Factory and field calibration data for float oxygen, beam transmission, backscatter, chlorophyll fluorescence and CDOM sensors from the Sargasso Sea from 2013-2014.

Website: https://www.bco-dmo.org/dataset/728371
Data Type: Cruise Results
Version: 1
Version Date: 2018-04-17

Project
» Rapid, Autonomous Particle Flux Observations in the Oligotrophic Ocean (RapAutParticleFlux)

Program
» Ocean Carbon and Biogeochemistry (OCB)

Contributors	Affiliation	Role
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Abstract
Optical proxy measurements of sinking particle flux and water-column bio-optical profiles were obtained from profiling floats in the Sargasso Sea to expand the number of particle flux observations in the critical and under-sampled “twilight zone”. Factory and field calibration data for dissolved oxygen, beam transmission, optical backscatter, chlorophyll fluorescence and colored dissolved organic matter sensors are provided. Float oxygen, chlorophyll fluorescence, and backscatter sensors were additionally cross-calibrated to bottle samples for oxygen, HPLC chlorophyll, and particulate organic carbon collected during concurrent Bermuda Atlantic Time-series Study (BATS) cruises prior to months-long deployment of the floats in the Sargasso Sea.

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Coverage

Spatial Extent: **N**:34.7787 **E**:-61.1357 **S**:28.3441 **W**:-69.1118
Temporal Extent: 2013 - 2014

Dataset Description

Factory and field calibration data for float oxygen, beam transmission, backscatter, chlorophyll fluorescence and CDOM sensors from the Sargasso Sea from 2013-2014.

Methods & Sampling

Multiple deployments of two Sea-Bird Scientific Navis BGCi floats (numbers F033 and F034) equipped with CTDs, transmissometers, O2 optodes, backscattering (700 nm), fluorescence (chlorophyll, colored dissolved organic matter), and tilt sensors were conducted between July 2013 and November 2014 in conjunction with Bermuda Atlantic Time-series Study cruises. Short-term deployments (1.5 – 3 days) followed by recovery of the floats were conducted during four monthly BATS cruises in July – October 2013 and one cruise in March 2014. Both floats were deployed during the July and August 2013 cruises and float F034 was deployed for the remaining cruises. Each float collected one profile per cruise with the exception of the August 2013 cruise, during which the two floats together collected 13 profiles. During short-term deployments, floats first completed an initial descent and ascent without parking, then completed 1 or 2 more profile cycles with different, consecutive target depths. Following the initial descent/ascent described above, the short-term profile cycles were structured as described below for long-term deployments. In addition to the short-term cruise deployments, F033 profiled continuously from October 2013 until early April 2014, yielding 77 profiles, and F034 profiled continuously from March 2014 until late November 2014, yielding 139 profiles. During these long-term deployments, a typical cycle consisted of 1) the descent to the target park depth, 2) a park phase at the target depth lasting 1.5 – 2.5 days during which measurements are made every 15 minutes, 3) a descent to 1000 dbar, 4) an ascent to the surface during which measurements are made, and 5) a surface telemetry phase, during which a GPS fix is obtained, data are uploaded via Iridium, and instructions for the next cycle are downloaded. During long-term deployments, floats cycled through park phases at 150/200, 300, 500, and 1000 dbar every 7 days, spending 2.5 days at 1000 dbar and 1.5 days at the shallower depths. The sequence of park phase depth at the three shallowest depths was varied between each 7-day cycle over a 21-day period to avoid aliasing in particle flux profiles.

Refer to http://www.bco-dmo.org/project/2124 or http://bats.bios.edu for a description of BATS bottle sample acquisition.

Data Processing Description

The following are factory and field determined calibration coefficients for float oxygen, beam transmission, chlorophyll fluorescence, backscatter, and CDOM sensors. Calibrated float data are presented in the 'Profile data' (https://www.bco-dmo.org/dataset/728347) and 'Park phase data' (https://www.bco-dmo.org/dataset/728335) datasets'. Float oxygen, chlorophyll fluorescence, and backscatter data were additionally calibrated to BATS bottle samples from concurrent BATS cruises. When possible, each float sample collected in profile mode was matched to the BATS bottle sample nearest in potential density that was collected within a 10-km radius and ±15-m depth window of the float location within 1 d of the float sampling time. The BATS bottle data used for float calibration are provided for reference through the 'Get Data' link at the top of this page. Original BATS bottle data are available at http://www.bco-dmo.org/project/2124 or http://bats.bios.edu.

	F033	F034
TA0	7.47E-04	7.18E-04
TA1	2.40E-04	2.49E-04
TA2	1.66E-06	8.42E-07
TA3	6.64E-08	9.26E-08
A0	1.0513	1.0513
A1	-0.0015	-0.0015
A2	0.3933	0.3432
B0	-0.2298	-0.2313
B1	1.6127	1.5647
C0	0.1018	0.1048
C1	0.0044	0.0045
C2	5.92E-05	6.20E-05

Table 1. Factory calibration coefficients for SBE 63 dissolved oxygen sensors.

