the Lloyd index of patchiness (Lloyd, 1967), is domain-dependent (i.e., zero values affect the estimates); the other one, the index of aggregation (Bez, 2000), is domain-independent.

The Lloyd index (Lloyd, 1967) was calculated as:

(equation 1) $$Lp = \left[m + \left(\frac{\sigma^2}{m} - 1\right)\right] m^{-1},$$

where *Lp* is the Lloyd index of patchiness, *m* the mean particle abundance (number of particles per frame in 1 m bins), and s^2 the variance of the particle abundance.

The index of aggregation (Bez, 2000) was calculated as:

(equation 2) $$ia = \sum_i z_i^2 \left[S \times \left(\sum_i z_i\right)^2\right]^{-1},$$

where *ia* is the index of aggregation, z_i the particle density, and *S* the sample scale (set to 1 for this analysis).

BCO-DMO Processing notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- reduced number of digits to right of decimal due to sampling precision methods

[table of contents | back to top]

Related Publications

Bez, N. (2000). On the use of Lloyd's index of patchiness. Fisheries Oceanography, 9(4), 372–376. doi:10.1046/j.1365-2419.2000.00148.x
Methods

Bochdansky, A. B., Clouse, M. A., & Hansell, D. A. (2017). Mesoscale and high-frequency variability of macroscopic particles (> 100 µm) in the Ross Sea and its relevance for late-season particulate carbon export. Journal of Marine Systems, 166, 120–131. doi:10.1016/j.jmarsys.2016.08.010
Results

Bochdansky, A. B., Jericho, M. H., & Herndl, G. J. (2013). Development and deployment of a point-source digital inline holographic microscope for the study of plankton and particles to a depth of 6000 m. Limnology and Oceanography: Methods, 11(1), 28–40. doi:10.4319/lom.2013.11.28
General

Bochdansky, A. B., van Aken, H. M., & Herndl, G. J. (2010). Role of macroscopic particles in deep-sea oxygen consumption. Proceedings of the National Academy of Sciences, 107(18), 8287–8291. doi:10.1073/pnas.0913744107
Methods

Hansell, D. (2014). Ship-based Trackline Geophysical Data (MGD77) from the Southern Ocean acquired during the Nathaniel B. Palmer expedition NBP1302 (2013) (Version 1) [Data set]. Interdisciplinary Earth Data Alliance (IEDA). https://doi.org/10.1594/ieda/320064 https://doi.org/10.1594/IEDA/320064
Related Research

Hansell, D. (2014). Underway Hydrographic, Weather and Ship-state Data (JGOFS) from Nathaniel B. Palmer expedition NBP1302 (2013) (Version 1) [Data set]. Interdisciplinary Earth Data Alliance (IEDA). https://doi.org/10.1594/ieda/320062 https://doi.org/10.1594/IEDA/320062
Related Research

Hansell, D. (2015). Calibrated Hydrographic Data from the Southern Ocean acquired with a CTD during the Nathaniel B. Palmer expedition NBP1302 (2013) (Version 1) [Data set]. Interdisciplinary Earth Data Alliance (IEDA). https://doi.org/10.1594/ieda/320068 https://doi.org/10.1594/IEDA/320068
Related Research

Hansell, D. (2015). Raw XBT Expendable Probe Data from the Southern Ocean acquired during the Nathaniel B. Palmer expedition NBP1302 (2013) (Version 1) [Data set]. Interdisciplinary Earth Data Alliance (IEDA). https://doi.org/10.1594/ieda/320066 https://doi.org/10.1594/IEDA/320066
Related Research

Hansell, D. (2016). Raw ship-based Multibeam Sonar Data from the Southern Ocean acquired during R/V Nathaniel B. Palmer expedition NBP1302 (2013) (Version 1) [Data set]. Interdisciplinary Earth Data Alliance (IEDA). https://doi.org/10.1594/ieda/320074 https://doi.org/10.1594/IEDA/320074
Related Research

Lloyd, M. (1967). `Mean Crowding'. The Journal of Animal Ecology, 36(1), 1. doi:10.2307/3012
Methods

Xu, W., Jericho, M. H., Meinertzhagen, I. A., & Kreuzer, H. J. (2001). Digital in-line holography for biological applications. Proceedings of the National Academy of Sciences, 98(20), 11301–11305. doi:10.1073/pnas.191361398
General

[table of contents | back to top]

Related Datasets

IsRelatedTo

Bochdansky, A. B. (2017) **Phaeocystis colony counts from raw Digital Holographic Microscope images from casts on RVIB Nathaniel B. Palmer NBP1302, March 2013 (TRACERS project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date

