SOS-Argo floats: atmospheric pO2 data acquired in different ocean basins between May 2012 and July 2023

Website: https://www.bco-dmo.org/dataset/915289
Data Type: Other Field Results
Version: 1
Version Date: 2023-02-08

Project
» The Biological Pump in the Eastern Equatorial Pacific: in situ measurements of Oxygen and Nitrate (Biological Pump in the Equatorial Pacific)

Contributors	Affiliation	Role
Emerson, Steven R.	University of Washington (UW)	Principal Investigator, Contact
Dirks, Jonah	University of Washington (UW)	Technician
Soenen, Karen	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset contains data from Argo floats deployed by the Emerson group at the University of Washington between May 2012 and July 2023. The name SOS-Argo stands for “Special Oxygen Sensor Argo” Floats. These floats have standard Argo sensors for hydrostatic pressure, temperature, and salinity in addition to an Aanderaa oxygen sensor (optode) installed on a 61 cm stalk above the end cap of the float. The tall stalk allows the float to make atmospheric pO2 measurements uncontaminated by surface waters while the float is at the surface during data transfer to shore. The atmospheric pO2 data are used for in situ calibration of the O2 sensor against atmospheric pO2.

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Coverage

Spatial Extent: **N**:52.558 **E**:180 **S**:-59.214 **W**:-179.99
Temporal Extent: 2012-05-31 - 2023-07-13

Dataset Description

These data also appear on the University of Washington Google website (see related datasets) along with maps of the float locations and preliminary sections and figures of selected data.

Data archived here are: time, location and the partial pressure of O_2.

Methods & Sampling

The floats were deployed in different ocean basins: Northwest, Central and Eastern Pacific, Atlantic, Arabian Sea and Indian Ocean. These floats are standard Argo APEX floats with a variety of sensors in addition to those for pressure, temperature, and salinity.

Most of the data (47 floats that are called SOS-Argo floats) have an Aanderaa pO2 sensor (optode) installed on a 61 cm stalk above the end cap of the float, which allows the float to capture uncontaminated atmospheric pO2 for the purpose of in-situ calibration while the float is at the surface.

In addition to the SOS-Argo floats there are five equatorial floats with sensors for nitrate (NO3) and pH in addition to a pO2 sensor on a stalk that is 10 cm high rather than the 61 cm on the SOS-Argo floats. We refer to these floats as BGC floats (here meaning they carry a NO3 and pH sensor in addition to the standard P,T and S sensors). The numbers of these floats are 8474, 8482, 11017, 12788, 17862 and 18608; and are marked with two asterisks ** on the UW website.

There are an additional six standard Argo floats without a 61 cm optode stalk. The numbers of these floats are 12632, 12780, 12783, 12792, 18827 and 18822; and are marked with a single asterisk * on the UW webpage.

Data Processing Description

Measurements of pO2 in the air when the floats reach the surface were used calibrate the optodes against atmospheric pO2. The procedure for doing this is described in detail in the paper by Bushinski et al., 2016. Briefly, we used a two-stage process in which each optode was calibrated as a function of pO2 and temperature in the Emerson Lab. This procedure resulted in the following polynomial for pO2 as a function of temperature and optode t-phase. The “C” values are presented in "Data Files" under the “Optode calibration table”.

pO2 = (((C(5)*T+C(4))/(C(6)+C(7)*y))-1)/(C(1)+C(2)*T+C(3)*T^2)

where: T is optode temperature (deg C), y is optode t-phase (degrees), “C” values are given in the table below

Laboratory-calibrated oxygen sensors were recalibrated at sea against in situ atmospheric pO2 values calculated from NCEP reanalysis atmospheric pressure, P, and humidity, pH2O, for the float location and sampling time along with the oxygen mole fraction in air (XO2=0.20946).”

pO2 (atm) = XO2 (P – pH2O)

When the SOS-Argo float surfaced the pO2 measurements were made every two minutes for a period of one hour. Profile timing was adjusted so that the float surfaced during night time to avoid heating of the optode foil by direct exposure to the sun. Surface profile pO2 measurements were adjusted to equal the mean of the atmospheric measurements while the float was on the surface.

