Time series of dissolved oxygen measured on an undulating glider collected from the South Atlantic Bight (SAB) cruises along the continental shelf off Long Bay from January to April in 2012 (Long Bay Wintertime Bloom project)

Website: https://www.bco-dmo.org/dataset/636636
Data Type: Cruise Results
Version: 1
Version Date: 2016-01-26

Project
» Mechanisms of nutrient input at the shelf margin supporting persistent winter phytoplankton blooms downstream of the Charleston Bump (Long Bay Wintertime Bloom)

Contributors	Affiliation	Role
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Abstract
Two Webb Slocum gliders were used to measure salinity, temperature, and depth. Glider 'Pelagia' was deployed in Long Bay, S. Carolina, South Atlantic Bight and glider 'Ramses' was deployed along the upper slope of S. Carolina. in 2012. Data were collected in a time series from January to April, 2012. NOTE: This is a very large dataset (1.53 million records). It takes a while to serve and may not display entirely depending on your browser. You can download all the data from the Data Files section on this metadata page.

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Coverage

Spatial Extent: **N**:33.38228 **E**:-78.05085 **S**:32.33788 **W**:-78.10772
Temporal Extent: 2012-01-25 - 2012-04-04

Methods & Sampling

Time series of dissolved oxygen were measured from an undulating Webb Slocum Electric glider (serial #44, named Pelagia and serial #32, named Ramses) every few seconds by an Aandera Oxygen Optode. The glider Pelagia nominally occupied a cross-shelf transect but deviated from its prescribed course due to currents and other issues. The glider Ramses occupied a profiling station on the upper slope.

Data Processing Description

Data were read from glider stored memory after recovery. The following table documents the specific steps applied to arrive at the Level 2 (L2) dataset. The details of the corrections and calibrations that were applied can be found in the Supplemental Files (Glider_L2_DissolvedOxygen_Corrections_20150817.pdf). Glider CTD dataset is described separately.

Regular sample interval	The CTD variables (temperature, salinity, and depth) are resampled at a 3 second sample interval.
Filter the CTD's temperature and salinity	Filter the temperature and salinity (from the CTD), using cut-off frequency fc = 1/30 per second i.e. Tc = 30 seconds. Matlab filtfilt was used with a 4th order butterworth filter i.e. 4th order forward- and 4th order reverse-filtered.
Delay the CTD variables	Delay the CTD variables by 27 seconds.
Interpolate CTD data to the DO time base	The delayed CTD variables (filtered temperature, filtered salinity, and depth) are interpolated to the DO sensor's time base, which has an irregular sample interval (median approximately 3.3 seconds).
Recalculate DO output variables	The TSP-corrected oxygen concentration (o2_tspcorr) is calculated using the modified CTD data: • Temperature filtered, delayed, and interpolated • Salinity filtered, delayed, and interpolated • Depth delayed and interpolated.
Apply Calibration Curve	The calibration curve (i.e. the slope and intercept described above in the "Calibration Fix" section) is applied. So, the calibrated TSP-corrected oxygen concentration (o2_sat) is: slope*o2_tspcorr + intercept.

BCO-DMO Processing:
-extracted data from MatLab .mat files
- added conventional header with dataset name, PI name, version date, reference information
- renamed parameters to BCO-DMO standard
- added yrday_utc and ISO_DateTime_UTC to served view
- reduced number of significant digits
- change NaN's to nd's

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Data Files

File	
glider_DO.csv	(Comma Separated Values (.csv), 173.13 MB) MD5:88558881e774d6ade26135c7fdcf5af1
Primary data file for dataset ID 636636	
Dissolved Oxygen data: Pelagia deployment #3 filename: Pelagia_Deployment3_DO_L2.mat	(MATLAB Data (.mat), 16.37 MB) MD5:9de09e8063da2178c9177b270c2b0883
Dissolved Oxygen data: Ramses deployment #1 filename: Ramses_Deployment1_DO_L2.mat	(MATLAB Data (.mat), 18.24 MB) MD5:26b4b6524becb3686d2d47b8b9022f9d
Dissolved Oxygen data: Ramses deployment #2 filename: Ramses_Deployment2_DO_L2.mat	(MATLAB Data (.mat), 23.32 MB) MD5:25f9d1a204ccebc986fa00be159e4a80

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Supplemental Files

File	
Corrections and calibrations of dissolved oxygen sensor (Aanderaa Optode) data collected with gliders filename: Glider_L2_DissolvedOxygen_Corrections_20150817.pdf	(Portable Document Format (.pdf), 8.09 MB) MD5:714602d5cf21c40ad5062024df43041b
Report on correction of dissolved oxygen sensor (Aanderaa Optode) data collected with gliders during the Long Bay field program in 2012. by Steve Lockhart and Harvey Seim, August 17, 2015	

