Hydrographic measurements from Niskin bottle samples from RVIB Nathaniel B. Palmer cruises in the Ross Sea Southern Ocean (CORSACS project)

Website: https://www.bco-dmo.org/dataset/3123
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Project
» Controls of Ross Sea Algal Community Structure (CORSACS)

Program
» Ocean Carbon and Biogeochemistry (OCB)

Contributors	Affiliation	Role
DiTullio, Giacomo	College of Charleston - Hollings Marine Lab (CoC-HML)	Principal Investigator
McKee, Theresa	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Table of Contents

- Dataset Description
  - Methods & Sampling
  - Data Processing Description
- Parameters
- Instruments
- Deployments
- Project Information
- Program Information
- Funding

Dataset Description

Water-column nutrients and CTD data from CORSACS 1 cruise (NBP-0601) and CORSACS2 cruise (NBP-0608) to the Ross Sea in 2005 and 2006.

Collection of these data was funded by the NSF Office of Polar Programs as "Collaborative Research: Interactive Effects of Iron, Light and Carbon Dioxide on Phytoplankton Community Dynamics in the Ross Sea", NSF Award OPP-0338097.

Methods & Sampling

Hydrographic reports on sampling and analytical methodology for both cruises can be found at the following website:

ftp://pangea.stanford.edu/pub/dunbar/CORSACSHydrographyReports/

Cruise Report Summary

Reported here are Conductivity, Temperature, Depth (CTD), C system, oxygen, and nutrient data from the CORSACS I & II cruises, which were collected aboard the Research Vessel Ice Breaker (RVIB) Nathaniel B. Palmer.

The RVIB Nathaniel B. Palmer is equipped with a SeaBird Electronics Model SBE- 911plus conductivity, temperature, and depth instrument, which is mounted on a SeaBird, epoxy coated 24-bottle rosette sampler. The sampler is equipped with a SeaBird pylon and 10-liter Bullister bottles.

Water samples were drawn in accord with Joint Global Ocean Flux Study (JGOFS) protocols [SCOR, 1994]and Nutrient samples were analyzed on a Lachat Quickchem FIA+, series 8000, a bench-top instrument. High precision pH determinations were made following the spectrophotometric method described in SOP7 of Dickson and Goyet (1994).

Salinity samples were analyzed using a Guildline 8400 Autosal four-electrode salinometer (S/N NSF 04504) aboard the RVIB Nathaniel B. Palmer. Discrete dissolved oxygen (DO) measurements were made with a Lamont-Doherty Earth Observatory amperometric oxygen titrator titration system [Langdon, 2003; Culberson and Huang, 1987].

Samples for Carbon analysis were collected in accordance with JGOFS protocols (Dickson and Goyet 1994) and were measured by infrared absorption analysis of CO2 in a nitrogen gas stream using an automated injection system connected to an infrared gas analyzer (LI-COR LI7000).

Important note: cast 35 on NBP06-08 was a 'ghost' CTD, that is no bottle samples were drawn. Some folks didn't realize that, so some data sets list stations 36 through 36+N as stations 35 through 35+N, where N is some unspecified number of casts, not always all remaining casts. This means it is very difficult to match measurements from other data sets with the hydro bottle data.

Data Processing Description

BCO-DMO processing note:
2010-Sep-09: NBP0601 station 21 year_day value corrected from 366.01xx to 1.01xx (this parameter was named Julian in the original contributed Excel file)

[table of contents | back to top]

Parameters

Parameter	Description	Units
cruise_id	ship's cruise designation	dimensionless
date_local	local date of sampling	YYYYMMDD
time_local	local time of sampling	hhmm
year_day	day of year for a specified year as a decimal	dimensionless
lat	latitude; North is positive, South is negative	decimal degrees
lon	longitude; East is positive, West is negative	decimal degrees
sta	station number	dimensionless
bot	bottle number	dimensionless
sample_label	sample number composed of cruise, station and bottle	dimensionless
depth	depth	meters
temp	temperature	degrees Celsius
cond	conductivity	Siemens per meter
sal	salinity from CTD sensor	practical salinity units (PSU)
sal_bottle	salinity from bottle by Autosal system	practical salinity units (PSU)
sal_diff	salinity difference; Autosal minus CTD sensor	practical salinity units (PSU)
sal_merged	salinity merged from Autosal and CTD sensor	practical salinity units (PSU)
sigma_t	sigma-t density	kilograms per meter cubed - 1000
O2sat	oxygen saturation	milliliters per liter

