Biogeochemical and biological data from Niskin bottle samples from R/V Atlantic Explorer cruises AE1102, AE1118, AE1206, AE1219 in the Sargasso Sea, Bermuda Atlantic Time-Series Station from 2011-2012 (Trophic BATS project)

Website: https://www.bco-dmo.org/dataset/3951
Data Type: Cruise Results
Version: 1
Version Date: 2013-05-21

Project
» Plankton Community Composition and Trophic Interactions as Modifiers of Carbon Export in the Sargasso Sea (Trophic BATS)

Program
» Ocean Carbon and Biogeochemistry (OCB)

Contributors	Affiliation	Role
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Abstract
Biogeochemical and biological data from Niskin bottle samples from R/V Atlantic Explorer cruises AE1102, AE1118, AE1206, AE1219 in the Sargasso Sea, Bermuda Atlantic Time-Series Station from 2011-2012.

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Coverage

Spatial Extent: **N**:33.5032 **E**:-63.3235 **S**:29.5012 **W**:-65.8
Temporal Extent: 2011-02-24 - 2012-07-31

Dataset Description

Biogeochemical and biological data collected on the Trophic BATS cruises in the Sargasso Sea. Data are from 4 cruises over the span 2011-2012. The provided data are complete matrices and therefore not every sample (columns) will be taken from every Niskin fired (rows).

Methods & Sampling

Methods are summarized below. Detailed methods for all data collected as part of this study can be found in the publications arising from this study (references given below).

On each BATS cruise, aquasi-lagrangian sampling scheme is employed. An in situ primary productivity array is deployed from dawn to dusk. The biogeochemistry and biological parameters reported in this data were measured from Niskin bottle water samples.

Bacterial production was measured using [3H-methyl] thymidine incorporation and converted to carbon-based bacterial production using standard equations. Bacterial abundance was determined using DAPI stained epifluorescence microscopy. Pico-autotrophs were identified as either Synechococcus and Prochlorococcus.

Samples for NO3/NO2, NO2 and PO4 are filtered and frozen (-20 degrees C) in HDPE bottles until analysis. Total organic carbon (TOC) and total nitrogen were determined using high temperature combustion techniques. Total phosphorus concentrations are quantified using a high temperature/persulfateoxidation technique. Particulate organic carbon (POC) and nitrogen (PON) samples were filtered on precombusted Whatman GF/F filters and frozen until analysis on an elemental analyzer. Particulate phosphorus samples were analyzed using an ash-hydrolysis method with oxidation efficiency and standard recovery checks.

Sample QA/QC procedures followed those given in the associated manuscripts. At the point of collection, any leaking niskin bottles were noted on the master cast sheets and samples were taken from a different niskin fired at the same depth as the leaking bottle. No data are reported for leaking Niskin bottles. During sample analysis, certified standards, where available, were carefully examined to ensure that they were consistent with expectations for accuracy and precision. If no obvious error or problem was found, the data were considered OK and in the range of environmental data that this study hoped to observe.

Sample accuracy was assessed by using certified standards, for those measurements where standards are available. Certified standards were run with each analytical run and compared to long term control charts for respective analyses. For those analyses where there are no standards (e.g., flow cytometric cell counts) data were assessed for reasonableness based upon extensive experience of the PI's.

Detailed information on analyses:
Lomas, M.W., Burke, A., Lomas, D.A., Bell, D.W., Shen, C., Ammerman, J.W., Dyhrman, S.T. 2010. Sargasso Sea phosphorus biogeochemistry: An important role for dissolved organic phosphorus (DOP). Biogeosciences 7: 695-710. doi: 10.5194/bg-7-695-2010
Lomas, M.W., Bates, N.R., Johnson, R.J., Knap, A.H., Steinberg, D.K., Carlson, C.A. 2013. Two decades and counting: overview of 24-years of sustained open ocean biogeochemical measurements. Deep Sea Research II doi: 10.1016/j.dsr2.2013.01.008.