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Parameters

Parameter	Description	Units
glider_id	glider identification	unitless
lat_start	starting latitude; north is positive	decimal degrees
lon_start	starting longitude; east is positive	decimal degrees
day	day of month	1-31
month	month	1-12
year	year	yyyy
yrday_utc	year day: UTC day and decimal time; as 326.5 for the 326th day of the year or November 22 at 1200 hours (noon).	day.part of day
ISO_DateTime_UTC	Date/Time (UTC) ISO formatted standard is based on ISO 8601:2004(E) and takes on any of the following forms: 2009-08-30T14:05:00Z (UTC time)	yyyy-mm-ddTHH:MM:SSZ
hour	hour	HH
min	minute	MM
sec	seconds	SS
lat	interpolated latitude; north is positive	decimal degrees
lon	interpolated longitude; east is positive	decimal degrees
depth	interpolated CTD depth	meters
O2_sat	corrected oxygen saturation	percent
O2_corr	temperature salinity and pressure corrected dissolved oxygen	10e-6 mol/dm3

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Instruments

Dataset-specific Instrument Name	CTD Sea-Bird
Generic Instrument Name	CTD Sea-Bird
Dataset-specific Description	The CTD is a component of the Slocum glider used for this dataset.
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	GPS
Generic Instrument Name	Global Positioning System Receiver
Dataset-specific Description	GPS is a component of the Slocum glider used for this dataset.
Generic Instrument Description	The Global Positioning System (GPS) is a U.S. space-based radionavigation system that provides reliable positioning, navigation, and timing services to civilian users on a continuous worldwide basis. The U.S. Air Force develops, maintains, and operates the space and control segments of the NAVSTAR GPS transmitter system. Ships use a variety of receivers (e.g. Trimble and Ashtech) to interpret the GPS signal and determine accurate latitude and longitude.

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Deployments

SAV-12-03

Website	https://www.bco-dmo.org/deployment/58863
Platform	R/V Savannah
Start Date	2012-01-24
End Date	2012-02-02
Description	Glider deployments (Ramses and Pelagia), glider monitoring; Acrobat (towed package) surveys of 3 cross-shelf sections (25 km along-shelf spacing, mid-shelf to upper slope); CTD profiles for hydrography, bio-optical, oxygen; station sampling for chlorophyll, nutrients, flow cytometry; Deployment of 2 moorings off Georgia on return leg to SkIO (75 m and 30 m). Cruise information and original data are available from the NSF R2R data catalog.

LB_2012_Pelagia-3

Website	https://www.bco-dmo.org/deployment/544635
Platform	AUV Slocum Glider Pelagia
Start Date	2012-03-16
End Date	2012-04-04
Description	Cross-shelf transect in Long Bay off South Carolina, USA. Glider Pelagia was deployed on 2012-03-16 on SAV-12-11, and recovered on 2012-04-04 on SAV-12-14.

LB_2012_Ramses-1

Website	https://www.bco-dmo.org/deployment/544639
Platform	AUV Slocum Glider Ramses
Start Date	2012-01-26
End Date	2012-02-14
Description	CTD measurements along upper slope off South Carolina, USA. Glider Ramses was deployed on 2012-01-26 on SAV-12-03, and recovered on 2012-02-14 on SAV-12-05.

LB_2012_Ramses-2

Website	https://www.bco-dmo.org/deployment/544643
Platform	AUV Slocum Glider Ramses
Start Date	2012-02-15
End Date	2012-03-14
Description	CTD measurements along upper slope off South Carolina, USA. Glider Ramses was deployed on 2012-02-05 on SAV-02-15, and recovered on 2012-03-14 on SAV-12-11.

SAV-12-05

Website	https://www.bco-dmo.org/deployment/58864
Platform	R/V Savannah
Start Date	2012-02-13
End Date	2012-02-24
Description	Glider recoveries (Ramses, Pelagia), shipboard replacement of batteries, ballast adjustments, then both units were redeployed. Survey work was conducted using the towed Acrobat package and CTD station section from upper slope to shelf. Deck incubation experiment for primary production, station sampling for various properties. Due to gale-force winds, the ship ran into Wilmington (docked at Cape Fear Community College) on 18 February. When heading back out on 20 February for an Acrobat survey and station work, a problem with a shaft coupling forced return to Wilmington on 21 February for repair work. When repairs were completed, strong SW winds had developed and were forecast to continue for several days, so offshore work was not possible the ship returned to SkIO along the coast. Cruise information and original data are available from the NSF R2R data catalog.

SAV-12-11

Website	https://www.bco-dmo.org/deployment/58865
Platform	R/V Savannah
Start Date	2012-03-13
End Date	2012-03-22
Description	Glider recoveries (Ramses, Pelagia), then battery replacement, reballasting, redeployment (at LB2). Acrobat surveys, upper slope to outer shelf CTD surveys, station sampling for water samples and primary productivity experiments (deck incubations and 'photosynthetron'). Attempted to survey a subsurface bloom in the mid-shelf (apparently Phaeocystis). During an Acrobat survey, the tow cable failed over upper slope. The Acrobat package was located with an acoustic range-finder but was too deep for a grapple attempt. With the very mild winter, shelf conditions were already post-winter (warm water across outer to mid-shelf) and not favorable for the winter bloom formation. Given the conditions the cruise was cut short by a few days. Cruise information and original data are available from the NSF R2R data catalog.

