Vertical CTD profiles, bin-averaged, and downcast from the R/V Savannah cruises in the South Atlantic Bight (SAB) continental shelf off Long Bay (-79W, 32N; -77W, 34 N) (Long Bay Wintertime Bloom project)

Website: https://www.bco-dmo.org/dataset/554711
Version: 2015-03-30

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

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Table of Contents

- Dataset Description
  - Methods & Sampling
  - Data Processing Description
- Data Files
- Parameters
- Instruments
- Deployments
- Project Information
- Funding

Dataset Description

CTD casts were conducted in Long Bay, South Atlantic Bight, SE United States from the middle continental shelf (~ 30 m depth) to upper slope (~260 m depth). The primary cross-shelf CTD survey line was off Myrtle Beach, SC between 33.17/-78.33 and 32.76/-77.91. On cruise SAV12-03, CTD profiles were also conducted at stations on parallel cross-shelf lines ~26 km to the SW and NE of the central line.

NOT FINAL - awaiting further calibration.

Methods & Sampling

Instrument configuration of the R/V Savannah CTD/carousel water sampler:
Sea-Bird SBE 25 Sealogger CTD; Sea-Bird SBE 33 deck box; Sea-Bird SBE 32C carousel pylon; Sea-Bird SBE 43 oxygen sensor; WET Labs ECO chlorophyll fluorometer; WET Labs ECO CDOM fluorometer; WET Labs ECO BB optical backscatter sensor; LI-COR 193SA PAR sensor; Sea-Bird SBE 5P pump. The carousel was equipped with eight 8-L external-closure water sampling bottles (Ocean Test Equipment Model 110).

The instrument inventory for the ship's CTD system (including spares for all components) was managed by the ship's Marine Technician (John Bichy). Instrument calibrations were performed by manufacturers within suggested intervals. Calibration factors and calibration dates are listed in the file "ctd_con_report.txt" that accompanies the cast data files. The sampling rate for the CTD system was set at 1 Hz.

The deployment procedure included a near-surface “soak” (at least one minute) prior to profiling to allow air to be purged from tubing lines and sensors to equilibrate. The package was then lowered (descent rate of ~0.3-0.4 m/s) to a target depth, typically about 2 m above the seafloor. If desired, water samples were collected during the upcast using the carousel water sampling system. Water sample depths were selected based on the real-time profiles obtained during the downcast.

Methods Reference:

Fofonoff, N.P. and R.C. Millard, Jr, 1983. Algorithms for computation of fundamental properties of seawater. UNESCO Technical Papers in Marine Science #44.

Data Processing Description

Initial CTD data processing used the Sea-Bird data processing software package with input of the raw data file (*.hex) and associated configuration file (*.con) for each cast. Processing steps are described in the file “ctd_process.txt” that accompanies the data files. For bin-averaging, scans acquired during the initial surface “soak” period prior to profiling were removed and only the downcast was processed using 1-m bins for station depths < 100 m and 2-m bins for station depths > 100 m. The bin-averaged data was output in ASCII file format (*b.cnv). Parameter names and units for the output data files are listed above (by column).

Factory calibration factors for CTD package sensors were applied to calculate conductivity, pressure, and temperature (see “ctd_con_report.txt”). Depth was calculated from pressure using the “seawater” setting in the Sea-Bird software and density was calculated by the EOS80 equation of state for seawater (Fofonoff and Millard, 1983). Oxygen (kg/m3, % saturation), optical backscatter (1/m) and PAR (as quantum scalar irradiance, micro-mole photons / m2 s1) were calculated using the manufacturer-supplied calibration factors and algorithms included in the Sea-Bird data processing package. Chlorophyll fluorescence and CDOM fluorescence are reported here as the raw voltages (0-5 volts total signal range).

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date, reference information, replacing ctd header
- renamed some parameters to BCO-DMO standard
- created toplevel file
- added ctd metadata columns to cast data: cruise_id, cast, year, mon, day_gmt, time_gmt, lat_deg, lat_min, lon_deg, lon_min, depth, station, comment

[table of contents | back to top]

Data Files

File
ship_CTD.csv (Comma Separated Values (.csv), 1.43 MB) MD5:40c5c5cdbe352caca2d60f4a3b83043c Primary data file for dataset ID 554711

[table of contents | back to top]

Parameters

Parameter	Description	Units
cruise_id	cruise identification	unitless
year	year	yyyy
cast	cast	integer
month_gmt	GMT month	mm
day_gmt	GMT day of month	dd
time_gmt	GMT time of day; 24 hour clock	HH:MM:SS
yrday_gmt	GMT day and decimal time: e.g. 326.5 for the 326th day of the year or November 22 at 1200 hours (noon)	unitless
ISO_DateTime_UTC	Date/Time (UTC) ISO formatted	yyyy-mm-ddTHH:MM:SS[.xx]Z
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
depth_max	maximum depth of cast	meters
station	station: LB# = Middle Transect LBS# = South Transect LBN# = North Transect # = distance counter (km) starting with +00 inshore and increasing offshore	unitless
comment	comments	unitless
depth	depth	meters
temp	temperature	degrees Celsius
cond	conductivity	Siemens/meter
sal	salinity	PSU
density	seawater density	kilograms/meter^3
flvolt	voltage 0: chlorophyll fluorometer; raw output	volts
CDOM_v	voltage 1: CDOM fluorometer; raw output	volts
light_bs	voltage 2: optical backscatter meter; raw output	volts
backscatter	WETLabs backscatter; factory calibration	per meter
O2_sat	oxygen saturation	percent
O2	dissolved oxygen concentration	umol/Kg
par	PAR/Quantum Scalar Irradiance	umol photons/m^2 s^1
flag	quality flag: 0.000e+00 is ok	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	CTD
Generic Instrument Name	CTD - profiler
Dataset-specific Description	Sea-Bird SBE 25 Sealogger CTD; Sea-Bird SBE 33 deck box; Sea-Bird SBE 32C carousel pylon; Sea-Bird SBE 43 oxygen sensor; WET Labs ECO chlorophyll fluorometer; WET Labs ECO CDOM fluorometer; WET Labs ECO BB optical backscatter sensor; LI-COR 193SA PAR sensor; Sea-Bird SBE 5P pump. The carousel was equipped with eight 8-L external-closure water sampling bottles (Ocean Test Equipment Model 110).
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column. It permits scientists to observe the physical properties in real-time via a conducting cable, which is typically connected to a CTD to a deck unit and computer on a ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This term applies to profiling CTDs. For fixed CTDs, see https://www.bco-dmo.org/instrument/869934.