Parameters

Parameter	Description	Units
cast	cast number	unitless
depth	depth; calculated from CTD pressure	meters
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
julianday	Julian Day in 2013	unitless
temp	temperature	degrees Celsius
sal	salinity	PSU
density	density	kg/m^3
sigmatheta	sigma theta: potential density as density minus 1000 (without the effect of pressure)	kg/m^3
max_sigmatheta_change	maximum change in sigma theta	kg/m^3
fluor	fluorescence	relative fluorescence units
beamtrans	light transmission as percent	dimensionless
O2	oxygen; dissolved; from CTD	micromol/kilogram
partnum_mean	Mean of particle numbers per video frame (averaged over 1 meter)	particles/meter
partnum_variance	Variance particle number per video frame (averaged over 1 meter)	particles/meter
length_mean	Mean of the maximum dimension of the particle per meter	pixels
esd_mean	Mean equivalent spherical diameter of particles per meter	pixels
esd_median	Median equivalent spherical diameter of particles per meter (pixels)	pixels
elongation	Mean elongation of particles	particles/meter
roundness	Mean roundness of particles	particles/meter
roughness	Mean roughness of particles	particles/meter
volume_mean	Mean volume of particles per meter	cubic pixels
volume_sum	Sum of volumes of particles per meter	cubic pixels
vmr	Variance to mean ratios of particle numbers per frame	dimensionless
lloyd_patchiness	Lloyd index of patchiness	unitless
ia	Index of aggregation	unitless

Instruments

Dataset-specific Instrument Name	CTD
Generic Instrument Name	CTD profiler
Dataset-specific Description	The rosette frame also held a video camera, Niskin sample bottles, conductivity, temperature and oxygen probes, and an optical backscatter sensor (Seapoint turbidity meter). The CTD with instruments was lowered at 0.5 m s−1 for the first 100 m, and then accelerated to 1 m s−1 for the remainder of each cast.
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column and permits scientists observe the physical properties in real time via a conducting cable connecting the CTD to a deck unit and computer on the ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This instrument designation is used when specific make and model are not known.

Dataset-specific Instrument Name	Black and white charge-coupled device video camera (Sentec)
Generic Instrument Name	Camera
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

[table of contents | back to top]

Deployments

NBP1302

Website	https://www.bco-dmo.org/deployment/547873
Platform	RVIB Nathaniel B. Palmer
Report	http://dmoserv3.whoi.edu/data_docs/TRACERS/NBP1302_data_report.pdf
Start Date	2013-02-12
End Date	2013-04-05
Description	Ross Sea, Antarctica (53 days) RVIB Nathaniel B. Palmer : February-April 2013 McMurdo Station, Antarctica - Punta Arenas, Chile Project Title: "TRacing the fate of Algal Carbon Export in the Ross Sea" (TRACERS)Chief Scientist: Dennis Hansell, UM-RSMASProject Description: The research focus of this cruise was to investigate the biogeochemistry associated after a phytoplankton bloom at the end of the Antarctic Austral Summer. I helped analyze and coordinate analyses of nutrients (silicic acid, phosphate, and nitrate) and collect samples for dissolved organic carbon (DOC). Note R2R Link takes user to Marine Geoscience Data System (MGDS):NBP1302 Nathaniel B. Palmer Systems and Specifications

[table of contents | back to top]

Project Information

TRacing the fate of Algal Carbon Export in the Ross Sea (TRACERS)

Coverage: Ross Sea

Sinking particles are a major element of the biological pump and they are commonly assigned to two fates: mineralization in the water column and accumulation at the seafloor. However, there is another fate of export hidden within the vertical decline of carbon, the transformation of sinking organic matter to fine suspended and/or dissolved organic fractions. This process has been suggested but has rarely been observed or quantified. As a result, it is presumed that the solubilized fraction is largely mineralized over short time scales. However, global ocean surveys of dissolved organic carbon are demonstrating a significant water column accumulation of organic matter under high productivity environments. This proposal will investigate the transformation of organic particles from sinking to solubilized phases of the export flux in the Ross Sea. The Ross Sea experiences high export particle production, low dissolved organic carbon export with overturning circulation, and the area has a predictable succession of production and export events. In addition, the basin is shallow (< 1000 m) so the products the PIs will target are relatively concentrated. To address the proposed hypothesis, the PIs will use both well-established and novel biochemical and optical measures of export production and its fate. The outcomes of this work will help researchers close the carbon budget in the Ross Sea.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Polar Programs (NSF PLR)	PLR-1142097

[table of contents | back to top]