Carbon and nitrogen flux measurements from the Sargasso Sea from 2013-2014.

Website: https://www.bco-dmo.org/dataset/728383
Data Type: Other Field 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
Nearly-continuous, optical sediment trap proxy measurements of particle flux were obtained in the Sargasso Sea over nearly a year by a beam transmissometer mounted vertically on quasi-Lagrangian profiling floats. Fluxes measured directly with neutrally-buoyant, drifting sediment traps co-deployed with the floats during a series of five BATS cruises prior to this year-long deployment provide a calibration for the float-based optical measurements. A well-correlated, positive relationship (R2=0.66, n=15) exists between the optical flux proxy and the particulate carbon flux measured directly using NBSTs.

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Coverage

Spatial Extent: **N**:34.7787 **E**:-61.1357 **S**:28.3441 **W**:-69.1118
Temporal Extent: 2013-07-05 - 2014-03-04

Dataset Description

Carbon and nitrogen flux measurements from R/V Atlantic Explorer AE1315, AE1318, AE1320, AE1323, AE1402.

Methods & Sampling

Particle flux measurements and images of settled particles were obtained from neutrally-buoyant sediment trap (NBST) deployments during a series of five short cruises in conjunction with the Bermuda Atlantic Time-series Study (BATS) in the Sargasso Sea from July 2013 to March 2014. The NBST platforms were constructed around Sounding Oceanographic Lagrangian Observer (SOLO) profiling floats and carried four sediment trap tubes with areas of 0.0113 m2 (see http://www.bco-dmo.org/instrument/632). NBSTs were programmed to descend to a single measurement depth (150, 200, 300 or 500 m), sample for a 2–3 d period, and then ascend to the surface for recovery. Details are described fully in Durkin et al. (2015) and Estapa et al. (2017).

To preserve settling particulate matter for carbon analysis, three trap tubes were filled with filtered seawater from beneath the mixed layer and 500 mL of formalin-poisoned brine was then added to the bottom through a tube. After trap recovery and a settling period of >1 h, the upper seawater layer was siphoned off each tube and the lower brine layer was drained through a 350-µm screen to separate the sinking fraction from zooplankton presumed to have actively entered the trap (Lamborg et al., 2008; Owens et al., 2013). Owens et al. (2013) found no significant difference between wet-picked and screened trap samples collected over multiple seasons at BATS. The <350-µm and screened zooplankton fractions were filtered onto separate, precombusted GF/F filters, immediately frozen at -20°C, dried overnight at 45 ± 5°C on shore, and analyzed for total carbon (TC) and total nitrogen (TN) content via combustion elemental analysis (note that particulate inorganic carbon fluxes at the BATS site are typically low, on average 5% of TC at 150 m; Owens et al., 2013). One TC and TN measurement was made per trap tube. One additional trap tube was identically prepared and processed, but was kept covered in the ship's lab during the deployment period to serve as a process blank.

A fourth tube on each NBST was loaded with a polyacrylamide gel insert to preserve sizes and shapes of settling particles for imaging. Polyacrylamide gel layers were prepared in 11-cm diameter polycarbonate jars using methods described in previous studies (Ebersbach and Trull, 2008; Lundsgaard, 1995; McDonnell and Buesseler, 2010) with slight modifications. To prepare 12% polyacrylamide gel, 7.5 g of sea salts was dissolved into 400 mL of surface seawater from Vineyard Sound, MA, USA and filtered through a 0.2-µm polycarbonate filter. The filtered brine was boiled for 15 min to reduce the oxygen content and reduce the brine volume to 350 mL. The solution was bubbled with nitrogen gas through glass pipet tips attached to a pressurized tank while the solution cooled to room temperature. The container of brine was then placed in an ice bath on a stir plate and 150 mL of 40% acrylamide solution and 1 g of ammonium persulfate was added to the solution while stirring. After the ammonium persulfate dissolved, 1 mL of tetramethylethylenediamine was added to catalyze polymerization. Gels were stored at 4°C until use. Prior to deployment, a jar containing a layer of polyacrylamide gel was fitted to the bottom of the trap tube and the tube was filled with filtered seawater. Upon recovery and a settling period of >1 h, the overlying seawater was pumped down to the top of the gel jar and the gel insert was removed and stored at 4°C until analysis. One additional gel trap tube was identically prepared and processed, but was kept covered in the ship's lab during the deployment period to serve as a process blank.

