Acoustic backscatter data collected from RVIB Nathaniel B. Palmer (NBP0103, NBP0104, NBP0202, NBP0204) in the Southern Ocean from 2001-2002 (SOGLOBEC project, Southern Ocean Krill project)

Website: https://www.bco-dmo.org/dataset/3207
Version:
Version Date: 2010-09-16

Project
» U.S. GLOBEC Southern Ocean (SOGLOBEC)
» GLOBEC: Winter Distribution and Success of Southern Ocean Krill (Southern Ocean Krill)

Programs
» U.S. GLOBal ocean ECosystems dynamics (U.S. GLOBEC)
» U.S. GLOBal ocean ECosystems dynamics (U.S. GLOBEC)

Contributors	Affiliation	Role
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Dataset Description

Each matlab file includes a number of matrices. The data are in sv_l, sv_2, sv_3, sv_4, and sv_5, where the suffix indicates frequency: 1=43 kHz, 2=120 kHz, 3=200 kHz, 4=420 kHz, 5=1000 kHz. The other matrices and vectors (bot, pings_noise, pings_noise_art, top) are things the PI used to keep track of where bad or otherwise unwanted data were located (e.g., all cells greater than those found in bot are echoes from below the bottom). These other matrices are not served here but can be made available.

The matrix structure for sv_# is consistent across all files. Each matrix has some number of rows corresponding to the number of acoustic observation points, or 'pings,' and then 407 columns. The first 7 columns give header information, and then the next 8-407 give the acoustic observations at increasing depth at the location of each ping. For each ping, the column structure is:
Col 1 = yearday time. For NBPOI03, this is GMT, for all other cruises it's local time.
Col 2 = latitude
Col 3 = longitude
Col 4 = frequency in kilohertz (kHz)
Col 5 = start depth (m), almost always 1m.
Col 6 = For most cruises, this is the end depth (m). For NBP0103, it gives the local time.
Col 7 = Vertical bin size (m). This is the vertical distance represented by each acoustic measurement. At 43 and 120 kHz, it's l.5m, and at the other frequencies it's 1m.

Then columns 8 through 407 give the acoustic measurements. Col 8 is the measurement made from the start depth to the start depth + bin size, Col 9 gives the next bin size, and so on. So at 43 kHz, for instance, col8=1-2.5m, col9=2.5-4m, etc. There is in fact a bit of squishiness associated with the start depth, so the first data column can be taken as 0-1.5 or 1-2.5.

These matrices are created by taking the data collected by the up-and down-looking transducers at each frequency, finding the position in the matrix corresponding to the position of the BIOMAPER (which is of course being towed up and down in the water column) and then filling in the matrix with the up-and down-data. The cell corresponding to the position of the BIOMAPER is set to NaN, as are a number of adjacent cells -the number varies with frequency, and corresponds to the acoustic near-field where we can't make reliable measurements. Cells corresponding to depths beyond the range of the acoustic system (300m at 43 and 120 kHz, 150m at 200kHz, 100m at 420kHz, and I think 35m at 1000kHz) are also set to NaN.

The remaining non-NaN cells give the acoustic measurements, which are unit-less volume backscattering coefficients. Here is a definition of the volume backscattering coefficient, from the manuscript submitted to DSR-II:
Volume scattering strength, or S_v (where $S_v = 10\log_{10}(s_v)$ in units of decibels relative to $1m^{-1}$, and s_v is the volume scattering coefficient), is a measure of the intensity of emitted sound that is scattered towards the acoustic receiver per cubic meter. When the source and receiver are co-located, the direction of scattering is back towards the source, and this quantity is commonly referred to as the volume backscattering strength. Target strength is a measure of the intensity of scattering received in the direction back towards the acoustic source from an individual ensonified target (TS = 10log$_{l0}$(Ïƒ$_{bs}$) in units of decibels relative to 1m2, where Ïƒ$_{bs}$ is the differential backscattering cross-section). Under the assumption made in zooplankton acoustics that scattering from individual targets in the ensonified volume sums incoherently, the volume backscattering coefficient is equal to the sum of the backscattering cross-sections of all targets present, normalized by the acoustic sample volume. Typically, acoustic data are displayed and analysed in logarithmic form (ie the volume backscattering strength), which as you can see from the above defInition, is given as 10 times the log$_{l0}$ of the volume backscattering coefficient values found in the sv_# matrices. Zeroes correspond to cells where the measurements were below the limit to detection or below the noise threshold.

These served files include the acoustic data that have now been cleaned up such that cells representing unwanted signal have been set to NaN -this includes noise, echoes from below the bottom, and the surface bubble layer. These cleaned up data are again found in matrices named sv_#. The data at 120 kHz (sv_2) have been cleaned up thoroughly. The data at the other frequencies have had the bottom and surface echoes removed, but then otherwise have only been cleaned in those portions of the water column where there were krill. There was no cleaning of the 1000 kHz data and so there is no sv_5 matrix in this file.