O2_volts	oxygen from CTD sensor	volts
O2	oxygen from CTD sensor	milliliters per liter
O2_bot	oxygen; from bottle by Winkler method	milliliters per liter
O2_diff	oxygen difference; Winkler method minus CTD sensor	milliliters per liter
O2_umol_kg	oxygen; from CTD sensor	micromoles per kilogram
fluor	fluorescence, FIECO-AFL	volts
PAR	Photosynthetically Available Radiation (PAR)	microeinsteins per meter2 per second
PAR_surface	surface PAR	microeinsteins per meter2 per second
DIC	dissolved inorganic Carbon	micromoles per kilogram
pH	pH; by colorimetric analysis	pH units
DIC_dC13	dissolved inorganic Carbon from C13	per mil (ppt)
PO4	dissolved inorganic phosphate concentration	micromoles per liter
NO2	dissolved nitrite concentration	micromoles per liter
NO3_NO2	dissolved nitrate plus nitrite concentration	micromoles per liter
NH4	dissolved ammonium concentration	micromoles per liter
Si_acid	dissolved silicic acid concentration	micromoles per liter
NO3	dissolved nitrate concentration	micromoles per liter
PON	Particulate Organic Nitrogen	percent
POC	Particulate Organic Carbon	percent
dN15_POM	Nitrogen 15 to Nitrogen 14 ratio	per mil (ppt)
dC13_POM	Carbon 13 to Carbon 12 ratio	per mil (ppt)
C_to_N	carbon to nitrogen ratio	dimensionless
PON_ug_L	Particulate Organic Nitrogen	micrograms per liter
POC_ug_L	Particulate Organic Carbon	micrograms per liter
temp_0	temperature; CTD sensor 0	degrees Celsius
temp_1	temperature; CTD sensor 1	degrees Celsius
potemp_1	potential temperature; CTD sensor 1	degrees Celsius
cond_0	conductivity; CTD sensor 0	Siemens per meter
cond_1	conductivity; CTD sensor 1	Siemens per meter
O2_volts_0	oxygen in volts; CTD sensor 0	volts
O2_volts_1	oxygen; CTD sensor 1	volts
O2_0	oxygen; CTD sensor 0	milliliters per liter
O2_1	oxygen; CTD sensor 1	milliliters per liter
O2_0_umol_kg	dissolved oxygen; CTD sensor 0 (primary)	micromoles per kilogram
O2_1_umol_kg	oxygen; CTD sensor 1	micromoles per kilogram
O2_1_PS	unknown	unknown

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Autosal salinometer
Generic Instrument Name	Autosal salinometer
Dataset-specific Description	Salinity samples were analyzed using a Guildline 8400 Autosal four-electrode salinometer (S/N NSF 04504) aboard the RVIB Nathaniel B. Palmer.
Generic Instrument Description	The salinometer is an instrument for measuring the salinity of a water sample.

Dataset-specific Instrument Name	CTD Sea-Bird 911
Generic Instrument Name	CTD Sea-Bird 911
Generic Instrument Description	The Sea-Bird SBE 911 is a type of CTD instrument package. The SBE 911 includes the SBE 9 Underwater Unit and the SBE 11 Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 and SBE 11 is called a SBE 911. The SBE 9 uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 and SBE 4). The SBE 9 CTD can be configured with 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	LI-COR LI-7000 Gas Analyzer
Generic Instrument Name	LI-COR LI-7000 Gas Analyzer
Dataset-specific Description	Samples for Carbon analysis were collected in accordance with JGOFS protocols (Dickson and Goyet 1994) and were measured by infrared absorption analysis of CO2 in a nitrogen gas stream using an automated injection system connected to an infrared gas analyzer (LI-COR LI7000).
Generic Instrument Description	The LI-7000 CO2/H2O Gas Analyzer is a high performance, dual cell, differential gas analyzer. It was designed to expand on the capabilities of the LI-6262 CO2/ H2O Gas Analyzer. A dichroic beam splitter at the end of the optical path provides radiation to two separate detectors, one filtered to detect radiation absorption of CO2 and the other to detect absorption by H2O. The two separate detectors measure infrared absorption by CO2 and H2O in the same gas stream. The LI-7000 CO2/ H2O Gas Analyzer is a differential analyzer, in which a known concentration (which can be zero) gas is put in the reference cell, and an unknown gas is put in the sample cell.

