Discrete O2 Argon (Ar) from NOAA Ship Ronald H. Brown cruise RB-08-02 in the Southwest Atlantic sector of the Southern Ocean near South Georgia Island in 2008 (SO_GasEx project)

Website: https://www.bco-dmo.org/dataset/4058
Version: 14 October 2013
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Project
» Southern Ocean Gas Exchange Experiment (SO_GasEx)

Programs
» Ocean Carbon and Biogeochemistry (OCB)
» United States Surface Ocean Lower Atmosphere Study (U.S. SOLAS)

Contributors	Affiliation	Role
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Table of Contents

Dataset Description

Dataset Description:
Final Discrete Oxygen/Argon, Nitrogen/Argon, and triple Oxygen Isotope Data along with associated productivity calculations

Operation Description:
Discrete measurements of oxygen/nitrogen/argon ratios (ONAr) and triple oxygen isotopes for productivity calculations.

Methods & Sampling

Sampling times and locations:
Sampled ONAR on every Niskin Rosette cast at 5m except stations 8 and 9 when the mass spec was out of commission. Duplicates were collected on approximately one cast per day in the latter portion of the cruise. Two short profiles in the upper 100m were collected on Stations 6 and 16. See CTD cast logs and bottle files for specific times, locations, and flask numbers for each cast. Discrete samples were also collected from the underway seawater line near the EIMS instrument.

Overall sampling strategy:
Plan was to collect discrete samples from the surface on every CTD cast and from the underway system at other times to provide discrete data every 6-12 hours.

Data Processing Description

Analytical method:
Flasks provided by Bender Lab. Each flask has HgCl2 dried onto the inside. Flasks were evacuated in the Bender Lab prior to the cruise. Back at the lab, sample flasks were weighed. The headspace is allowed to equilibrate with the water sample at room temperature, followed by removal of the water phase. Approximately half the samples are analyzed using a Finnigan DeltaPlus XP mass spectrometer for measurement of O2/N2/Ar as well as d18O of O2 and d15N of N2. Others are chromatographed to separate O2 and Ar from N2, followed by analysis of O2/Ar and the triple isotope composition of O2 using a Finnigan MAT 252 mass spectrometer. Air standards are processed in the same way and used to calibrate the mass spec standard. Uncertainties based on duplicates from this cruise were +/- 0.23% in O2/Ar and +/- 0.0052 ‰ in the mass-independent fractionation anomaly of 17O.

Calculations:
O2/Ar and N2/Ar ratios are corrected for the gases remaining in the water phase, so that the provided values represent whole sample ratios. Isotopes of O2 are not corrected for this fractionation, so that provided values represent those in the headspace only. Saturations are calculated based on Garcia and Gordon (1992,1993) for O2 and Hamme and Emerson (2004) for Ar and N2. Net community oxygen production is calculated from the O2/Ar data, T, S, and a weighted gas exchange rate. This value approximates the NOP of the mixed layer over 10 days prior to the measurement of O2/Ar. Gross productivities are calculated from the O2 isotope data and a windspeed parameterization based on the calculation method of Kaiser (2011). For gas exchange, we use the Reuer et al. (2007) wind speed weighting over 60 days prior to the measurement using combined QuikSCAT/NCEP wind speeds and the Ho et al. (2006) gas exchange parameterization. For more details see Hamme, R. C., et al. (2012), Dissolved O2/Ar and other methods reveal rapid changes in productivity during a Lagrangian experiment in the Southern Ocean, J. Geophys. Res., 117, C00F12, doi:10.1029/2011JC007046.

BCO-DMO Processing Notes
Original file: "Hamme2012_discrete.csv" contributed by Roberta Hamme
Metadata file: "Metadata_report_DiscreteO2Ar_Final.xls" contributed by Roberta Hamme
- year, month, date combined into a single date field formatted as YYYYMMDD
- hour, minute, second combined into a single time field formatted as HHMMSS
- Parameter names edited to conform to BCO-DMO parameter naming conventions

[table of contents | back to top]

Data Files

File
Discrete_O2_Ar.csv (Comma Separated Values (.csv), 20.55 KB) MD5:1c5a0d7cb09916e2538107f2801b621e Primary data file for dataset ID 4058

[table of contents | back to top]

Parameters

Parameter	Description	Units
event_num	Unique event number for CTD/Rosette cast or underway sampling event	YDAHHMM

date	date (UTC)	YYYYMMDD
time	time (UTC)	HHMMSS
latitude	latitude; negative denotes South	decimal degrees
longitude	longitude; negative denotes West	decimal degrees
station	SO-GasEx CTD Station ID (NAN for underway samples)	dimensionless
niskin	Rosette Niskin number (NAN for underway samples)	dimensionless
press	pressure from CTD or presumed from underway inlet location	dbar
depth	depth from CTD pressure or presumed from underway inlet location	meters
CTDtemp	Temperature	degrees C
pot_temp	Potential Temperature	degrees C
CTDsal	salinity; from CTD on PSS-78 scale; (underway salinity from data by David Drapeau measured on a nearby SBE45 but corrected for observed CTD/underway offsets)	PSS-78
sigma_theta	Potential density - 1000	kg/m^3
in_mixed_layer_flag	1=sample is in mixed layer; 0= sample not in mixed layer	dimensionless
O2_conc	O2 concentration	umol/kg

