Compilation of primary productivity measurements collected from 1983-2006 from the Ross Sea

Website: https://www.bco-dmo.org/dataset/863815
Data Type: Cruise Results
Version: 2
Version Date: 2021-12-01

Project
» Ross Productivity (Ross Productivity)

Program
» U.S. Joint Global Ocean Flux Study (U.S. JGOFS)

Contributors	Affiliation	Role
Smith, Walker O.	Virginia Institute of Marine Science (VIMS)	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset is a compilation of primary productivity measurements from a total of 449 stations in the Ross Sea. Data were collected on multiple cruises conducted from 1983 to 2006 on USCGC Glacier, RVIB Nathaniel B. Palmer, R/V Polar Duke, USCGC Polar Star, and USCGC Polar Sea. These data were published in a variety of papers, including Wilson et al. (1986), Smith et al. (1999, 2000, 2013), and Nelson and Smith (1991). Many of the productivity data are available within individual data reports available on BCO-DMO (e.g., AESOPS, CORSACS), but others were collected prior to the initiation of a centralized data center and hence are not available except in this dataset. Integrated station data are provided in the attached Supplemental File titled "Integrated Water Column Station Data" (.csv file). See the "Supplemental Files" section of the BCO-DMO dataset landing page for more information on the integrated station data.

Table of Contents

Coverage

Spatial Extent: **N**:-72.462 **E**:-165 **S**:-78.25 **W**:168
Temporal Extent: 1983-01-26 - 2006-12-03

Acquisition Description

Methodology:
The methods used in all were based on simulated in situ incubations and productivity measured by uptake of radiocarbon. Methodology for all is largely the same, with some slight variations in the irradiance levels for incubation. Incubations lasted for 24 h and 7 depths per station were measured. A total of 449 stations are compiled that were sampled from 1983 to 2006. Details of the methodology are described in Smith et al. (2000). Any inconsistencies found within the 449 stations should be reported to the PI for correction. Additional details on data compilation are in the attached README file (PDF).

Sampling and Analytical Procedures:
Samples were obtained from CTD casts with attached Niskins on the rosette. Irradiance was determined largely using an in situ PAR sensor, but earlier cruises also used a Secchi disk. Samples had ca. 100 µCi ^{14}C-bicarbonate added and placed in on-deck incubators flushed with flowing seawater. Most incubations lasted 24 h after which samples were filtered onto 25 mm GFF filters, rinsed with 5 mL 0.01N HCL in filtered seawater, placed in scintillation vials, and had ca. 7 mL scintillation cocktail added. Total activity added to each bottle was assessed by counting an unfiltered sample (100 µL) directly in LS cocktail. All samples were counted using a liquid scintillation counter after 24 h in darkness, and DPMs converted to absolute carbon units using known equations (Smith et al., 1977).

Chlorophyll was determined fluorometrically using standard JGOFS procedures. Samples were collected from known depths into amber polycarbonate bottles, known volumes filtered through 25 mm GFF filters under low vacuum, extracted for 24 h in 90% acetone in dark, cold conditions, and the fluorescence read before and after acidification.

Mixed layers were determined from the vertical profiles of density (sigma-t) determined from CTD profiles. A change of 0.01 kg m^{-3} from a stable surface layer reading was defined as the base of the mixed layer (Smith et al., 2013).

Integrated primary productivity and chlorophyll concentrations were determined using trapezoidal integrations through the 0.1 and 1.0% isolumes, respectively. Photosynthetically active radiation (PAR) were collected using a BioSpherical Sensor Model QSP-240 placed as close to the incubators as possible. All data were integrated from 1-minute values over the period of incubation. The integrated data by station are provided in the attached Supplemental File "Integrated Water Column Station Data" (.csv file).

Processing Description

Data Processing:
No specific data processing procedures were used in the generation of the productivity rates; all are simply compiled and analyzed on routine numerical packages.

BCO-DMO Processing:
- replaced "---" and "-999" with "nd" ("no data");
- renamed fields to comply with BCO-DMO naming conventions;
- changed date format to YYYY-MM-DD;
- replaced `66.`05 with 166.105 in the Longitude column;
- removed spaces from "NBP" cruise IDs for naming consistency;
- 2021-12-01: updated the Integrated Station Data and README Supplemental Files. The v2 Integrated Station Data includes a column for Integrated_PAR, which was not in the previous version.