Dataset-specific Instrument Name	Niskin Bottle
Generic Instrument Name	Niskin bottle
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	Oyxgen Titrator -Langdon
Generic Instrument Name	Oyxgen Titrator -Langdon
Dataset-specific Description	Discrete dissolved oxygen (DO) measurements were made with a Lamont-Doherty Earth Observatory amperometric oxygen titrator titration system [Langdon, 2003; Culberson and Huang, 1987].
Generic Instrument Description	A Langdon Oyxgen Titrator is an amperometric oxygen titration system developed to measure dissolved oxygen in seawater. The device uses a conventional polarographic electrode in connection with chronoamperometry to overcome many of the problems limiting the performance of oxygen electrodes. Reproducibility is typically better than +/- 0.8 micromolar and essentially drift-free for several weeks. A microcomputer controls all phases of the measuring process: pulse generation, data acquisition, reduction, and storage. Software is used to correct sensor output for temperature dependence and an activity coefficient, a function of temperature and salinity, is computed to correct for salinity. (Langdon, 1984. Deep Sea Research Part A. Oceanographic Research Papers, Volume 31, Issue 11, pp. 1357-1367; Culberson and Huang, 1987. Automated amperometric oxygen titration. Deep Sea Res. 34:875-880).

[table of contents | back to top]

Deployments

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 **Methods & Sampling** CORSACS I The RVIB Nathaniel B. Palmer departed Lyttleton, New Zealand at December 18, 2005 and arrived at station #000 on December 24, 2005 at 00:07 UTC. The cruise track proceeded into the Ross Sea polynya where a total of 102 hydrographic stations were occupied through late January, 2006. Sampling and analytical methods are described in full in the CORSACS-I Cruise Report CORSACS I Cruise Report

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 **Methods & Sampling** CORSACS II The RVIB Nathaniel B. Palmer departed Lyttleton, New Zealand at November 1, 2006 and arrived at station #001 on November 8, 2006 at 00:51 UTC. The cruise track proceeded into the Ross Sea polynya where a total of 74 hydrographic stations were occupied through December 6, 2006. Sampling and analytical methods are described in full in the CORSACS-II Cruise Report CORSACS II Cruise Report

[table of contents | back to top]

Project Information

Controls of Ross Sea Algal Community Structure (CORSACS)

Website: http://www.whoi.edu/sites/corsacs

Coverage: Ross Sea Southern Ocean

Project summary

The Controls of Ross Sea Algal Community Structure (CORSACS) project was funded by the NSF Office of Polar Programs as "Collaborative Research: Interactive Effects of Iron, Light and Carbon Dioxide on Phytoplankton Community Dynamics in the Ross Sea". Two cruises were completed in 2006 to investigate the interactions between the primary productivity of the Ross Sea and pCO2, iron and other trace elements. Data sets of carbon, nutrient, metal, and biological measurements will be reported.

The main objective in the proposed research was to investigate the relative importance and potential interactive effects of iron, light and CO2 levels in structuring algal assemblages and growth rates in the Ross Sea. The investigators hypothesized that the interaction of these three variables largely determines the bottom-up control on these two dominant Southern Ocean phytoplankton taxa. While grazing and other loss processes are important variables in determining the relative dominance of these two taxa, the CORSACS research project was designed to focus on the bottom-up control mechanisms. It is important to understand such environmentally-driven taxonomic shifts in primary production, since they are expected to impact the fixation and export of carbon and nutrients, and the production of DMS, thus potentially providing both positive and negative feedbacks on climate.

The CORSACS investigators considered a range of ambient iron, light and pCO2 levels that span those typically observed in the Ross Sea during the growing season. That is, dissolved iron ranging from ~0.1 nM (low iron) to greater than 1 nM (high iron) (Fitzwater et al. 2000; Sedwick et al. 2000); mean irradiance (resulting from vertical mixing/self shading) ranging from less than 10% Io (low light) to greater than 40% (high light) (Arrigo et al., 1998, 1999), possibly adjusted based on field observations during the CORSACS cruises; and pCO2 ranging (Sweeney et al. 2001) from ~150 ppm (low CO2) to the probable higher levels of pCO2 - 750 ppm as a conservative estimate - that are likely to be attained later this century due to anthropogenic perturbation of the global carbon cycle (IPCC, 2001).