A series of photomicrographs was taken of each gel trap at 7×, 16×, and 63× magnifications using an Olympus SZX12 stereomicroscope with an Olympus Qcolor 5 camera attachment and QCapture imaging software. At a magnification of 7×, 49–67% of the gel surface area was imaged in 16–22 fields of view (0.1 pixels per µm) in a single focal plane. At 16×, 17–38% of the gel surface area was imaged in randomly distributed fields of view (0.236 pixels per µm) across the entire gel surface. At this magnification, a single focal plane could not capture every particle within one field of view; large particles typically accumulated toward the bottom of the gel layer and relatively small particles were distributed in more focal planes throughout the gel layer. To reduce the underestimation of small particle abundance, two images were taken from different focal planes in each field of view (27–60 fields, 54–120 images). At 63×, 0.5–0.8% of the total gel surface area was imaged (12–20 fields of view). Images were taken in cross-sections spanning the diameter of the gel. The purpose of imaging a small percentage of the gel at high magnification was to accurately quantify the abundance of small particles. Between 11 and 15 focal planes were imaged in each field of view (0.746 pixels per µm), depending on the depth of the gel and how many distinct focal planes contained particles. Imaging the same particle twice within one field of view was avoided by ensuring that focal planes did not include overlapping particles. Between 132 and 220 images were captured of each gel at 63× magnification. By imaging at three magnifications, between 240 and 360 images were captured of each gel. Image files are named as 'month_trapdepth_magnification_fieldofview_focalplane.tiff', with field of view represented as sequential integers and focal plane represented as sequential letters. Recognizable zooplankton, presumed to have actively entered the gel traps, were also counted manually in 40 fields of view per gel at 32× magnification.

Flux measurements and images are not available at 200 m for the July 5, 2013 deployment due to failure of the lid closure mechanisms on all tubes. Occasionally a single tube sample was compromised during collection or

analysis and only two replicate flux measurements are reported.

Data Processing Description

BCO-DMO Data Processing Description:

-Reformatted column names to comply with BCO-DMO standards.
-Reformatted date to yyyy/mm/dd

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Data Files

File
NBST_flux.csv (Comma Separated Values (.csv), 1.94 KB) MD5:88b351d0342e2b39e4ec129ea23cedd9 Primary data file for dataset ID 728383

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Related Publications

Durkin, C. A., Estapa, M. L., & Buesseler, K. O. (2015). Observations of carbon export by small sinking particles in the upper mesopelagic. Marine Chemistry, 175, 72–81. doi:10.1016/j.marchem.2015.02.011
Results
,
Methods

Ebersbach, F., & Trull, T. W. (2008). Sinking particle properties from polyacrylamide gels during the KErguelen Ocean and Plateau compared Study (KEOPS): Zooplankton control of carbon export in an area of persistent natural iron inputs in the Southern Ocean. Limnology and Oceanography, 53(1), 212–224. doi:10.4319/lo.2008.53.1.0212
Methods

Estapa, M., Durkin, C., Buesseler, K., Johnson, R., & Feen, M. (2017). Carbon flux from bio-optical profiling floats: Calibrating transmissometers for use as optical sediment traps. Deep Sea Research Part I: Oceanographic Research Papers, 120, 100–111. doi:10.1016/j.dsr.2016.12.003
Results
,
Methods

Jackson, G. A., Maffione, R., Costello, D. K., Alldredge, A. L., Logan, B. E., & Dam, H. G. (1997). Particle size spectra between 1 µm and 1 cm at Monterey Bay determined using multiple instruments. Deep Sea Research Part I: Oceanographic Research Papers, 44(11), 1739–1767. doi:10.1016/s0967-0637(97)00029-0
Methods