Methods & Sampling

BIOMAPER-II collects acoustic backscatter echo integration data from a total of ten echosounders (five pairs of transducers with center frequencies of 43 kHz, 120 kHz, 200 kHz, 420 kHz, and 1 MHz). Half of the transducers are mounted on the top of the tow-body looking upward, while the other half are mounted on the bottom looking downward. This arrangement enables acoustic scattering data to be collected for much of the water column as the instrument is towed vertically through the survey track. Due to differences in absorption of acoustic energy by seawater, the range limits of the transducers are different. The lower frequencies (43 and 120 kHz) collect data up to 300 m away from the instrument (in 1.5 m range bins), while the higher frequencies (all with 1 m range bins) have range limits of (150, 100, and 35 m respectively). The acoustic data were recorded by HTI software and stored as .INT, .BOT and .RAW files on a computer hard drive. Data were transferred and backed up on Jaz disks and CDs. They were also compressed before transfer using the PKZIP utility. The .INT and .BOT files were further post-processed to combine the information from the upward and downward looking transducers to make maps of acoustic backscatter of the entire water column (or at least to the range limits of the transducers). The .RAW files were processed to look at target strength data collected from individual scatterers in the water column. The acoustic backscatter data from the HTI system were then integrated with environmental data from the ESS (Environmental Sensing System) onboard BIOMAPER-II. These data included depth of the towed body, salinity, temperature, fluorescence, transmittance, and other parameters. In addition, information about the three-dimensional position of BIOMAPER-II (pitch, roll, yaw) and data from the winch (tension, wire out, wire speed) were also recorded.

Data Processing Description

Acoustic data were processed using a series of MATLAB files contained in the HTI2MAT toolbox (written by Joe Warren, Andy Pershing, and Peter Wiebe). These files patch together the upward and downward looking data, integrate the environmental sensor information and concatenate the acoustic records into typically half-day (am or pm) chunks. Larger files (of the entire survey track for instance) are possible but become unwieldy to plot due to file and memory size. Files containing a half-day of information are approximately 30 MB. These files were saved as d123_am_sv.mat and d123_am_sv_w.mat, in addition a tiff image of a plot of all the acoustic data were included. The d123_am_sv.mat file is in the correct format for looking at environmental information and can be plotted using the pretty_pic* series of m-files. The data in d123_am_sv_w.mat are in New Wiebe format and can be viewed using the curtainnf.m program.

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Data Files

File
acoustic_back.csv (Comma Separated Values (.csv), 56.80 KB) MD5:a44b3ea2efdb3595451e90752c71c280 Primary data file for dataset ID 3207

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Parameters

Parameter	Description	Units
cruiseid	cruise identification, e.g. NBP0204, for Nathaniel B. Palmer cruise 0204	
year	year, local time, e.g. 2004	
jpg	Thumbnail picture linked to full-sized picture	
mat	link to processed data in matlab format	
yrday	day of the year, with Jan. 1 being 1	YYY
day_local	day of the month in local time (01-31)	
month_local	Month of the year, local time. (1-12)	
tow	tow number. Sequential.	
station_start	station number from eventlog where the tow began	
station_end	Station from event log where the tow ended	
lat_start	latitude, North is positive	decimal degrees
lat_end	latitude, North is positive	decimal degrees
lon_start	longitude at the start of the tow, West is negative	decimal degrees
lon_end	longitude at the end of the tow, West is negative	decimal degrees
depth_w_start	depth of water at the start of the tow, from eventlog	meters
depth_w_end	depth of water at the end of the tow, from eventlog	meters
depth_start	depth of the instrument at the beginning of the tow	meters
depth_end	depth of the instrument at the end of the tow	meters

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Instruments

Dataset-specific Instrument Name	BIo-Optical Multi-frequency Acoustical and Physical Environmental Recorder II
Generic Instrument Name	BIo-Optical Multi-frequency Acoustical and Physical Environmental Recorder II
Dataset-specific Description	(see dataset description)
Generic Instrument Description	BIOMAPER II is a set of sensors on a long aluminum frame that resembles the tail of a World War II airplane. A research vessel tows the instrument through the water on a specialized tow cable that sends power to the sensors and brings data back to the ship. People use BIOMAPER II to learn about phytoplankton and zooplankton over areas that are too large to study with the traditional net-and-microscope method. Whereas nets can sample areas up to about 5 meters (16 feet) on a side, BIOMAPER II can record data from 500 meters (1,640 feet) or more of the water column at a time. The instrument's standard suite of sensors were chosen for studying plankton: a five-frequency sonar system, a video plankton recorder and an environmental sensor system (ESS, like the one on MOCNESS). The ESS measures water temperature, salinity, oxygen, chlorophyll and light levels. BIOMAPER II also has room for attaching other instruments for specific uses. The instrument's official name is BIOMAPER-II: the BIo-Optical Multi-frequency Acoustical and Physical Environmental Recorder. The Roman numeral II indicates that it's a redesign of the original BIOMAPER, a prototype that was invented and tested in the mid 1990s. (more information).

