Underway pCO2, dissolved oxygen concentrations, and fluxes from RVIB Nathaniel B. Palmer NBP1005 in the Amundsen Sea, Southern Ocean from 2010-2011 (ASPIRE project)

Website: https://www.bco-dmo.org/dataset/540038
Version: 18 November 2014
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Project
» Amundsen Sea Polynya International Research Expedition (ASPIRE)

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Dataset Description

Underway shipboard data from uncontaminated seawater flowing continuously from intake at 5 m depth. Includes pCO2, dissolved oxygen, chlorophyll fluorescence, temperature, salinity, and wind speed data from the USAP RV *Nathaniel B. Palmer* during austral summer 2010-11 as it sampled the Amundsen Sea Polynya during the Amundsen Sea Polynya International Research Expedition.

Methods & Sampling

See: Spatial variability of surface pCO2 and air-sea CO2 flux in the Amundsen Sea Polynya, Antarctica

Data Processing Description

Initial pCO_2 data was processed at Lamont Doherty Earth Observatory and quality controlled according to Sutherland et al. (2011). We merged this data with the ship's underway data stream and the underway oxygen optode data (see manuscript), and then removed observations during heavy sea ice conditions. Please see the attached manuscript for all equations and assumptions used in the calculations.

See: Spatial variability of surface pCO2 and air-sea CO2 flux in the Amundsen Sea Polynya, Antarctica

BCO-DMO Processing Notes
- Generated from MGDS:jgofs files dowloaded from MGDS data for NBP1005
- Awk routine generated to reformat original files into BCO-DMO servable file format
- Awk routine: "MGDS_Underway_jgofs_2_BCO-DMO.awk"
- Parameter names generated from: JGOFSDataFormat.pdf
- Parameter names edited to conform to BCO-DMO naming convention found at Choosing Parameter Name
- Date reformatted from DD-MM-YY to YYYYMMDD
- Time reformatted from HH:MM:SS to HHMMSS
- Records with Lat/Lon values of "NAN" deleted
- Tab separated data converted to comma separated data

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Data Files

File
Underway_Mu_etal.csv (Comma Separated Values (.csv), 1.01 MB) MD5:15347f6d5bcd85c07eb689f64e9e2288 Primary data file for dataset ID 540038

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Parameters

Parameter	Description	Units
Julian_day	GMT time starting from January 1 2010 (day 1). E.g. December 31 2010 – day 365 and January 1 2011 – day 366. Hours and minutes are converted to decimal fractions of a day.	day
Latitude	Latitude (South is negative)	decimal degrees
Longitude	Longitude (West is negative)	decimal degrees
SST	abbreviation for Sea Surface Temperature in degrees C	deg C
Temp_eq	Temperature in the underway CO2 equilibrator where pCO2 is measured. Used to correct measured value back to SST.	deg C
SSS	abbreviation for Sea Surface Salinity (no units)	no units
density	sea surface density (kg L-1)	kg L−1
sigma_theta	(Density – 1) x 1000 (unitless)	no units
Sc	Schmidt number – a parameter related to gas transfer velocity calculation (no units) (Wanninkhof 1992)	no units

Chl_a	sea surface chlorophyll a fluorescence (relative units)	relative units
ln_Beta	CO2 solubility (Weiss 1974)	no units
Beta_Ko	CO2 solubility (Weiss 1974)	mol kg−1 atm−1
Wind	shipboard wind speed at 25 m height	m s−1
Wind_cor	wind speed corrected to 10 m height	m s−1
Wind_avr	cruise-averaged wind speed at 10 m height	m s−1
k	CO2 gas transfer velocity (cm hr-1)	cm hr−1
P_eq	atmospheric pressure inside of CO2 analyzer (kPa)	kPa
pCO2_w	partial pressure of CO2 in surface seawater (uatm)	uatm
pCO2_a	partial pressure of CO2 in atmosphere (uatm)	uatm
Delta_pCO2	air-sea pCO2 gradient = pCO2(w) − pCO2(a) (uatm)	uatm
CO2_sat	saturation state for CO2 (%)	percentage
DO	dissolved oxygen concentration in the surface seawater (umol L-1)	umol L−1
Cstar_DO	DO solubility (concentration in equilibrium with the atmosphere)	umol L−1
DO_sat	saturation state for DO (%)	percentage
Flux	air-sea CO2 flux (mmol C m-2 d-1)	mmol C m−2 d−1

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Instruments

Dataset-specific Instrument Name	GPS
Generic Instrument Name	Global Positioning System Receiver
Dataset-specific Description	This data set was acquired with a ship-based Navigation system
Generic Instrument Description	The Global Positioning System (GPS) is a U.S. space-based radionavigation system that provides reliable positioning, navigation, and timing services to civilian users on a continuous worldwide basis. The U.S. Air Force develops, maintains, and operates the space and control segments of the NAVSTAR GPS transmitter system. Ships use a variety of receivers (e.g. Trimble and Ashtech) to interpret the GPS signal and determine accurate latitude and longitude.