Lamborg, C. H., Buesseler, K. O., Valdes, J., Bertrand, C. H., Bidigare, R., Manganini, S., Pike, S., Steinberg. D., Trull, T.,& Wilson, S. (2008). The flux of bio- and lithogenic material associated with sinking particles in the mesopelagic "twilight zone" of the northwest and North Central Pacific Ocean. Deep Sea Research Part II: Topical Studies in Oceanography, 55(14-15), 1540–1563. doi:10.1016/j.dsr2.2008.04.011
Methods

Lundsgaard, C. (1995) Use of a high viscosity medium in studies of aggregates.In S. Floderus, A.-S. Heisakanen, M. Oleson and P. Wassman, [eds.], Proceedings of the Symposium on Seasonal Dynamics of Planktonic Ecosystems and Sedimentation in Coastal Nordic Waters. Finnish Environment Agency. 211 p.
Methods

McDonnell, A. M. P., & Buesseler, K. O. (2010). Variability in the average sinking velocity of marine particles. Limnology and Oceanography, 55(5), 2085–2096. doi:10.4319/lo.2010.55.5.2085
Methods

R Development Core Team. 2008. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, http://www.R-project.org.
Methods

S.A., O., K.O., B., C.H., L., J., V., M.W., L., R.J., J., … D.A, S. (2013). A new time series of particle export from neutrally buoyant sediments traps at the Bermuda Atlantic Time-series Study site. Deep Sea Research Part I: Oceanographic Research Papers, 72, 34–47. doi:10.1016/j.dsr.2012.10.011
Methods

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Parameters

Parameter	Description	Units
deploy_date	Date of deployment; yyyy/mm/dd	unitless
depth	The nominal depth of the NBST. During the July 2013 deployment the NBSTs were programmed to hold depth within +/-25 m of the measurement depth while in subsequent deployments this band was narrowed to +/-10 m.	meters
deploy_lat	Latitude of the deployment	decimal degrees
deploy_lon	Longitude of the deployment	decimal degrees
recover_lat	Latitude of the point of recovery	decimal degrees
recover_lon	Longitude of the point of recovery	decimal degrees
deploy_length	Days between deployment of NBST and tube lid closure	days
no_replicates	Number of tubes averaged to obtain mean TC and TN flux measurements at a single depth	number
TC_f	Total carbon flux of the sinking fraction operationally defined as particles <350 um. The carbon measured in all process blanks from the five cruises was averaged to determine the mean process blank in sediment trap tubes for the field program (0.11 +/-0.2 mg C). This mean process blank was subtracted from the total carbon measured in each trap sample, and the result was divided by the trap collection area (0.0113 m^2) and the deployment length to yield flux. Reported fluxes are the mean of measurements from 2 or 3 tubes.	milligrams of carbon per square meter per day

