Biology from R/V Oceanus cruises OC399-03, OC408-01, OC408-02 from the Northwestern Sargasso Sea roughly 35-28N and 58-68W, water depths always exceeded 4200m; 2004-2005 (NP project)

Website: https://www.bco-dmo.org/dataset/3217
Version: 07Dec2009
Version Date: 2009-12-07

Project
» New Production During Winter Convective Mixing Events (NP)

Contributors	Affiliation	Role
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Dataset Description

New Production - Biology Data

Methods & Sampling

Detailed methods for all data collected as part of this study can be found in one of the three publications arising from this study (references given below). This contains information on analytical machines and certified standards where applicable.

Sample QA/QC procedures followed those of the Bermuda Atlantic Time-series Study (BATS). 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 standard curves and/or certified standards were carefully examined to ensure that they were consistent with expectations and accurate. Next, data were plotted as depth profiles and compared to a quality control window for the February/March period at BATS. The QC window consisted of the upper and lower 95% confidence limits based upon all data collected at BATS during February/March from 1989-2005. If our data fell well within these bounds it was considered 'acceptable'. For those data that fell near or outside the QC window, we went back to the original data run to ensure there was no miscalculation or other error. If nothing was found, then we examined other data from that niskin to see if other samples are in question. If no obvious error or problem was found, the data were considered OK and in the range of extremes that this study hoped to observe.

Sample accuracy and precision. Sample accuracy was assessed by using certified standards, for those measurements where standards are available (dissolved oxygen, nutrients, salinity, dissolved inorganic and organic carbon). Certified standards were run with each analytical run and compared to long term control charts for respective analyses. Samples were not run until certified standards were shown to be accurate for that analytical run. Sample precision was determined by analyzing replicate samples (not replicate analyses on the same sample) and therefore is higher than analytical precision due to the inclusion of sampling error. At the concentrations observed during this study, sample precision was <5% for stock measurements and <10-15% for rate measurements. Some analyses, namely dissolved oxygen and salinity, were much better and often had a sample precisions <1%. These precision estimates are consistent with the long term QA/QC seen with the BATS program.

The provided data files 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" in the spreadsheets.

References:

Detailed information on phytoplankton analysis.
Lomas, M.W., Roberts, N., Lipschultz, F., Krause, J.W., Nelson, D.M., and Bates, N.R. 2009. Biogeochemical responses to late-winter storms in the Sargasso Sea. IV. Rapid succession of major phytoplankton groups.
Deep Sea Research I, 56: 892-909.
doi:10.1016/j.dsr.2009.03.004

Detailed information on all silica cycle measurements.
Krause, J.W., Nelson, D.M., and Lomas, M.W. 2009. Biogeochemical responses to late-winter storms in the Sargasso Sea. 2009. II. Increased rates of biogenic silica production and export.
Deep Sea Research I, 56: 861-875.
doi:10.1016/j.dsr.2009.01.002

Maiti, K., Benitez-Nelson, C.R., Lomas, M.W., and Krause, J. W. 2009. Biogeochemical responses to late-winter storms in the Sargasso Sea. IV. Comparison of Export Production by 234Th and Sediment Traps.
Deep Sea Research I, 56: 875-892.
doi:10.1016/j.dsr.2009.01.008

Detailed information on general biogeochemical measurements.
Lomas, M.W., Lipschultz, F., Nelson, D.M., and Bates, N.R. 2009. Biogeochemical responses to late-winter storms in the Sargasso Sea. I. Pulses of new and primary production.
Deep Sea Research I, 56: 843-861.
doi:10.1016/j.dsr.2008.09.002

Data Processing Description

Most of the data given in this dataset are not derived variables and are calculated using reasonably standard equations as given in the appropriate reference above. The one exception is CTD data. Raw CTD data were processed using SBE-Data Processing software using configuration and calibration files provided by the Shipboard Science technician. Sensors were calibrated shortly before each cruise, however, most sensor data were 'calibrated' using data collected in this project. Manual determinations of dissolved oxygen, salinity and HPLC Chlorophyll a, once passing the above QA/QC steps, were taken as correct. CTD sensor data was regressed against the appropriate manual variable. In all cases save 1, regression statistics were very strong and linear, and represent an offset (y-intercept) and drop in sensitivity (slope of the regression). CTD data were corrected to manual measurements using the regression data and it is this corrected data that is given in the associated data files. OCE399-3 had a problem with the dissolved oxygen sensor that could not be resolved so only manual oxygen data are reported for that cruise.

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 1.5nM for nitrate and nitrite using a standard autoanalyzer with a 1m fiber optic flow cell, ~20nM for phosphate on a standard autoanalyzer,
and <100nM for Si(OH)4 by manual analysis and a 10cm cuvette. Samples below the MDL are reported as calculated
for the reason that they somewhere between the MDL and a true zero; we consider listing them as either to be incorrect. Carbon productivity rate measurements, particularly at the base of the euphotic or below, on occasion are negative due to subtraction of the dark incubated sample from the light incubated sample. This was not considered below the MDL because there is a reasonable explanation for negative values. These measurements were ~14h deployments and it is possible that at very low light there can be less 14C in the light bottles due to grazing, than in the dark bottles that are subtracted from the light bottles. Moreover, light and dark respiration rates are not the same and therefore this correction is not a perfect correction for inherent respiration by the autotrophs.