From the information previously available from both field observations and experiments, the investigators formulated the following specific hypotheses regarding the interactive role of iron, light and CO2 in regulating algal composition in the Ross Sea: diatoms bloom in the southern Ross Sea only under optimum conditions of high iron, light and pCO2; colonial Phaeocystis dominate under conditions of high iron with either (or both) low light or low pCO2; and solitary Phaeocystis are predominant under conditions of low iron with either (or both) low light or low pCO2.

References:

Fitzwater, S.E., K.S. Johnson, R.M. Gordon, K.H. Coale, and W.O. Smith, Jr. (2000). Trace metal concentrations in the Ross Sea and their relationship with nutrients and growth. Deep-Sea Research II, 47: 3159-3179.

Martin JH, Gordon RM, Fitzwater SE. Iron in Antarctic waters. Nature 1990 ;345(6271):156-158. Martin JH. 1990. Glacial-interglacial CO2 change: The iron hypothesis. Paleoceanography 5(1):1-13

P. N. Sedwick, G. R. DiTullio, and D. J. Mackey, Iron and manganese in the Ross Sea, Antarctica: Seasonal iron limitation in Antarctic shelf waters, Journal of Geophysical Research, 105 (C5), 11,321-11,336, 2000.

Sweeney, C. K. Arrigo, and G. van Gijken (2001). Prediction of seasonal changes in surface pCO2 in the Ross Sea, Antarctica using ocean color satellite data. 2001 Annual AGU meeting, San Fransisco, CA Dec. 10-15.

IPCC, 2001: Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of theIntegovernmental Panel on Climate Change [Watson, R.T. and the Core Writing Team (eds.)]. Cambridge University Press, Cambridge,United Kingdom, and New York, NY, USA, 398 pp.

Publications

Saito, M. A., Goepfert, T. J., Noble, A. E., Bertrand, E. M., Sedwick, P. N., and DiTullio, G. R.: A seasonal study of dissolved cobalt in the Ross Sea, Antarctica: micronutrient behavior, absence of scavenging, and relationships with Zn, Cd, and P, Biogeosciences, 7, 4059-4082, doi:10.5194/bg-7-4059-2010, 2010 (http://www.biogeosciences.net/7/4059/2010/bg-7-4059-2010.html)

Bertrand EM, Saito MA, Lee PA, Dunbar RB, Sedwick PN and DiTullio GR (2011) Iron limitation of a springtime bacterial and phytoplankton community in the Ross Sea: implications for vitamin B12 nutrition. Front. Microbio. 2:160. doi: 10.3389/fmicb.2011.00160 (http://www.frontiersin.org/Aquatic_Microbiology/10.3389/fmicb.2011.00160/abstract)

[table of contents | back to top]

Program Information

Ocean Carbon and Biogeochemistry (OCB)

Website: http://us-ocb.org/

Coverage: Global

The Ocean Carbon and Biogeochemistry (OCB) program focuses on the ocean's role as a component of the global Earth system, bringing together research in geochemistry, ocean physics, and ecology that inform on and advance our understanding of ocean biogeochemistry. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by U.S. federal agencies including NASA, NOAA, and NSF.

The scientific mission of OCB is to study the evolving role of the ocean in the global carbon cycle, in the face of environmental variability and change through studies of marine biogeochemical cycles and associated ecosystems.

The overarching OCB science themes include improved understanding and prediction of: 1) oceanic uptake and release of atmospheric CO2 and other greenhouse gases and 2) environmental sensitivities of biogeochemical cycles, marine ecosystems, and interactions between the two.

The OCB Research Priorities (updated January 2012) include: ocean acidification; terrestrial/coastal carbon fluxes and exchanges; climate sensitivities of and change in ecosystem structure and associated impacts on biogeochemical cycles; mesopelagic ecological and biogeochemical interactions; benthic-pelagic feedbacks on biogeochemical cycles; ocean carbon uptake and storage; and expanding low-oxygen conditions in the coastal and open oceans.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-0338097

[table of contents | back to top]