TC_f_err	Total carbon flux error; Uncertainties are propagated from the standard deviation of the process blanks from the five cruises (0.2 mg C) and the standard deviation or range of the two or three TC measurements per NBST deployment: TC_f_err = (STD tubes^2 + STD blanks^2)^1/2 / deployment length / trap area; For depths with only two replicate analyses the range of the TC fluxes measured in each tube is used in place of STDtubes in the above equation.	milligrams of carbon per square meter per day
N_f	Total nitrogen flux of the sinking fraction operationally defined as particles <350 um. The nitrogen measured in all process blanks from the five cruises was averaged to determine the mean process blank in sediment trap tubes for the field program (0.015 +/- 0.006 mg N). This mean process blank was subtracted from the total nitrogen measured in each trap sample and the result was divided by the trap collection area (0.0113 m^2) and the deployment length to yield flux. Reported fluxes are the mean of measurements from 2 or 3 tubes.	milligrams of nitrogen per square meter per day
N_f_err	Total nitrogen flux error; Uncertainties are propagated from the standard deviation of the process blanks from the five cruises (0.006 mg N) and the standard deviation or range of the two or three TN measurements per NBST deployment. TN_f_err = (STD tubes^2 + STD blanks^2)^1/2 / deployment length / trap area; For depths with only two replicate analyses the range of the TN fluxes measured in each tube is used in place of STDtubes in the above equation.	milligrams of nitrogen per square meter per day
TC_f_swimmer	Total carbon flux of the >350-um screened fraction presumed to be zooplankton that actively entered the trap. Calculated as for 'total carbon flux' above using a >350-um process blank of 0.05 +/- 0.04 mg C.	milligrams of carbon per square meter per day
TC_f_err_swimmer	Swimmer total carbon flux error; Calculated for the >350-um screened fraction as for 'total carbon flux error' above using a >350-um process blank standard deviation of 0.04 mg C.	milligrams of carbon per square meter per day
N_f_swimmer	Total nitrogen flux of the >350-um screened fraction presumed to be zooplankton that actively entered the trap. Calculated as for 'total nitrogen flux' above using a >350-um process blank of 0.005 +/- 0.003 mg N.	milligrams of nitrogen per square meter per day
N_f_err_swimmer	Swimmer total nitrogen flux error; Calculated for the >350-um screened fraction as for 'total nitrogen flux error' above using a >350-um process blank standard deviation of 0.003 mg N.	milligrams of nitrogen per square meter per day

A	Flux particle size distribution magnitude and slope parameters (parameter names ‘A’, ‘B’): Particles imaged in each gel at the same magnification were identified, enumerated and measured using an analysis macro created using ImageJ software. Using this macro, images were processed by 1) converting images to greyscale, 2) removing background, 3) adjusting brightness/contrast to a consistent degree, 4) thresholding using the “Intermodes” technique, 5) filling holes, and 6) measuring particles. Particles imaged from the same field of view but different focal planes were grouped together and the equivalent spherical diameter (ESD) of each particle was calculated based on the measured two-dimensional surface area. Particles were divided into 26 base-2, log-spaced size classes ranging from 1 um to 8192 um based on their ESD. Counting error was calculated as the square root of the number of particles counted in each size category. Size classes with 4 or fewer counted particles (≥50% error) were excluded from analysis. The abundance of particles in each size bin was calculated by normalizing the number of particles counted by the size bin width and by the percentage of the gel surface counted. The optimal magnification to calculate the abundance of a particle size category was defined as the magnification where the observed abundance most closely followed a power-law distribution. The abundance of 11–45 um particles was quantified at 63× magnification, the abundance of 45–128 um particles was quantified at 16× magnification, and the abundance of >128 um particles was quantified at 7× magnification. Three samples had slightly different size detection limits at each magnification and required different size ranges to quantify a power law distribution of particle abundance. For the 200-m sample collected in August, optimal particle size ranges were 11–64 um (63×), 64–90 um (16×), and >90 um (7×). For the 500-m samples collected in October and March, the optimal size ranges were 11–45 um (63×), 45–64 um (16×), and >64 um (7×). The particle abundance of all five gel trap process blanks were measured and averaged together, and the average was subtracted from the particle abundance measured in each gel trap sample. Particle number flux was calculated by dividing blank-subtracted particle abundance by the trap deployment time. The slope of each particle size distribution (B) was calculated by fitting the observations of particle number flux (Num_f) to a differential power law size distribution model (Jackson et al., 1997), $Num\_f(ESD) = A(ESDr) \times (ESD/ESDr)^{-B}$ where A(ESDr) equals the number flux of particles in the reference size category ESDr (here 300 um). B indicates the slope of the power law function; higher values have steeper slopes and a higher proportion of small particles relative to large particles. The “optim” function in R (R. Development Core Team, 2008) was used to find the least-squares, best-fit values of A(ESDr) and B describing particle number fluxes measured in each gel trap.	unitless