Dataset-specific Instrument Name	RVIB Nathaniel B. Palmer Underway Sampling Systems
Generic Instrument Name	Shipboard Surface Mapping System
Dataset-specific Description	RVIB Nathaniel B. Palmer Underway Sampling Systems
Generic Instrument Description	Surface Mapping System (SMS): The SMS records navigation, meteorological and sea surface data every 10 seconds.

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Deployments

NBP1005

Website	https://www.bco-dmo.org/deployment/58154
Platform	RVIB Nathaniel B. Palmer
Start Date	2010-11-26
End Date	2011-01-16
Description	See more information in R2R: https://www.rvdata.us/search/cruise/NBP1005 Expedition by the USAP RV Nathaniel B. Palmer during austral summer 2010-11 to sampled the Amundsen Sea Polynya during the Amundsen Sea Polynya International Research Expedition (ASPIRE). Also identified as OSO 2010-11 (Oden Southern Ocean – two vessel operation 2010-11) The US Research Icebreaker Nathaniel B. Palmer was joined by the Swedish Icebreaker Oden for a two-vessel expedition to the Amundsen Sea. Scientists on the Palmer focused on understanding the climate-sensitive dynamics of the open water region, known as a "polynya." Oden scientists investigated the sea ice ecosystem nearby. The aim of both groups was to improve our understanding of how climate change will impact this important ecosystem. Note the following links take users to Marine Geoscience Data System (MGDS): NBP1005 NBP1005A Data at MGDS were available as NBP1005 and NBP1005A. The data are from the same expedition and are combined in BCO-DMO into the one deployment - NBP1005. Nathaniel B. Palmer Systems and Specifications

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Project Information

Amundsen Sea Polynya International Research Expedition (ASPIRE)

Website: http://AntarcticASPIRE.org/

Coverage: Amundsen Sea, South Pacific Sector of Antarctica, Southern Ocean 73 S 115 W

The Amundsen Sea Polynya is areally the most productive Antarctic polynya, exhibits higher chlorophyll levels during peak bloom and greater interannual variability than the better-studied Ross Sea Polynya ecosystem. Polynyas may be the key to understanding the future of polar regions as their extent is expected to increase with anthropogenic warming. The project will examine 1) sources of iron to the Amundsen Sea Polynya as a function of climate forcing, 2) phytoplankton community structure in relation to iron supply and mixed-layer depths, 3) the efficiency of the biological pump of carbon to depth and 4) the net flux of carbon as a function of climate and micronutrient forcing. The research also will compare results for the Amundsen Sea to existing data synthesis and modeling efforts for the Palmer LTER and Ross Sea. The project will 1) build close scientific collaborations between US and Swedish researchers; 2) investigate climate change implications with broad societal relevance; 3) train new researchers; 4) encourage participation in research science by underrepresented groups, and 5) involve broad dissemination of results via scientific literature and public outreach, including close interactions with NSF-supported PolarTrec and COSEE K-12 teachers.

This project brings together experienced US and Swedish investigators (trace metal and carbon chemists, phytoplankton physiologists, microbial and zooplankton ecologists, and physical oceanographers) to investigate climate controls on carbon dioxide uptake by one of the most productive ecosystems in the Antarctic.

The Amundsen Sea Polynya is the most productive Antarctic polynya per square meter, and exhibits higher chlorophyll levels during peak bloom and greater interannual variability than the better-studied Ross Sea polynya ecosystem to the west.

Polynyas, or recurring areas of seasonally open water surrounded by ice, are foci for energy and material transfer between the atmosphere, polar surface ocean and deep sea. Most help take up large amounts of carbon dioxide from the atmosphere.

These polar ecosystems are characterized by high biological productivity and intense biogeochemical cycling - a bit like an oasis. Polynyas may be the key to understanding the future of polar regions since their extent is expected to increase with anthropogenic warming. On the other hand, if seasonal sea ice disappears completely, the unique nature of polynyas may also be lost.

Regional reductions or growth in sea-ice over the past decade have been extensive and are coupled to climate-sensitive global cycles such as ENSO and the Southern Annular Mode. Without many historical measurements, this regional and interannual variability is our best present-day indication for what controls or “forces” these critical polar ecosystems and their sensitivity to future change.

Variability in the productivity of Antarctic polynyas is high for reasons the science community do not currently understand. The supply of trace metals such as iron is thought to determine phytoplankton community structure and production in the Southern Ocean, particularly in conjunction with mixed-layer depth controls on light limitation. A key question is whether interannual variability is driven by these two climate-sensitive factors, and whether we can expect climate-sensitive shifts in ecosystem function and carbon flux in the future. Understanding critical feedbacks between climate and the marine biosphere becomes increasingly urgent as we project rates of change into the future.

Special ASPIRE journal feature in ELEMENTA

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Funding

Funding Source	Award
NSF Antarctic Sciences (NSF ANT)	ANT-0839069
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