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Deployments

NBP0103

Website	https://www.bco-dmo.org/deployment/57636
Platform	RVIB Nathaniel B. Palmer
Report	http://globec.whoi.edu/so-dir/reports/nbp0103/nbp0103.html
Start Date	2001-04-24
End Date	2001-06-05
Description	**Methods & Sampling** "During the first three weeks of the cruise, BIOMAPER-II experienced a series of electronic problems and component failures. These involved both the HTI echosounder and the VPR. For reasons that are still unknown, the echosounder stopped working on 5 May 2001 because of the failure of several electronic components (an integrated chip and several mercury relays). Fortunately, a spare parts board on the R/V L.M. Gould, coupled with the superb electronic skills of Scott Gallager with assistance from Andy Girard and Joe Warren, resulted in a repair to the system that served for the rest of the cruise." "Due to a series of near-catastrophes (cables fraying, relays welding closed, and impact between the instrument and the ship transom) and the related near-miraculous repairs (led by Scott Gallager and Andy Girard with assistance from HTI personnel and Mark Dennet, Cabell Davis, and Joe Warren), there were a variety of transducer configurations used on this cruise. The original (and standard) configuration and MUX assignments were used for approximately 10 days. There was then a half-week period where data were only collected from the three lower frequency pairs of transducers. Finally, a stable configuration was obtained where data were collected from nine transducers (the upward looking 1 MHz was not used) with a different MUX assignment protocol. The processing of these data required constant modification of both the HTI software and the HTI2MAT toolbox; however, the majority of the survey track contains data from the 43, 120, 200, and 420 kHz transducers (both up and down looking)."(Cruise Report NBP0103)

NBP0104

Website	https://www.bco-dmo.org/deployment/57638
Platform	RVIB Nathaniel B. Palmer
Report	http://www.ccpo.odu.edu/Research/globec/cruises01/nbp0104_menu.html
Start Date	2001-07-22
End Date	2001-08-31

NBP0202

Website	https://www.bco-dmo.org/deployment/57641
Platform	RVIB Nathaniel B. Palmer
Report	http://globec.whoi.edu/so-dir/reports/nbp0202/nbp0202b.html
Start Date	2002-04-09
End Date	2002-05-21

NBP0204

Website	https://www.bco-dmo.org/deployment/57643
Platform	RVIB Nathaniel B. Palmer
Report	http://globec.whoi.edu/so-dir/reports/nbp0204/nbp0204b.html
Start Date	2002-07-31
End Date	2002-09-18
Description	Also see NBP0204 Cruise Data Report

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Project Information

U.S. GLOBEC Southern Ocean (SOGLOBEC)

Website: http://www.ccpo.odu.edu/Research/globec_menu.html

Coverage: Southern Ocean

The fundamental objectives of United States Global Ocean Ecosystems Dynamics (U.S. GLOBEC) Program are dependent upon the cooperation of scientists from several disciplines. Physicists, biologists, and chemists must make use of data collected during U.S. GLOBEC field programs to further our understanding of the interplay of physics, biology, and chemistry. Our objectives require quantitative analysis of interdisciplinary data sets and, therefore, data must be exchanged between researchers. To extract the full scientific value, data must be made available to the scientific community on a timely basis.

GLOBEC: Winter Distribution and Success of Southern Ocean Krill (Southern Ocean Krill)

Coverage: Southern Ocean

The U.S. Global Ocean Ecosystems Dynamics (U.S. GLOBEC) program has the goal of understanding and ultimately predicting how populations of marine animal species respond to natural and anthropogenic changes in climate. Research in the Southern Ocean (SO) indicates strong coupling between climatic processes and ecosystem dynamics via the annual formation and destruction of sea ice. The Southern Ocean GLOBEC Program (SO GLOBEC) will investigate the dynamic relationship between physical processes and ecosystem responses through identification of critical parameters that affect the distribution, abundance and population dynamics of target species. The overall goals of the SO GLOBEC program are to elucidate shelf circulation processes and their effect on sea ice formation and krill distribution, and to examine the factors which govern krill survivorship and availability to higher trophic levels, including penguins, seals and whales. The focus of the U.S. contribution to the international SO GLOBEC program will be on winter processes. This component will focus on juvenile and adult krill and mesozooplankton prey distribution and abundance using a sophisticated instrument package, BIOMAPPER II, which is equipped with an acoustic backscatter sonar system, a video plankton recorder and an environmental sensor system. The system is used in large-scale studies. Additionally, a remotely-operative vehicle will be used to map the distribution and behavior of krill under ice. The result of the integrated SO GLOBEC program will be to improve the predictability of living marine resources, especially with respect to local and global climatic shifts.

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Program Information

U.S. GLOBal ocean ECosystems dynamics (U.S. GLOBEC)

Website: http://www.usglobec.org/

Coverage: Global

U.S. GLOBEC (GLOBal ocean ECosystems dynamics) is a research program organized by oceanographers and fisheries scientists to address the question of how global climate change may affect the abundance and production of animals in the sea.

The U.S. GLOBEC Program currently had major research efforts underway in the Georges Bank / Northwest Atlantic Region, and the Northeast Pacific (with components in the California Current and in the Coastal Gulf of Alaska). U.S. GLOBEC was a major contributor to International GLOBEC efforts in the Southern Ocean and Western Antarctic Peninsula (WAP).

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Funding

Funding Source	Award
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