O2_Ar_ratio	O2/Ar ratio	ratio
O2_Arsat	O2/Ar supersaturation =((O2/Ar)meas / (O2/Ar)equil - 1)*100	percentage
O2_Arsat_std_dev	standard deviation of duplicates for O2/Ar supersaturation (NaN if no duplicate)	percentage
N2_Ar_ratio	N2/Ar ratio	ratio
N2_Arsat	N2/Ar supersaturation =((N2/Ar)meas / (N2/Ar)equil - 1)*100	percentage
N2_Arsat_std_dev	standard deviation of duplicates for N2/Ar supersaturation (NaN if no duplicate)	percentage
d17O_headspace	delta17O of O2 in sample headspace	permil
d17O_headspace_std_dev	standard deviation of duplicates for delta17O of O2 in sample headspace	permil
d18O_headspace	delta18O of O2 in sample headspace	permil
d18O_headspace_std_dev	standard deviation of duplicates for delta18O of O2 in sample headspace	permil
SeventeenD_with_ref_slope_0point5154	17D = (ln(d17Odis/1000 + 1) -0.5154*ln(d18Odis/1000 + 1)) * 1e6	per meg
SeventeenD_with_ref_slope_0point5154_std_dev	standard deviation of duplicates for 17D with 0.5154 reference slope	per meg

SeventeenD_with_ref_slope_0point5179	17D = (ln(d17Odis/1000 + 1) -0.5179*ln(d18Odis/1000 + 1)) * 1e6	per meg
SeventeenD_with_ref_slope_0point5179_std_dev	standard deviation of duplicates for 17D with 0.5179 reference slope	per meg
Net_O2_community_production_based_on_prior_O2_Ar	NOP = kw * O2/Arsat * [O2]equil * density	mmol O2 /m2/d
Gross_O2_production_based_on_triple_isotopes	GOP calculated from oxygen isotopes; see Hamme et al. 2012 appendix A	mmol O2 /m2/d
weighted_gas_exchange_coefficient_used_for_productivity_calcs	kw	m/d
mixed_layer_depth_used_for_gas_exchange_weighting	mixed layer depth for determining kw	meters

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	CTD Sea-Bird SBE 911plus
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Generic Instrument Description	The Sea-Bird SBE 911 plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911 plus 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 9 plus and SBE 11 plus is called a SBE 911 plus. The SBE 9 plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 plus and SBE 4). The SBE 9 plus 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	Gas Chromatograph
Generic Instrument Name	Gas Chromatograph
Dataset-specific Description	Others are chromatographed to separate O2 and Ar from N2
Generic Instrument Description	Instrument separating gases, volatile substances, or substances dissolved in a volatile solvent by transporting an inert gas through a column packed with a sorbent to a detector for assay. (from SeaDataNet, BODC)

Dataset-specific Instrument Name	Finnigan DeltaPlus XP mass spectrometer
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Approximately half the samples are analyzed using a Finnigan DeltaPlus XP mass spectrometer for measurement of O2/N2/Ar as well as d18O of O2 and d15N of N2
Generic Instrument Description	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

Dataset-specific Instrument Name	Finnigan MAT 252 mass spectrometer
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Others are chromatographed to separate O2 and Ar from N2, followed by analysis of O2/Ar and the triple isotope composition of O2 using a Finnigan MAT 252 mass spectrometer.
Generic Instrument Description	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

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	Pump - surface underway ship intake
Generic Instrument Name	Pump - Surface Underway Ship Intake
Dataset-specific Description	Discrete samples were also collected from the underway seawater line near the EIMS instrument.
Generic Instrument Description	The 'Pump-underway ship intake' system indicates that samples are from the ship's clean water intake pump. This is essentially a surface water sample from a source of uncontaminated near-surface (commonly 3 to 7 m) seawater that can be pumped continuously to shipboard laboratories on research vessels. There is typically a temperature sensor near the intake (known as the hull temperature) to provide measurements that are as close as possible to the ambient water temperature. The flow from the supply is typically directed through continuously logged sensors such as a thermosalinograph and a fluorometer. Water samples are often collected from the underway supply that may also be referred to as the non-toxic supply. Ideally the data contributor has specified the depth in the ship's hull at which the pump is mounted.

