One-meter averaged downcast profile data from RVIB Nathaniel B. Palmer cruises in the Ross Sea Southern Ocean (CORSACS project)

Website: https://www.bco-dmo.org/dataset/3223
Version: 21 September 2009
Version Date: 2009-09-21

Project
» Controls of Ross Sea Algal Community Structure (CORSACS)

Program
» Ocean Carbon and Biogeochemistry (OCB)

Contributors	Affiliation	Role
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Dataset Description

Profile 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

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. Data from dual temperature, dual conductivity, pressure, oxygen, and other instruments were transmitted in real-time to the SBE-11 deck unit via conducting cable. Onboard, the data were recorded digitally on a Windows computer running SBE Seasave software (ver.5.37d).

Prior to the start of each hydrocast, the CTD was lowered to a depth of 10 m to allow time for the CTD pumps to activate and the sensors to equilibrate. During this washing period, the differences between the primary and secondary readings of the temperature and conductivity were monitored as well as dissolved O2 levels. Once stability was achieved, the CTD was brought back to the surface in preparation for the hydrocast. During all hydrocasts, the CTD was lowered at a rate of 30 m min-1 through the upper water column (usually 150 m) and then at 50 m min-1 at greater depths. The distance between the sensor package and the bottom was determined using a Datasonics pinger. A mechanical safety switch notified the CTD operator when the package had reached a distance of 3 to 5 m from the bottom. We reached the seabed on about half of the hydrocasts conducted during both NBP0601 and NBP0608. The remaining casts focused on sampling the uppermost, biologically active portion of the water column. Ten-liter Bullister bottles were tripped at selected depths on the upcast to provide in situ sampling of chemical, biological, and physical properties of the water column as well as to provide calibration data for the CTD. Once the CTD was back onboard, the temperature, conductivity, and dissolved oxygen sensors were flushed with deionized water and covered with rubber boots to minimize instrument fouling between casts.

Detailed descriptions of calibration and processing are available in the full cruise reports (see the cruise specific data documentation). Those reports, along with the original data contributions were downloaded from Rob Dunbar's site at Stanford University on 15 May 2009: CTD data from Rob Dunbar.

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Parameters

Parameter	Description	Units
cruise_id	ship's cruise designation	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
date	date of sampling; local or UTC unknown	YYYYMMDD
time	time of sampling; local or UTC unknown	hhmm
year_day	day of year for a specified year as a decimal; note that noon on Jan 1 is 1.5; range 1 to 366	dimensionless
depth	sample depth, in meters	meters
temp_0	temperature, from the CTD 'primary sensor', in degrees Celsius.	degrees Celsius
temp_1	temperature, from the CTD 'secondary sensor', in degrees Celsius.	degrees Celsius
cond_0	conductivity, from the CTD 'primary sensor', in Siemens/meter.	Siemens per meter
cond_1	conductivity, from the CTD 'secondary sensor', in Siemens/meter.	Siemens per meter
sal_0	salinity, calculated from the CTD 'primary sensor' in Practical Salinity Units (PSU)	dimensionless
sal_1	salinity, calculated from the CTD 'secondary sensor' in Practical Salinity Units (PSU)	dimensionless
sigma_t	sigma-t density	kilograms per meter cubed - 1000
density	density, from the CTD 'primary sensor'	kilograms per meter cubed
density_S	density, from the CTD 'secondary sensor'	kilograms per meter cubed
fluor	fluorescence, FIECO-AFL	volts
PAR	Photosynthetically Available Radiation (PAR)	microeinsteins per meter^2 per second
PAR_surface	surface PAR	microeinsteins per meter^2 per second
O2_0	oxygen; CTD sensor 0 (primary)	milliliters per liter
O2_1	oxygen; CTD sensor 1 (secondary)	milliliters per liter
O2_0_umol_kg	dissolved oxygen; CTD sensor 0 (primary) in micromoles per kilogram	micromoles per kilogram
O2_1_umol_kg	dissolved oxygen; CTD sensor 1 (secondary) in micromoles per kilogram	micromoles per kilogram
O2sat	oxygen saturation	milliliters per liter
O2_0_PS	unknown; primary sensor; percent saturation?	unknown
O2_1_PS	unknown; secondary sensor; percent saturation?	unknown
O2_volts_0	oxygen in volts; primary sensor	volts
O2_volts_1	oxygen in volts; secondary sensor	volts

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Instruments

Dataset-specific Instrument Name	CTD Seabird 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.

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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 Hydrographic Report CORSACS I Hydrography 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 Hydrography Report CORSACS II Hydrography Report

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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)

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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 CO_2 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.

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Funding

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

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