References:
Casey, J.R., Aucan, J.P., Goldberg, S.R., and Lomas, M.W. 2013. Changes in partitioning of carbon amongst photosynthetic pico- and nano-plankton groups in the Sargasso Sea in response to changes in the North Atlantic Oscillation. Deep Sea Research II doi: 10.1016/j.dsr2.2013.02.002

Data Processing Description

The provided data are complete matrices and therefore not every sample (columns) will be taken from every Niskin fired (rows). Data that were either not collected, or were associated with leaking Niskins, or were found to be in error for other reasons are denoted by 'nd'. Most of the data given in this dataset are not derived variables and are calculated using reasonably standard equations as given in the appropriate references. Where data are derived (e.g., bacterial carbon biomass) the appropriate reference is given in the parameter definition.

Only nutrient analyses were close to analytical method detection limits (MDL). MDLs were estimated as 3x the standard deviation of the lowest standard used for the analysis and are ~30nM for nitrate and phosphate using a standard autoanalyzer. We used the MAGIC co-precipitation method for phosphate which lowered our MDL to ~0.5nM. Samples below the MDL are reported as the MDL.

BCO-DMO Processing Notes:
- Modified parameter names to conform with BCO-DMO naming conventions.
- Replaced '-9.99' with 'nd'.

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Data Files

File
biogeochem.csv (Comma Separated Values (.csv), 410.97 KB) MD5:1727a75a85251a1595db29d11bd8cf6a Primary data file for dataset ID 3951

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Parameters

Parameter	Description	Units
cruise_id	Official cruise identifier e.g. AE1102 = R/V Atlantic Explorer cruise number 1102.	text
date	Date of operation in mm/dd/yyyy format.	unitless
cast	CTD drop number.	integer
station	Station number/name.	integer or text
lat	Latitude; positive is North.	decimal degree
lon	Longitude; positive is East.	decimal degree
julian_day	Julian day.	decimal day
time_local	Time (local).	HHMM
depth	Actual depth of niskin fire.	meters
depth_nom	Target depth of niskin fire.	meters
niskin_flag	Quality flag for the niskin bottle fire.	dimensionless
temp	Temperature measured by CTD.	degrees Celsius
sal	Salinity measured by CTD.	parts per thousand (ppt)
density	Density measured by CTD (kg m-3).	kg per cubic meter
chl_a	Chlorohyll-a measured by CTD (ug/L).	micrograms per liter
O2	O2 measured by CTD (umol/kg).	micromoles per kilogram
beam	Beam attenuation (1/m).	reciprocal meters
chla_tot_whole	Total chlorophyll-a (ug/L).	micrograms per liter
chla_tot_gt5um	Chlorophyll-a (ug/L); fraction greater than 5 um.	micrograms per liter
bact_prod	Small volume bacterial production measured by thymidine incorporation (pmol Thy L-1 h-1)	pmol Thy per liter per hour
bact_prod_C	Bacterial thymidine production converted to C units using conversions in Carlson et al. 1996 (mgC m-3 d-1).	milligrams C per cubic meter per day