B	Flux particle size distribution magnitude and slope parameters (parameter names ‘A’, ‘B’): Particles imaged in each gel at the same magnification were identified, enumerated and measured using an analysis macro created using ImageJ software. Using this macro, images were processed by 1) converting images to greyscale, 2) removing background, 3) adjusting brightness/contrast to a consistent degree, 4) thresholding using the “Intermodes” technique, 5) filling holes, and 6) measuring particles. Particles imaged from the same field of view but different focal planes were grouped together and the equivalent spherical diameter (ESD) of each particle was calculated based on the measured two-dimensional surface area. Particles were divided into 26 base-2, log-spaced size classes ranging from 1 um to 8192 um based on their ESD. Counting error was calculated as the square root of the number of particles counted in each size category. Size classes with 4 or fewer counted particles (≥50% error) were excluded from analysis. The abundance of particles in each size bin was calculated by normalizing the number of particles counted by the size bin width and by the percentage of the gel surface counted. The optimal magnification to calculate the abundance of a particle size category was defined as the magnification where the observed abundance most closely followed a power-law distribution. The abundance of 11–45 um particles was quantified at 63× magnification, the abundance of 45–128 um particles was quantified at 16× magnification, and the abundance of >128 um particles was quantified at 7× magnification. Three samples had slightly different size detection limits at each magnification and required different size ranges to quantify a power law distribution of particle abundance. For the 200-m sample collected in August, optimal particle size ranges were 11–64 um (63×), 64–90 um (16×), and >90 um (7×). For the 500-m samples collected in October and March, the optimal size ranges were 11–45 um (63×), 45–64 um (16×), and >64 um (7×). The particle abundance of all five gel trap process blanks were measured and averaged together, and the average was subtracted from the particle abundance measured in each gel trap sample. Particle number flux was calculated by dividing blank-subtracted particle abundance by the trap deployment time. The slope of each particle size distribution (B) was calculated by fitting the observations of particle number flux (Num_f) to a differential power law size distribution model (Jackson et al., 1997), Num_f(ESD) = A(ESDr) × (ESD/ESDr)−B where A(ESDr) equals the number flux of particles in the reference size category ESDr (here 300 um). B indicates the slope of the power law function; higher values have steeper slopes and a higher proportion of small particles relative to large particles. The “optim” function in R (R. Development Core Team, 2008) was used to find the least-squares, best-fit values of A(ESDr) and B describing particle number fluxes measured in each gel trap.	unitless
zoop_conc	Zooplankton concentration; Recognizable zooplankton presumed to have actively entered the gel traps were counted manually in 40 fields of view at 32_ magnification on the stereomicroscope. The number of individuals counted was normalized by the percentage of gel surface counted and divided by the total surface area of the gel (0.0095 m^2).	individuals per square meter
zoop_conc_err	Zooplankton concentration error; Calculated as the square root of the number of individuals counted normalized by the percentage of gel surface counted and divided by the total surface area of the gel (0.0095 m^2).	individuals per square meter

zoop_f	Zooplankton flux; The zooplankton concentration calculated above was divided by the deployment length to yield flux.	individuals per square meter per day
zoop_f_err	Zooplankton flux error; Calculated as the square root of the number of individuals counted normalized by the percentage of gel surface counted and divided by the total surface area of the gel (0.0095 m^2) and the deployment length.	individuals per square meter per day

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Instruments

Dataset-specific Instrument Name	Combustion Elemental Analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	Used to measure TC and TN
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

Dataset-specific Instrument Name	Olympus SZX12 stereomicroscope with an Olympus Qcolor 5 camera attachment
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Used to take photomicrographs
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	NBST
Generic Instrument Name	Neutrally Buoyant Sediment Trap
Dataset-specific Description	Used to measure particles
Generic Instrument Description	In general, sediment traps are specially designed containers deployed in the water column for periods of time to collect particles from the water column falling toward the sea floor. The Neutrally Buoyant Sediment Trap (NBST) was designed by researchers at Woods Hole Oceanographic Institution. The central cylinder of the NBST controls buoyancy and houses a satellite transmitter. The other tubes collect sediment as the trap drifts in currents at a predetermined depth. The samples are collected when the tubes snap shut before the trap returns to the surface. (more: http://www.whoi.edu/instruments/viewInstrument.do?id=10286)

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Deployments

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

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

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

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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