BCO-DMO Edits
- Parameter names modified to conform to BCO-DMO convention
- CruiseId, date, time, lat, lon added from event log
- NOTE: OC408-2 Station 62 is CTD Out date, time, lat, lon (no posit for CTD In)
- OC408-2, Station 67 latitude corrected from 13 to 31 degs

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Data Files

File
Biology.csv (Comma Separated Values (.csv), 562.13 KB) MD5:962ba08605981b37cf300658466a7e8b Primary data file for dataset ID 3217

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Parameters

Parameter	Description	Units
CruiseId	Cruise Id	text
station	CTD drop number	integer
date	date operation occurred (GMT)	YYYYMMDD
time	time operation occurred (GMT)	HHMM
lon	Longitude position (West is negative)	decimal degrees
lat	Latitude position (South is negative)	decimal degrees
Niskin	Niskin bottle number	integer
depth	depth where Niskin was fired	meters
Fluor_Chl	CTD Chlorophyll a	nanograms/liter
FCM_Synecho	Flowcytometer Synechococcus counts	cells/milliliter
FCM_Prochloro	Flowcytometer Prochlorococcus counts	cells/milliliter
FCM_Picoeuks	Flowcytometer Picoeukaryote counts	cells/milliliter
FCM_gt_3umEuks	Flowcytometer >3um Eukaryote counts	cells/milliliter
Chl_c3	HPLC Chlorophyll c3	nanograms/liter
Chl_c2	HPLC Chlorophyll c2	nanograms/liter
Chl_c1	HPLC Chlorophyll c1	nanograms/liter
Chlide_a	HPLC Chlorophyllide a	nanograms/liter
Phide_a	HPLC Phaeophorbide	nanograms/liter
Perid	HPLC Peridinin	nanograms/liter
Butan_fucox	HPLC 19-Butanoyloxyfucoxanthin	nanograms/liter
Fuco	HPLC Fucoxanthin	nanograms/liter
Neo	HPLC Neoxanthin	nanograms/liter
Pras	HPLC Prasinoxanthin	nanograms/liter
Viola	HPLC Violaxanthin	nanograms/liter
Hex_fuco	HPLC 19-Hexanoyloxyfucoxanthin	nanograms/liter
Diadino	HPLC Diadinoxanthin	nanograms/liter
Allo	HPLC Alloxanthin	nanograms/liter
Diato	HPLC Diatoxanthin	nanograms/liter
Zea	HPLC Zeaxanthin	nanograms/liter
Lut	HPLC Lutein	nanograms/liter
Gyr_diester	HPLC Gyrodinium diester	nanograms/liter
Chl_b	HPLC Chlorophyll b	nanograms/liter
DV_chl_a	HPLC Divinyl Chlorophyll a	nanograms/liter
Chl_a	HPLC Chlorophyll a	nanograms/liter
Phytin_a	HPLC Phaeophytin	nanograms/liter
Caro	HPLC a+b Carotene	nanograms/liter
TChl_a	HPLC Chlorophyll a + Divinyl Chlorophyll a	nanograms/liter

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Instruments

Dataset-specific Instrument Name	CTD Seabird 911
Generic Instrument Name	CTD Sea-Bird 911
Dataset-specific Description	SBE 911+ Deck Unit and CTD Rosette
Generic Instrument Description	The Sea-Bird SBE 911 is a type of CTD instrument package. The SBE 911 includes the SBE 9 Underwater Unit and the SBE 11 Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 and SBE 11 is called a SBE 911. The SBE 9 uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 and SBE 4). The SBE 9 CTD can be configured with auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). More information from Sea-Bird Electronics.

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Deployments

OC399-03

Website	https://www.bco-dmo.org/deployment/57994
Platform	R/V Oceanus
Report	http://data.bco-dmo.org/NewProduction/NP_Cruise_report_Oceanus399-03.pdf
Start Date	2004-02-15
End Date	2004-03-15
Description	New Production During Winter Convective Mixing Events: A Missing Component of Current Estimates Cruise Summary In 2004 the New Production research group conducted a 30-day research cruise in the Sargasso Sea from February 15th to March 15th. The primary objective of this cruise was to study the biological response to the passage of winter storms. From Julian Day 66.5 to 74, we 'caught' a significant storm event and were indeed able to follow the biological response. Original cruise data are available from the NSF R2R data catalog

OC408-01

Website	https://www.bco-dmo.org/deployment/57995
Platform	R/V Oceanus
Report	http://data.bco-dmo.org/NewProduction/NP_Cruise_report_Oceanus408-1and2.pdf
Start Date	2005-02-15
End Date	2005-03-04
Description	New Production During Winter Convective Mixing Events: A Missing Component of Current Estimates Original cruise data are available from the NSF R2R data catalog