Dataset-specific Instrument Name	CTD SBE 25
Generic Instrument Name	CTD Sea-Bird 25
Dataset-specific Description	Sea-Bird SBE 25 Sealogger CTD
Generic Instrument Description	The Sea-Bird SBE 25 SEALOGGER CTD is battery powered and is typically used to record data in memory, eliminating the need for a large vessel, electrical sea cable, and on-board computer. All SBE 25s can also operate in real-time, transmitting data via an opto-isolated RS-232 serial port. Temperature and conductivity are measured by the SBE 3F Temperature sensor and SBE 4 Conductivity sensor (same as those used on the premium SBE 9plus CTD). The SBE 25 also includes the SBE 5P (plastic) or 5T (titanium) Submersible Pump and TC Duct. The pump-controlled, TC-ducted flow configuration significantly reduces salinity spiking caused by ship heave, and in calm waters allows slower descent rates for improved resolution of water column features. Pressure is measured by the modular SBE 29 Temperature Compensated Strain-Gauge Pressure sensor (available in eight depth ranges to suit the operating depth requirement). The SBE 25's modular design makes it easy to configure in the field for a wide range of auxiliary sensors, including optional dissolved oxygen (SBE 43), pH (SBE 18 or SBE 27), fluorescence, transmissivity, PAR, and optical backscatter sensors. More information from Sea-Bird Electronics: http:www.seabird.com.

Dataset-specific Instrument Name	CTD-fluorometer
Generic Instrument Name	CTD-fluorometer
Dataset-specific Description	WET Labs ECO chlorophyll fluorometer; WET Labs ECO CDOM fluorometer
Generic Instrument Description	A CTD-fluorometer is an instrument package designed to measure hydrographic information (pressure, temperature and conductivity) and chlorophyll fluorescence.

Dataset-specific Instrument Name	LI-COR LI-193SA PAR sensor
Generic Instrument Name	LI-COR LI-193 PAR Sensor
Generic Instrument Description	The LI-193 Underwater Spherical Quantum Sensor uses a Silicon Photodiode and glass filters encased in a waterproof housing to measure PAR (in the 400 to 700 nm waveband) in aquatic environments. Typical output is in micromol s-1 m-2. The LI-193 Sensor gives an added dimension to underwater PAR measurements as it measures photon flux from all directions. This measurement is referred to as Photosynthetic Photon Flux Fluence Rate (PPFFR) or Quantum Scalar Irradiance. This is important, for example, when studying phytoplankton, which utilize radiation from all directions for photosynthesis. LI-COR began producing Spherical Quantum Sensors in 1979; serial numbers for the LI-193 begin with SPQA-XXXXX (licor.com).

Dataset-specific Instrument Name	SBE 33
Generic Instrument Name	Sea-Bird SBE 33 Carousel Deck Unit
Generic Instrument Description	The rack-mountable SBE 33 provides power and real-time data acquisition and control for an SBE 32 Carousel Water Sampler that has the SBE 33 interface option installed in its pylon. The SBE 33 is compatible with all Carousel sizes - full size, compact, and sub-compact. When powered and controlled by the SBE 33, the Carousel can be used: - with an SBE 19, 19plus, 19plus V2, 25, 25plus, or 49 CTD - without a CTD - with a Neil Brown Mk III CTD (requires optional interface for both SBE 32 and 33) The SBE 33 can also provide power and real-time data acquisition and control for the smaller SBE 55 ECO Water Sampler used with an SBE 19, 19plus, 19plus V2, 25, 25plus, or 49 CTD, or no CTD. See http://www.seabird.com/sbe33-deck-unit for further details.

Dataset-specific Instrument Name	SBE-43 DO
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
Generic Instrument Description	The Sea-Bird SBE 43 dissolved oxygen sensor is a redesign of the Clark polarographic membrane type of dissolved oxygen sensors. more information from Sea-Bird Electronics

[table of contents | back to top]

Deployments

SAV-12-02

Website	https://www.bco-dmo.org/deployment/58862
Platform	R/V Savannah
Start Date	2012-01-18
End Date	2012-01-21
Description	Deployment of SKIO Seahorse profiler and bottom frame at LB2 (76 m); deployment of taunt line and bottom frame at LB1 (31 m); 12 CTD stations, starting at 271 m ending at 30 m. We kept a 5 km spacing from the offshore end until ~45 m. (Section run from ~1905 EST to 2320 EST on 01/19/12). Cruise information and original data are available from the NSF R2R data catalog.

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.

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.

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

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NSF Division of Ocean Sciences (NSF OCE)	OCE-1032285
NSF Division of Ocean Sciences (NSF OCE)	OCE-1032276

[table of contents | back to top]