[table of contents | back to top]

Supplemental Files

File
Integrated Water Column Station Data (v2) filename: integrated_water_column_station_data_v2.csv (Comma Separated Values (.csv), 63.51 KB) MD5:78366887f686e3c884fde65ec680e7be *This csv file contains primary productivity and chlorophyll concentrations integrated by station; determined using trapezoidal integrations through the 0.1 and 1.0% isolumes, respectively.* *Data column names, descriptions, and units:* *Cruise = name of the cruise, generally with the year (unitless);* *Station_Number = station number within cruise (unitless);* *Cast_Event_Number = cast or event number, if used (unitless);* *Latitude = sample latitude; negative values indicate south (decimal degrees);* *Longitude = sampling longitude; negative values indicate west (decimal degrees);* *Date = date of collection in format YYYY-MM-DD (dates are provided in the local (New Zealand) time zone; NZ is 13 h ahead of UTC) (unitless);* *Mixed_Layer_Depth = depth of mixed later (meters);* *Integrated_Primary_Productivity = integrated euphotic zone primary productivity (mg C m-2 d-1);* *Integrated_Chlorophyll = integrated euphotic zone chlorophyll (mg Chl m-2);* *Integrated PAR = integrated photosynthetically active radiation near the incubator (mol photons m-2 d-1)* *Dominant_Mixed_Layer_Phytoplankton = Name of dominant species, determined by either HPLC analyses, degree of Si(OH)4 removal, or microscopic examination(unitless);* *Reference = data source (unitless).* *Updated on 2021-12-01.*
Ross Sea Productivity Data Compilation README (v2) filename: Ross_Sea_Productivity_README_v2.pdf (Portable Document Format (.pdf), 117.27 KB) MD5:f0bffac7e9636f3c80f8042ea9c4e8a0 *Details on data compilation for the Ross Sea Productivity dataset (PI: Walker Smith). Updated on 2021-12-01.*

[table of contents | back to top]

Related Publications

DiTullio, G. R., & Smith, W. O. (1995). Relationship between dimethylsulfide and phytoplankton pigment concentrations in the Ross Sea, Antarctica. Deep Sea Research Part I: Oceanographic Research Papers, 42(6), 873–892. doi:10.1016/0967-0637(95)00051-7
References

Nelson, D. M., & Smith, W. . (1991). Sverdrup revisited: Critical depths, maximum chlorophyll levels, and the control of Southern Ocean productivity by the irradiance-mixing regime. Limnology and Oceanography, 36(8), 1650–1661. doi:10.4319/lo.1991.36.8.1650
Results

Smith, W. (1999). Phytoplankton growth rates in the Ross Sea, Antarctica, determined by independent methods: temporal variations. Journal of Plankton Research, 21(8), 1519–1536. doi:10.1093/plankt/21.8.1519
Results

Smith, W. O., & Gordon, L. I. (1997). Hyperproductivity of the Ross Sea (Antarctica) polynya during austral spring. Geophysical Research Letters, 24(3), 233–236. doi:10.1029/96gl03926
References

Smith, W. O., & Nelson, D. M. (1985). Phytoplankton Bloom Produced by a Receding Ice Edge in the Ross Sea: Spatial Coherence with the Density Field. Science, 227(4683), 163–166. doi:10.1126/science.227.4683.163

References

Smith, W. O., Asper, V., Tozzi, S., Liu, X., & Stammerjohn, S. E. (2011). Surface layer variability in the Ross Sea, Antarctica as assessed by in situ fluorescence measurements. Progress in Oceanography, 88(1-4), 28–45. doi:10.1016/j.pocean.2010.08.002
References

Smith, W. O., Barber, R. T., & Huntsman, S. A. (1977). Primary production off the coast of northwest Africa: excretion of dissolved organic matter and its heterotrophic uptake. Deep Sea Research, 24(1), 35–47. doi:10.1016/0146-6291(77)90539-2
Methods