bact_abund	Bacterial abundance by DAPI staining and epifluorescent counting (cells/mL).	cells per milliliter
bact_POC	Bacterial abundance converted to C units using factors in Carlson et al. 1996 (ug/L).	micrograms per liter
prochlorococcus	Prochlorococcus abundance by flow cytometry (cells/mL).	cells per milliliter
synechococcus	Synechococcus abundance by flow cytometry (cells/mL).	cells per milliliter
peuks	Picoeukaryote abundance by flow cytometry (cells/mL).	cells per milliliter
neuks	Nanoeukaryote abundance by flow cytometry (cells/mL).	cells per milliliter
prochlor_POC_per_cell	Average particulate organic carbon (POC) content of Prochlorococcus cells derived from POC vs. flow cytometry based forward angle light scatter (Casey et al. 2013); fg/cell.	femtograms C per cell
synecho_POC_per_cell	Average particulate organic carbon (POC) content of Synechococcus cells derived from POC vs. flow cytometry based forward angle light scatter (Casey et al. 2013); fg/cell	femtograms C per cell
peuks_POC_per_cell	Average particulate organic carbon (POC) content of picoeukaryotes derived from POC vs. flow cytometry based forward angle light scatter (Casey et al. 2013); fg/cell.	femtograms C per cell
neuks_POC_per_cell	Average particulate organic carbon (POC) content of nanoeukaryotes derived from POC vs. flow cytometry based forward angle light scatter (Casey et al. 2013); fg/cell.	femtograms C per cell
prochlor_POC	POC (umol/L) for the entire Prochlorococcus population, calculated as POC per cell times cell abundance.	micromoles per liter
synecho_POC	POC (umol/L) for the entire Synechococcus population, calculated as POC per cell times cell abundance.	micromoles per liter
peuks_POC	POC (umol/L) for the entire picoeukaryote population, calculated as POC per cell times cell abundance.	micromoles per liter
neuks_POC	POC (umol/L) for the entire nanoeukaryote population, calculated as POC per cell times cell abundance.	micromoles per liter
NO3_NO2	Combined nitrate and nitrite concentrations by AutoAnalyzer (umol/L).	micromoles per liter
NO2	Nitrite concentration by AutoAnalyzer (umol/L).	micromoles per liter
PO4	Phosphate concentration by AutoAnalyzer (umol/L).	micromoles per liter
SiOH4	Silicate concentration by AutoAnalyzer (umol/L).	micromoles per liter
PO4_MAGIC	High sensitivity phosphate concentration by MAGIC method (umol/L).	micromoles per liter
POC	Particulate organic carbon concentration (umol/L).	micromoles per liter
PON	Particulate organic nitrogen concentration (umol/L).	micromoles per liter
POP	Particulate organic phosphorus concentration (umol/L).	micromoles per liter
TOC	Total organic carbon concentration (umol/L).	micromoles per liter

TON	Total organic nitrogen concentration (umol/L).	micromoles per liter
TDP	Total dissolved phosphorus concentration concentration (umol/L).	micromoles per liter

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Instruments

Dataset-specific Instrument Name	CHN Elemental Analyzer
Generic Instrument Name	CHN Elemental Analyzer
Dataset-specific Description	A CE440 CHN elemental analyzer was used to measure POC and PON.
Generic Instrument Description	A CHN Elemental Analyzer is used for the determination of carbon, hydrogen, and nitrogen content in organic and other types of materials, including solids, liquids, volatile, and viscous samples.

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	Nutrient Autoanalyzer
Generic Instrument Name	Nutrient Autoanalyzer
Dataset-specific Description	TechniconAAII and AlpkemFSIV autoanalyzers were used to determine nitrate, nitrite, silicate, and phosphate.
Generic Instrument Description	Nutrient Autoanalyzer is a generic term used when specific type, make and model were not specified. In general, a Nutrient Autoanalyzer is an automated flow-thru system for doing nutrient analysis (nitrate, ammonium, orthophosphate, and silicate) on seawater samples.

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Deployments

AE1102

Website	https://www.bco-dmo.org/deployment/58672
Platform	R/V Atlantic Explorer
Start Date	2011-02-23
End Date	2011-03-07
Description	This cruise was the first in a series of four cruises planned to study the trophic interactions and particle export during the winter season in the Sargasso Sea. The researchers focused on several sampling locations including an anticyclonic eddy, slope waters of the eddy, and repeated visits to the Bermuda Atlantic Time Series (BATS) study site. The research focus for the cruise included phytoplankton production, microzooplankton grazing, mesozooplankton grazing and particle export. This process cruise was designed to quantify stocks and rate processes in the Sargasso Sea food web. Work entailed CTD casts, over the stern deployment of in situ primary production arrays and surface tethered sediment traps. Until 26 November 2012 this cruise was identified by BIOS and R2R as AE-X1101. On 26 November 2012, the cruise ID was corrected to AE1102. Original cruise data are available from the NSF R2R data catalog

AE1118

Website	https://www.bco-dmo.org/deployment/58934
Platform	R/V Atlantic Explorer
Start Date	2011-07-22
End Date	2011-08-04
Description	AE1118 was a process cruise aboard the R/V Atlantic Explorer to quantify stocks and rate processes in the Sargasso Sea food web. This was the second in a series of cruises for the Trophic BATS project. On each cruise, sampling was conducted at three stations: the center and edge of a mesoscale eddy and at one station outside of the eddy. Core CTD casts to ~2000 meters and pre-dawn 'Productivity' CTD casts were made at each station. Original cruise data are available from the NSF R2R data catalog.