Float	Cruises	Sensor	Dark	Slope
F033	B295, B296	CHL	54	0.0040
		BB700	242	1.24E-06
		CDOM	73	0.0245
F034	B295, B296	CHL	50	0.0028
		BB700	285	6.36E-07
		CDOM	-	-
F034	B297, B298, B301	CHL	48	0.0032
		BB700	245	8.17E-07
		CDOM	115	0.0122

Table 2. Factory determined scale factors and field measured dark values for float chlorophyll fluorescence, backscatter (700 nm), and colored dissolved organic matter fluorescence sensors.

		F033	F034
Cruise	Profiles	Counts	Counts
B295	all	15587	15281
B296	1,2	15587	15281
	3-8	15510	15308
	9,10	15510	-
B297	1	-	15405
	2,3	-	15357
B298	all	-	15343
B301	all	-	15343

Table 3. Transmissometer counts measured with the optical path filled with Milli-Q water prior to deployment. The dark signal is 0

BCO-DMO Data Processing Description:

-Reformatted column names to comply with BCO-DMO standards.
-Data were originally organized into multiples files and have been consolidated for display here.

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Data Files

File
bottle.csv (Comma Separated Values (.csv), 3.04 KB) MD5:86fbd8701e9dae46325933a808c51ebc Primary data file for dataset ID 728371

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Related Publications

Benson, B. B., & Krause, D. (1984). The concentration and isotopic fractionation of oxygen dissolved in freshwater and seawater in equilibrium with the atmosphere1. Limnology and Oceanography, 29(3), 620–632. doi:10.4319/lo.1984.29.3.0620
General

Bittig, H. C., Fiedler, B., Fietzek, P., & Körtzinger, A. (2015). Pressure Response of Aanderaa and Sea-Bird Oxygen Optodes. Journal of Atmospheric and Oceanic Technology, 32(12), 2305–2317. doi:10.1175/jtech-d-15-0108.1 https://doi.org/10.1175/JTECH-D-15-0108.1
General

Boss, E., & Pegau, W. S. (2001). Relationship of light scattering at an angle in the backward direction to the backscattering coefficient. Applied Optics, 40(30), 5503. doi:10.1364/ao.40.005503 https://doi.org/10.1364/AO.40.005503
General

Briggs, N., Perry, M. J., Cetinić, I., Lee, C., D'Asaro, E., Gray, A. M., & Rehm, E. (2011). High-resolution

observations of aggregate flux during a sub-polar North Atlantic spring bloom. Deep Sea Research Part I: Oceanographic Research Papers, 58(10), 1031–1039. doi:10.1016/j.dsr.2011.07.007
Methods

Estapa, M. L., Buesseler, K., Boss, E., & Gerbi, G. (2013). Autonomous, high-resolution observations of particle flux in the oligotrophic ocean. Biogeosciences, 10(8), 5517–5531. doi:10.5194/bg-10-5517-2013
Results

Garcia, H. E., & Gordon, L. I. (1992). Oxygen solubility in seawater: Better fitting equations. Limnology and Oceanography, 37(6), 1307–1312. doi:10.4319/lo.1992.37.6.1307
General

Morgan, P.P., Pender, L., (1993) SEAWATER. MATLAB Central File Exchange. Retrieved August 8, 2017. https://www.mathworks.com/matlabcentral/fileexchange/47595-mixing--mx--oceanographic-toolbox-for-em-apex-float-data
Software

Thierry, V., Bittig, H., Gilbert, D., Kobayashi, T., Kanako, S., & Schmid, C. (2016). Processing Argo oxygen data at the DAC level cookbook (Version 2.2). Ifremer. https://doi.org/10.13155/39795
General

Weiss, R. F., & Price, B. A. (1980). Nitrous oxide solubility in water and seawater. Marine Chemistry, 8(4), 347–359. doi:10.1016/0304-4203(80)90024-9
General

Xing, X., Claustre, H., Boss, E., Roesler, C., Organelli, E., Poteau, A., … D'Ortenzio, F. (2016). Correction of profiles of in-situ chlorophyll fluorometry for the contribution of fluorescence originating from non-algal matter. Limnology and Oceanography: Methods, 15(1), 80–93. doi:10.1002/lom3.10144
General

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Parameters

Parameter	Description	Units
Float_profile	Deployment number	unitless
Float_pressure	Float pressure	dbar
Float_O2	Float dissolved oxygen concentration	umol/kg
Float_chla	Float chlorophyll-a	ug/L
Float_bbp	Float particulate backscattering coefficient	m -1
Bottle_ID	BATS bottle ID number	unitless
BATS_Depth	BATS nominal depth where sample was taken	meters
BATS_O2	BATS dissolved oxygen concentration	umol/kg
BATS_chla	BATS chlorophyll-a	ug/L
BATS_POC	BATS particulate organic carbon	mg/meters cubed