Smith, W. O., Marra, J., Hiscock, M. R., & Barber, R. T. (2000). The seasonal cycle of phytoplankton biomass and primary productivity in the Ross Sea, Antarctica. Deep Sea Research Part II: Topical Studies in Oceanography, 47(15-16), 3119–3140. doi:10.1016/s0967-0645(00)00061-8
Methods
Results

Smith, W. O., Tozzi, S., Long, M. C., Sedwick, P. N., Peloquin, J. A., Dunbar, R. B., … DiTullio, G. R. (2013). Spatial and temporal variations in variable fluoresence in the Ross Sea (Antarctica): Oceanographic correlates and bloom dynamics. Deep Sea Research Part I: Oceanographic Research Papers, 79, 141–155. doi:10.1016/j.dsr.2013.05.002
References
Methods
Results

Wilson, D. L., Smith, W. O., & Nelson, D. M. (1986). Phytoplankton bloom dynamics of the western Ross Sea ice edge—I. Primary productivity and species-specific production. Deep Sea Research Part A. Oceanographic Research Papers, 33(10), 1375–1387. doi:10.1016/0198-0149(86)90041-5
Results

[table of contents | back to top]

Parameters

Parameter	Description	Units
Cruise	name of the cruise, generally with the year	unitless
Station_Number	station number within cruise	unitless
Cast_Event_Number	cast or event number, if used	unitless
Latitude	sampling latitude; negative values indicate south	unitless
Longitude	sampling longitude; negative values indicate west	unitless
Date	date of collection in format YYYY-MM-DD; dates are provided in the local (New Zealand) time zone; NZ is 13 h ahead of UTC	unitless
Month	month of collection	unitless
Julian_Date	Julian day of collection	daus
Julian_Date_Consecutive	Consecutive Julian date is calculated by adding January day to 365 through the end of the sampling season	days
Biweek	portion of month: 1 or 2 (1 = day 1-15; 2 = 16-end of month)	unitless
Incubation_Length	length of incubation rounded to the nearest hour	hours
Depth	depth of sample collection	meters (m)
Irradiance	isolume of depth sampled as percent surface irradiance	unitless (percent)
Primary_Productivity	14C-uptake	milligrams C per cubic meter per hour (mg C m-3 h-1)
Chlorophyll	Chlorophyll concentration	milligrams per cubic meter (mg m-3)
Assimilation_Number	14C-uptake/chlorophyll	milligrams C per milligram chl per hour (mg C (mg chl)-1 h-1)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Niskin bottles
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Niskin bottles were largely fitted with Teflon closing springs in cruises after 1996.
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	in situ PAR sensor
Generic Instrument Name	Photosynthetically Available Radiation Sensor
Dataset-specific Description	Irradiance was determined largely using an in situ PAR sensor, but earlier cruises also used a secchi disk.
Generic Instrument Description	A PAR sensor measures photosynthetically available (or active) radiation. The sensor measures photon flux density (photons per second per square meter) within the visible wavelength range (typically 400 to 700 nanometers). PAR gives an indication of the total energy available to plants for photosynthesis. This instrument name is used when specific type, make and model are not known.

Dataset-specific Instrument Name	BioSpherical Sensor Model QSP-240
Generic Instrument Name	Photosynthetically Available Radiation Sensor
Dataset-specific Description	Photosynthetically active radiation (PAR) were collected using a BioSpherical Sensor Model QSP-240 placed as close to the incubators as possible.
Generic Instrument Description	A PAR sensor measures photosynthetically available (or active) radiation. The sensor measures photon flux density (photons per second per square meter) within the visible wavelength range (typically 400 to 700 nanometers). PAR gives an indication of the total energy available to plants for photosynthesis. This instrument name is used when specific type, make and model are not known.