AE1206

Website	https://www.bco-dmo.org/deployment/58935
Platform	R/V Atlantic Explorer
Start Date	2012-03-14
End Date	2012-03-23
Description	AE1206 was the third in a series of four cruises for the Trophic BATS project. On each cruise, sampling was conducted at three stations: the center and edge of a mesoscale eddy and at one station outside of the eddy. Core CTD casts to ~2000 meters and pre-dawn 'Productivity' CTD casts were made at each station. Cruise information and original data are available from the NSF R2R data catalog.

AE1219

Website	https://www.bco-dmo.org/deployment/58936
Platform	R/V Atlantic Explorer
Start Date	2012-07-19
End Date	2012-07-31
Description	AE1219 was the final cruise in a series of four for the Trophic BATS project. On each cruise, sampling was conducted at three stations: the center and edge of a mesoscale eddy and at one station outside of the eddy. Core CTD casts to ~2000 meters and pre-dawn 'Productivity' CTD casts were made at each station. Cruise information and original data are available from the NSF R2R data catalog.

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Project Information

Plankton Community Composition and Trophic Interactions as Modifiers of Carbon Export in the Sargasso Sea (Trophic BATS)

Coverage: Sargasso Sea, BATS site

Fluxes of particulate carbon from the surface ocean are greatly influenced by the size, taxonomic composition and trophic interactions of the resident planktonic community. Large and/or heavily-ballasted phytoplankton such as diatoms and coccolithophores are key contributors to carbon export due to their high sinking rates and direct routes of export through large zooplankton. The potential contributions of small, unballasted phytoplankton, through aggregation and/or trophic re-packaging, have been recognized more recently. This recognition comes as direct observations in the field show unexpected trends. In the Sargasso Sea, for example, shallow carbon export has increased in the last decade but the corresponding shift in phytoplankton community composition during this time has not been towards larger cells like diatoms. Instead, the abundance of the picoplanktonic cyanobacterium, Synechococccus, has increased significantly. The trophic pathways that link the increased abundance of Synechococcus to carbon export have not been characterized. These observations helped to frame the overarching research question, "How do plankton size, community composition and trophic interactions modify carbon export from the euphotic zone". Since small phytoplankton are responsible for the majority of primary production in oligotrophic subtropical gyres, the trophic interactions that include them must be characterized in order to achieve a mechanistic understanding of the function of the biological pump in the oligotrophic regions of the ocean.

This requires a complete characterization of the major organisms and their rates of production and consumption. Accordingly, the research objectives are: 1) to characterize (qualitatively and quantitatively) trophic interactions between major plankton groups in the euphotic zone and rates of, and contributors to, carbon export and 2) to develop a constrained food web model, based on these data, that will allow us to better understand current and predict near-future patterns in export production in the Sargasso Sea.

The investigators will use a combination of field-based process studies and food web modeling to quantify rates of carbon exchange between key components of the ecosystem at the Bermuda Atlantic Time-series Study (BATS) site. Measurements will include a novel DNA-based approach to characterizing and quantifying planktonic contributors to carbon export. The well-documented seasonal variability at BATS and the occurrence of mesoscale eddies will be used as a natural laboratory in which to study ecosystems of different structure. This study is unique in that it aims to characterize multiple food web interactions and carbon export simultaneously and over similar time and space scales. A key strength of the proposed research is also the tight connection and feedback between the data collection and modeling components.

Characterizing the complex interactions between the biological community and export production is critical for predicting changes in phytoplankton species dominance, trophic relationships and export production that might occur under scenarios of climate-related changes in ocean circulation and mixing. The results from this research may also contribute to understanding of the biological mechanisms that drive current regional to basin scale variability in carbon export in oligotrophic gyres.

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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-1030149

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