OC408-02

Website	https://www.bco-dmo.org/deployment/57996
Platform	R/V Oceanus
Report	http://data.bco-dmo.org/NewProduction/NP_Cruise_report_Oceanus408-1and2.pdf
Start Date	2005-02-15
End Date	2005-03-16
Description	New Production During Winter Convective Mixing Events: A Missing Component of Current Estimates Note the break in the cruise was due to the loss of the CTD. Returned to Bermuda to pick up a spare CTD that had been flown in from WHOI. Original cruise data are available from the NSF R2R data catalog

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Project Information

New Production During Winter Convective Mixing Events (NP)

Website: http://www.bios.edu/Labs/pel/Research%20Pages/Research_NP.html

Coverage: Northwestern Sargasso Sea roughly 35-28N and 58-68W. Water depths always exceeded 4200m

New Production During Winter Convective Mixing Events: A Missing Component of Current Estimates

Daily biogeochemical data collected during winter convection in the Sargasso Sea.

Photosynthetic uptake of CO_2 by oceanic phytoplankton and the export of the resulting organic carbon to the deep sea comprise a 'biological pump' (Volk and Hoffert, 1985), capable of extracting globally significant amounts of CO_2 from the atmosphere. As a consequence, it is important from the perspective of the global carbon cycle to understand both the present efficiency and the main controlling mechanisms of this important carbon pathway. In the open ocean the biological pump is driven by new production of organic matter (production supported by externally supplied nutrients) and export of that organic matter to depth. Many methods have been employed to estimate new production, with varying degrees of agreement.

In the Sargasso Sea, for example, geochemical estimates of new production largely exclude the winter mixing period (because their fundamental assumption are valid only during stratified periods). Biological methods suggest that the pre-stratification period can be as important, in terms of new production, as the remainder of the year. Those biological estimates are poorly constrained and based on sparse data. Because of the enormous spatial extent of subtropical gyres similar to the Sargasso Sea, uncertainty in the rate of new production and organic matter export in those systems leads to large uncertainty in biologically-driven carbon fluxes at the global-scale.

Short-term stochastic events are increasingly recognized as being disproportionately important for biogeochemical cycling and carbon storage in the ocean. Recent data suggest that in the Sargasso Sea, the passage of weather fronts leads to increased new production during the winter mixing period. We hypothesize that these events lead to enhanced NO_3-input, followed by a rapid biological response and accumulation of biomass, and an equally rapid export of that biomass. This rapid export may be systematically missed by the 3-4 day particle trap deployments of the Bermuda Atlantic Time-series Study (BATS) because they are hypothesized to happen during or immediately after the passage of frontal systems, when the vessel used for the BATS sampling program does not leave port. Such events have, however, been captured as increases in the fluorometer traces at the Bermuda Testbed Mooring (BTM) and increases in organic carbon flux in the continuous Ocean Flux Program (OFP) sediment traps, both of which are deployed in the Sargasso Sea near Bermuda

We propose a process-oriented study of new production and its control during the period before formation of the seasonal thermocline in the BATS/BTM/OFP region near Bermuda. This study will be conducted during two 30-day cruises (one in 2004 and one in 2005) during the winter mixing period when the passage of these fronts is most common and when few data are available to constrain new production estimates. It will be crucial for this study to sample from a fully weather-capable research vessel, which can stay out and continue operations through most winter storms. We will use direct measurements of NO3-entrainment, NO3-uptake, phytoplankton community structure change, and dissolved and particulate organic matter export to elucidate the linkages between new production and export production as well as determine the main biological responses to short-term physical forcing. Particular emphasis will be placed on biogeochemically critical phytoplankton groups such as diatoms and coccolithophorids, which can exploit transiently favorable conditions of the kind we hypothesize to occur in late winter/early spring and which play a disproportionately large role in organic-matter export in many systems.

An understanding of ocean function is no longer important just to practicing ocean scientists. This project will provide information critical for biogeochemical modelers seeking to constrain future predictions of changes in the oceanic biological pump, and will also provide information of interest to students, teachers and the general public.

If in fact a significant, and previously unmeasured, amount of new production occurs in subtropical gyres during the winter mixing period, then biological processes in the central oceans play a greater role in the global carbon cycle - including regulation of atmospheric CO2 - than we recognize at present. Regardless of whether or not our study shows that this is the case, we will explain the results and their implications to graduate and undergraduate courses through the teaching programs at BBSR and OSU, to high-school and elementary-school teachers through a targeted teacher-training program at BBSR and to the broader public in seminars and other public presentations.

Related files

OC399-3 Cruise Report
OC408-1,2 Cruise Report

References:
Detailed information on phytoplankton analysis.
Lomas, M.W., Roberts, N., Lipschultz, F., Krause, J.W., Nelson, D.M., and Bates, N.R. 2009. Biogeochemical responses to late-winter storms in the Sargasso Sea. IV. Rapid succession of major phytoplankton groups.
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