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Instruments

Dataset-specific Instrument Name	SBE 41CP CTD
Generic Instrument Name	CTD Sea-Bird
Dataset-specific Description	Used for sampling
Generic Instrument Description	A Conductivity, Temperature, Depth (CTD) sensor package from SeaBird Electronics. This instrument designation is used when specific make and model are not known or when a more specific term is not available in the BCO-DMO vocabulary. Refer to the dataset-specific metadata for more information about the specific CTD used. More information from: http://www.seabird.com/

Dataset-specific Instrument Name	WET Labs MCOMS Chlorophyll Fluorometer
Generic Instrument Name	Fluorometer
Dataset-specific Description	Used for sampling
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

Dataset-specific Instrument Name	WET Labs MCOMS Scattering Meter
Generic Instrument Name	Optical Backscatter Sensor
Dataset-specific Description	Used to sample backscatter

Dataset-specific Instrument Name	SBE63 optode
Generic Instrument Name	Oxygen Sensor
Dataset-specific Description	Used to sample dissolved oxygen
Generic Instrument Description	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed

Dataset-specific Instrument Name	Transmissometer
Generic Instrument Name	Transmissometer
Dataset-specific Description	Used to measure fraction of light
Generic Instrument Description	A transmissometer measures the beam attenuation coefficient of the lightsource over the instrument's path-length. This instrument designation is used when specific manufacturer, make and model are not known.

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Deployments

Estapa_2013

Website	https://www.bco-dmo.org/deployment/682684
Platform	shoreside SargassoSea
Start Date	2013-11-19
End Date	2014-11-24

AE1320

Website	https://www.bco-dmo.org/deployment/729045
Platform	R/V Atlantic Explorer
Report	http://ezid.cdlib.org/id/doi:10.7284/903281
Start Date	2013-09-15
End Date	2013-09-21
Description	BATS cruise

AE1318

Website	https://www.bco-dmo.org/deployment/729047
Platform	R/V Atlantic Explorer
Report	http://ezid.cdlib.org/id/doi:10.7284/903360
Start Date	2013-08-01
End Date	2013-08-10
Description	BATS cruise

AE1315

Website	https://www.bco-dmo.org/deployment/729072
Platform	R/V Atlantic Explorer
Report	http://ezid.cdlib.org/id/doi:10.7284/903354
Start Date	2013-07-06
End Date	2013-07-12
Description	BATS cruise

AE1323

Website	https://www.bco-dmo.org/deployment/729043
Platform	R/V Atlantic Explorer
Report	http://ezid.cdlib.org/id/doi:10.7284/903370
Start Date	2013-10-18
End Date	2013-10-23
Description	BATs cruise

AE1402

Website	https://www.bco-dmo.org/deployment/729041
Platform	R/V Atlantic Explorer
Report	http://ezid.cdlib.org/id/doi:10.7284/903364
Start Date	2014-03-04
End Date	2014-03-08
Description	BATS cruise

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Project Information

Rapid, Autonomous Particle Flux Observations in the Oligotrophic Ocean (RapAutParticleFlux)

Coverage: Sargasso Sea

Particles settling into the deep ocean remove carbon and biologically-important trace elements from sunlit, productive surface waters and from contact with the atmosphere over short timescales. A shifting balance among physical, chemical, and biological processes determines the ultimate fate of most particles at depths between 100 and 1,000 m, where fluxes are hardest to measure. Our challenge is to expand the number of particle flux observations in the critical "twilight zone", something that has proven elusive with ship-based “snapshots” that have lengths of, at most, a few weeks. Here, we propose an optical, transmissometer-based method to make particle flux observations from autonomous, biogeochemical profiling floats. Novel developments in data interpretation, sensor operation, and platform control now allow flux measurements at hourly resolution and give us observational access to the water-column processes driving particle flux over short timescales. The sensors and float platforms that we propose to use are simple, robust, and commercially-available, making them immediately compatible with community-scale efforts to implement other float-based biogeochemical measurements.

We have two main goals: First, we will *quantify particulate organic carbon (POC) flux using float-based optical measurements* by validating our observations against fluxes measured directly with neutrally-buoyant, drifting sediment traps. Second, we will *evaluate the contribution of rapid export events to total POC fluxes in the oligotrophic ocean* by using a biogeochemical profiling float to collect nearly-continuous, depth-resolved flux measurements and coupled, water-column bio-optical profiles.

To achieve these goals, we will implement a work plan consisting of 1) a set of laboratory-based sensor calibration experiments to determine detection limits and evaluate sensitivity to particle size; 2) a series of four sediment trap and biogeochemical float co-deployments during which we will collect POC flux and field calibration data; and 3) a long-term sampling and analysis period (approximately 1 year) during which data will be returned by satellite from the biogeochemical float. We will conduct calibration fieldwork in conjunction with monthly Bermuda Atlantic Time-series Study (BATS) cruises, taking advantage of the timeseries measurements and the context provided by the 25-year record of POC flux at that site. The data returned by the float will comprise the first quantitative particle flux observations made at high-enough temporal resolution to interpret in the context of short-term, upper-ocean production events.

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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 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.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1406552

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