Dataset-specific Instrument Name	SeaBird 911+
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Dataset-specific Description	All CTDs were SeaBird 911+ systems that had their sensors calibrated before each cruise.
Generic Instrument Description	The Sea-Bird SBE 911plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911plus includes the SBE 9plus Underwater Unit and the SBE 11plus Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9plus and SBE 11plus is called a SBE 911plus. The SBE 9plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3plus and SBE 4). The SBE 9plus CTD can be configured with up to eight auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). more information from Sea-Bird Electronics

Dataset-specific Instrument Name	Secchi disk
Generic Instrument Name	Secchi Disc
Dataset-specific Description	Irradiance was determined largely using an in situ PAR sensor, but earlier cruises also used a Secchi disk.
Generic Instrument Description	Typically, a 16 inch diameter white/black quadrant disc used to measure water optical clarity

Dataset-specific Instrument Name	various
Generic Instrument Name	Liquid Scintillation Counter
Dataset-specific Description	Various LSCs were used, depending on the unit on each ship, but all samples were processed at sea.
Generic Instrument Description	Liquid scintillation counting is an analytical technique which is defined by the incorporation of the radiolabeled analyte into uniform distribution with a liquid chemical medium capable of converting the kinetic energy of nuclear emissions into light energy. Although the liquid scintillation counter is a sophisticated laboratory counting system used the quantify the activity of particulate emitting (ß and a) radioactive samples, it can also detect the auger electrons emitted from 51Cr and 125I samples.

[table of contents | back to top]

Deployments

Glacier 1983 - Leg I and Leg II

Website	https://www.bco-dmo.org/deployment/863849
Platform	USCGC Glacier
Start Date	1983-01-12
End Date	1983-02-23

NBP0601

Website	https://www.bco-dmo.org/deployment/57985
Platform	RVIB Nathaniel B. Palmer
Report	http://data.bco-dmo.org/CORSACS/cruises/Dunbar_Hydrography_report_NBP0601.pdf
Start Date	2005-12-17
End Date	2006-01-30
Description	This was the first of two Controls of Ross Sea Algal Community Structure (CORSACS) project cruises and was funded by the NSF Office of Polar Programs. The NBP0601 cruise was conducted in the Ross Sea in December 2005 and January 2006, Ross Sea, ca. 65.21°S-78.65°S, 164.98°E-164.70°W, and supported by NSF research grant, OPP-0338097. The 'Science Pan and Project Description' document includes details of the cruise sampling strategy. Related Files: Science Plan and Project Descriptions (PDF file)Cruise track map (PDF file)Photo of Ice Breaker Nathaniel B. Palmer on station near Beaufort Island (JPG image) Related Sites: MGDS catalog: http://www.marine-geo.org/tools/search/entry.php?id=NBP0601

NBP-94-06

Website	https://www.bco-dmo.org/deployment/57754
Platform	RVIB Nathaniel B. Palmer
Report	http://www.marine-geo.org/tools/search/entry.php?id=NBP9406
Start Date	1994-11-03
End Date	1994-12-19
Description	Note that the NBP-94-6 cruise was not a U.S. JGOFS cruise but is included here by the P.I. as having collected relevant data. The cruise was associated with the Collaborative Research on Bloom Dynamics and Food Web Structure in the Ross Sea research initiative funded by NSF OPP award OPP93-17587. The cruise report is provided by the LDEO MGDS data repository.

NBP-96-04A

Website	https://www.bco-dmo.org/deployment/57718
Platform	RVIB Nathaniel B. Palmer
Report	http://usjgofs.whoi.edu/aesops/p1.html
Start Date	1996-10-02
End Date	1996-11-08
Description	Ross Sea Process Study 1

NBP-97-01

Website	https://www.bco-dmo.org/deployment/57720
Platform	RVIB Nathaniel B. Palmer
Report	http://usjgofs.whoi.edu/aesops/p2.html
Start Date	1997-01-13
End Date	1997-02-11
Description	Ross Sea Process Study 2

NBP-97-03

Website	https://www.bco-dmo.org/deployment/57721
Platform	RVIB Nathaniel B. Palmer
Report	http://usjgofs.whoi.edu/aesops/p3.html
Start Date	1997-04-04
End Date	1997-05-11
Description	Ross Sea Process Study 3

NBP-97-08

Website	https://www.bco-dmo.org/deployment/57722
Platform	RVIB Nathaniel B. Palmer
Report	http://usjgofs.whoi.edu/aesops/p4.html
Start Date	1997-11-05
End Date	1997-12-13
Description	Ross Sea Process Study 4 SeaWiFS transmits images to U.S. JGOFS scientists aboard the Palmer, for first time on November 23, 1997.