BCO-DMO Processing Description

* Merged data of all floats into a single dataset

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Data Files

File	
915289_v1_sosargo_atmosphericpo2.csv	(Comma Separated Values (.csv), 18.30 MB) MD5:a960002b89bf1d28b32450fc46ab9606
Primary data file for dataset ID 915289, version 1	

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Supplemental Files

File
Optode Calibration File filename: Float_Optodes_coef_table.docx (Microsoft Word document, 23.33 KB) MD5:497e3983cd79f182d3a4b29cfbc4248b

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Related Publications

Bushinsky, S. M., Emerson, S. R., Riser, S. C., & Swift, D. D. (2016). Accurate oxygen measurements on modified Argo floats using in situ air calibrations. Limnology and Oceanography: Methods, 14(8), 491–505. Portico. https://doi.org/10.1002/lom3.10107
Methods

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Related Datasets

IsRelatedTo

Dirks, J., Emerson, S. R. (2024) **SOS-Argo floats: ocean profile pO2 data acquired in different ocean basins between May 2012 and July 2023.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-01-15 doi:10.26008/1912/bco-dmo.914892.1 [view at BCO-DMO]
Relationship Description: Profile pO2 data

SOS Argo website hosted by University of Washington. The website contains all the numerical data in addition to figures with different versions of the data. https://sites.google.com/a/uw.edu/sosargo/

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Parameters

Parameter	Description	Units
Float	Float serial number	unitless
Float_Profile	Float profile number (1, 2, 3...)	unitless
Matlab_Time	Matlab time (days since Jan 1, year 0000)	unitless
Excel_Time	Excel time (days since Jan 1, 1900)	unitless
Longitude	Degrees Longitude (east is positive)	decimal degrees
Latitude	Degrees Latitude (north is positive)	decimal degrees
O2_tphase	Oxygen sensor (optode) t-phase (degrees)	degrees
O2_temp	Oxygen sensor (optode) temperature (deg C)	degrees Celsius (C)
Matlab_time_HumanReadable	Matlab time converted to human readable date notation (yyyy-mm-dd).	unitless
O2_optode	Oxygen (optode) pO2 (atmospheres)	atmospheres (atm)

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Instruments

Dataset-specific Instrument Name	SOS-Argo Float
Generic Instrument Name	drifting subsurface profiling float
Generic Instrument Description	An unmanned instrumented platform drifting freely in the water column that periodically makes vertical traverses through the water column (e.g. Argo float).

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Project Information

The Biological Pump in the Eastern Equatorial Pacific: in situ measurements of Oxygen and Nitrate (Biological Pump in the Equatorial Pacific)

Website: https://sites.google.com/a/uw.edu/sosargo/home?authuser=0

NSF Award Abstract:
In the sunlit surface waters of the world's oceans, phytoplankton combine nutrients and carbon dioxide to form organic matter and release oxygen. Some of this surface water biological production ends up in the deep ocean, resulting in a net removal of carbon from the surface ocean and atmosphere. One way to estimate this export of carbon to the deep ocean, also called the "biological pump," is by carefully measuring the amount of oxygen that is produced along with the organic matter. Oxygen dissolved in seawater can be measured very precisely by sensors that can be deployed for years at a time on instrument platforms like moorings, floats, or gliders. In this project, a team of investigators will deploy twelve floats in the equatorial Pacific Ocean to measure ocean profiles of temperature, salinity, oxygen, and nitrate (a nutrient for phytoplankton). The data will be transmitted by satellite and combine with computer models of ocean circulation to understand the biological pump in this productive area of the ocean. The project will support two early-career researchers: a graduate student and a postdoctoral research fellow.

The project will be a combination of in situ measurements of oxygen and nitrate on specially-equipped profiling floats with data interpretation using a high-resolution Global Circulation Model (GCM). The plan is to construct 12 Argo floats with specially-mounted Aanderaa Optode oxygen sensors and ISUS nitrate sensors, and to deploy them in the region between 8 degrees N and 8 degrees S from about 95 degrees W to 140 degrees W; the location where carbon export is greatest in both satellite-based and GCM-based maps of global carbon export. The data will be interpreted in terms of net biological oxygen production, which is stoichiometrically related to Annual Net Community Production (ANCP) and annual organic carbon export, using a Regional Ocean Model System (ROMS) physical transport model with a Biogeochemical Elemental Cycling (BEC)-like ecosystem. Previous NSF research has shown that it is possible to determine the air-sea pO2 difference using oxygen sensors on profiling floats to an accuracy of plus or minus 0.2 % by calibrating the sensors against atmospheric oxygen when the floats surface to transmit data to shore. Since the air-sea flux and net biological production are usually the dominant terms in the upper ocean oxygen mass balance, it has been possible to determine ANCP in subarctic and subtropical gyre locations using a one-dimensional, upper-ocean model. The goal in this project is to determine the ANCP in the strongly advective equatorial region, and compare it to carbon export values determined from satellite-based and GCM-based methods that so far have not been tested with observations.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1737080

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