[table of contents | back to top]

Deployments

RB-08-02

Website	https://www.bco-dmo.org/deployment/57846
Platform	NOAA Ship Ronald H. Brown
Report	http://bcodata.whoi.edu/SO-GasEx/SO_GasEx_Cruise_Report.pdf
Start Date	2008-02-29
End Date	2008-04-12
Description	The Southern Ocean GasEx experiment was conducted aboard the NOAA ship Ronald H. Brown with 31 scientists representing 22 institutions, companies and government labs. The cruise departed Punta Arenas, Chile on 29 February, 2008 and transited approximately 5 days to the nominal study region at 50°S, 40°W in the Atlantic sector of the Southern Ocean. The scientific work concentrated on quantifying gas transfer velocities using deliberately injected tracers, measuring CO2 and DMS fluxes directly in the marine air boundary layer, and elucidating the physical, chemical, and biological processes controlling air-sea fluxes with measurements in the upper-ocean and marine air. The oceanic studies used a Lagrangian approach to study the evolution of chemical and biological properties over the course of the experiment using shipboard and autonomous drifting instruments. The first tracer patch was created and studied for approximately 6 days before the ship was diverted from the study site, 350 miles to the south, to wait near South Georgia Island for calmer seas. After more than 4 days away, we returned to the study area and managed to find some remnants of the tracer patch. After collecting one final set of water column samples and recovering the two drifting buoys deployed with the patch, we relocated to the northwest, closer to the area where the first patch was started. A second tracer patch was created and studied for approximately 15 days before we had to break off the experiment and transit to Montevideo, Uruguay for the completion of the cruise.

[table of contents | back to top]

Project Information

Southern Ocean Gas Exchange Experiment (SO_GasEx)

Website: http://so-gasex.org/

Coverage: Southwest Atlantic sector of the Southern Ocean (nominally at 50°S, 40°W, near South Georgia Island)

The Southern Ocean Gas Exchange Experiment (SO-GasEx; also known as GasEx III) took place in the Southwest Atlantic sector of the Southern Ocean (nominally at 50°S, 40°W, near South Georgia Island) in austral fall of 2008 (February 29-April 12, 2008) on the NOAA ship *Ronald H. Brown*. SO-GasEX is funded by NOAA, NSF and NASA.

The research objectives for Southern Ocean GasEx are to answer the following questions:

- What are the gas transfer velocities at high winds?
- What is the effect of fetch on the gas transfer?
- How do other non-direct wind effects influence gas transfer?
- How do changing pCO2 and DMS levels affect the air-sea CO2 and DMS flux, respectively in the same locale?
- Are there better predictors of gas exchange in the Southern Ocean other than wind?
- What is the near surface horizontal and vertical variability in turbulence, pCO2, and other relevant biochemical and physical parameters?
- How do biological processes influence pCO2 and gas exchange?
- Do the different disparate estimates of fluxes agree, and if not why?
- With the results from Southern Ocean GasEx, can we reconcile the current discrepancy between model based CO2 flux estimates and observation based estimates?

Related files

SO-GasEx cruise report
SO-GasEx Science Plan
SO-GasEx Implementation Plan

The SO-GasEx cruise report and Science and Implementation plans, may also be available at the SO-GasEx science Web page.

[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.

United States Surface Ocean Lower Atmosphere Study (U.S. SOLAS)

Website: http://www.us-solas.org/

Coverage: Global

The Surface Ocean Lower Atmosphere Study (SOLAS) program is designed to enable researchers from different disciplines to interact and investigate the multitude of processes and interactions between the coupled ocean and atmosphere.

Oceanographers and atmospheric scientists are working together to improve understanding of the fate, transport, and feedbacks of climate relevant compounds, and also weather and hazards that are affected by processes at the surface ocean.

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Physical, chemical, and biological research near the ocean-atmosphere interface must be performed in synergy to extend our current knowledge to adequately understand and forecast changes on short and long time frames and over local and global spatial scales.

The findings obtained from SOLAS are used to improve knowledge at process scale that will lead to better quantification of fluxes of climate relevant compounds such as CO2, sulfur and nitrogen compounds, hydrocarbons and halocarbons, as well as dust, energy and momentum. This activity facilitates a fundamental understanding to assist the societal needs for climate change, environmental health, weather prediction, and national security.

The US SOLAS program is a component of the International SOLAS program where collaborations are forged with investigators around the world to examine SOLAS issues ubiquitous to the world's oceans and atmosphere.

Â» International SOLAS Web site

Science Implementation Strategy Reports

US-SOLAS (4 MB PDF file)
Other SOLAS reports are available for download from the US SOLAS Web site

[table of contents | back to top]

Funding

Funding Source	Award
National Oceanic and Atmospheric Administration (NOAA)	unknown SO_GasEx NOAA
NSF Antarctic Sciences (NSF ANT)	PLR-0636744
National Aeronautics & Space Administration (NASA)	NNX08AF12G
National Sciences and Engineering Research Council of Canada (NSERC)	328290-2006

[table of contents | back to top]