NBP0305A

Website	https://www.bco-dmo.org/deployment/863857
Platform	RVIB Nathaniel B. Palmer
Start Date	2003-12-18
End Date	2004-01-01

NBP0501

Website	https://www.bco-dmo.org/deployment/863860
Platform	RVIB Nathaniel B. Palmer
Start Date	2005-01-28
End Date	2005-02-15

NBP0608

Website	https://www.bco-dmo.org/deployment/57986
Platform	RVIB Nathaniel B. Palmer
Report	http://data.bco-dmo.org/CORSACS/cruises/Dunbar_Hydrography_report_NBP0608.pdf
Start Date	2006-11-01
End Date	2006-12-15
Description	This was the second of two Controls of Ross Sea Algal Community Structure (CORSACS) project cruises and was funded by the NSF Office of Polar Programs. The NBP0608 cruise was conducted in the Ross Sea in November and December 2006, ca. 65.21°S-78.65°S, 164.98°E-164.70°W. Related files: Cruise track map (PDF file) Related Sites: MGDS catalog: http://www.marine-geo.org/tools/search/entry.php?id=NBP0608

NBP9508

Website	https://www.bco-dmo.org/deployment/863863
Platform	RVIB Nathaniel B. Palmer
Start Date	1995-12-11
End Date	1996-01-17

Polar Duke 1990

Website	https://www.bco-dmo.org/deployment/863867
Platform	R/V Polar Duke
Start Date	1989-12-15
End Date	1990-02-11

Polar Duke 1992

Website	https://www.bco-dmo.org/deployment/863868
Platform	R/V Polar Duke
Start Date	1992-01-19
End Date	1992-03-08

Polar Star 2004

Website	https://www.bco-dmo.org/deployment/863871
Platform	USCGC Polar Star
Start Date	2004-11-04
End Date	2005-03-16

Polar Sea 2001 - Leg 1 and Leg 2

Website	https://www.bco-dmo.org/deployment/863873
Platform	USCGC Polar Sea
Start Date	2001-12-03
End Date	2002-03-18

Polar Sea 2002

Website	https://www.bco-dmo.org/deployment/863875
Platform	USCGC Polar Sea
Start Date	2002-11-04
End Date	2003-04-01

Polar Sea 2003-2004

Website	https://www.bco-dmo.org/deployment/863877
Platform	USCGC Polar Sea
Start Date	2003-11-17
End Date	2004-03-31

[table of contents | back to top]

Project Information

Ross Productivity (Ross Productivity)

Coverage: Ross Sea continental shelf

This compilation was funded by NSF in ca. 10 independent projects, and pulling all the data together was not directly part of any single NSF project. The value of the database is that these measurements are from a restricted area, cover nearly 25 years, and use a consistent methodology.

[table of contents | back to top]

Program Information

U.S. Joint Global Ocean Flux Study (U.S. JGOFS)

Website: http://usjgofs.whoi.edu/

Coverage: Global

The United States Joint Global Ocean Flux Study was a national component of international JGOFS and an integral part of global climate change research.

The U.S. launched the Joint Global Ocean Flux Study (JGOFS) in the late 1980s to study the ocean carbon cycle. An ambitious goal was set to understand the controls on the concentrations and fluxes of carbon and associated nutrients in the ocean. A new field of ocean biogeochemistry emerged with an emphasis on quality measurements of carbon system parameters and interdisciplinary field studies of the biological, chemical and physical process which control the ocean carbon cycle. As we studied ocean biogeochemistry, we learned that our simple views of carbon uptake and transport were severely limited, and a new "wave" of ocean science was born. U.S. JGOFS has been supported primarily by the U.S. National Science Foundation in collaboration with the National Oceanic and Atmospheric Administration, the National Aeronautics and Space Administration, the Department of Energy and the Office of Naval Research. U.S. JGOFS, ended in 2005 with the conclusion of the Synthesis and Modeling Project (SMP).

[table of contents | back to top]

Funding

Funding Source	Award
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-0338157

[table of contents | back to top]