SAV-12-14

Website	https://www.bco-dmo.org/deployment/58866
Platform	R/V Savannah
Start Date	2012-04-02
End Date	2012-04-05
Description	Recovery of moored instrument packages at LB3 (150 kHz ADCP in large TRBM pod/frame, MicroCAT, ECO FLNTU fluorometer/turbidity), LB2 (ADCP, MicroCAT, ECOFLNTU), LB1 (two moorings – ADCP; Taut-line package with HOBO T-chain [two with C], 3 ECO FLNTU units); Recovery of Ramses and Pelagia gliders; CTD section from upper slope to outer shelf (stations at 5 km intervals, LB+60 to LB+30, also at LB2 site), with samples for nutrients at selected stations/depths, some chlorophyll samples; Inter-calibration of the ECO FLNTU fluorometer/turbidity instruments after recovery of moorings (mounted on CTD/carousel for co-located sampling at two depths. This is the last CTD station). Cruise information and original data are available from the NSF R2R data catalog.

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Project Information

Mechanisms of nutrient input at the shelf margin supporting persistent winter phytoplankton blooms downstream of the Charleston Bump (Long Bay Wintertime Bloom)

Website: http://nccoos.org/projects/long-bay-wintertime-blooms/

Coverage: outer South Atlantic Bight (SAB) continental shelf off Long Bay

NSF Project Title: Mechanisms of nutrient input at the shelf margin supporting persistent winter phytoplankton blooms downstream of the Charleston Bump

Sustained phytoplankton blooms along the outer South Atlantic Bight (SAB) continental shelf off Long Bay are observed in winter in multi-year satellite chlorophyll imagery. This section of the shelf lies north of the "Charleston Bump" (between 32.5-33.5°N), where the Gulf Stream is often strongly deflected offshore. Due to this offshore deflection, this is not an area where nutrient input to the shelf would be enhanced by upwelling associated with Gulf Stream frontal eddies, a major mechanism of nutrient input in other parts of the SAB shelf (Lee et al., 1991). Yet prior in situ observations suggest that there is recurring input of nutrients from the upper slope to the outer shelf off Long Bay from winter to early spring. This project will investigate a fundamental aspect of physical-biological coupling in the outer shelf to upper slope region. The PIs will test the hypotheses that: 1) the persistence of winter blooms on the outer shelf off Long Bay results from repeated

episodes of nutrient input and mixing which maintains nutrient-sufficient conditions for extended periods; 2) several physical mechanisms are involved, including enhanced mixing energy from the internal tide along this section of the upper slope/shelf break; 3) the relatively high nutrient, intermittently turbulent environment will favor larger bloom-forming phytoplankton. The latter could have important implications for higher trophic levels, including early life history strategies of fish that spawn along the shelf margin off Long Bay in winter to early spring.

This project will combine several maturing observational technologies to address the following:

1. What is the frequency and magnitude on on-shelf transport of nitrate from the upper slope?
2. What are the mechanisms of nutrient delivery from the upper slope to the outer continental shelf zone that are operating off Long Bay under the range of hydrographic and forcing conditions encountered in winter?
3. What is the 3-D structure of outer shelf hydrography and associated winter bloom features and how do these evolve through multiple nutrient input/mixing events?
4. What are the rates of nitrate utilization and primary production associated with the winter blooms?
5. Does the winter regime consistently favor a bloom assemblage dominated by larger diatom forms?

Near-continuous cross-shelf and upper slope observations will be obtained with two autonomous gliders, time-series measurements on the outer shelf and slope from a set of moored instruments (including a moored profiling system at the shelf break), and repeated cross- and along-shelf ship surveys using a towed, undulating package. Ship station work will include measurements of primary production and on-board analyses of key functional characteristics of the phytoplankton assemblage (cell forms, abundance, size and bio-volume distributions) using a microfluidics/imaging system. In combination, these systems will provide a level of spatial and temporal resolution of physical, nutrient and biological fields that could not be achieved in earlier, station-based field studies and the basis for improved understanding of physical mechanisms of recurring nutrient input to the shelf, and how the nutrient, mixing, and circulation regime in winter structures the phytoplankton community. Coastal naturalists will be engaged through a seabird survey component of the field program that will augment existing information on pelagic seabirds in winter and define their association with oceanographic features on the central South Atlantic Bight shelf and slope.

This project will provide a deeper understanding of shelf/slope exchange processes and how these influence shelf ecosystems, generating information that will contribute to implementation of ecosystem-based management in the region.

References:
Lee, T. N., J. A. Yoder, and L. P. Atkinson, 1991: Gulf Stream frontal eddy influence on productivity of the southeast U.S. continental shelf. J. Geophys. Res, 96, 22191-22205.

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Funding

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