Water column data collected during Dataflow cruises in the lower York River Estuary, VA during and following two successive harmful algal blooms

Website: https://www.bco-dmo.org/dataset/854194
Data Type: Cruise Results
Version: 1
Version Date: 2021-06-22

Project
» Alteration of carbon fluxes by intense phytoplankton blooms in a microtidal estuary (LYRE)

Contributors	Affiliation	Role
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Abstract
This dataset includes grab sample and continuous data collected during Dataflow cruises in the lower York River Estuary, VA during and following two successive harmful algal blooms in 2020.

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Coverage

Spatial Extent: **N**:37.28 **E**:-76.39 **S**:37.22 **W**:-76.53
Temporal Extent: 2020-08-11 - 2020-09-16

Methods & Sampling

High-resolution sampling via Dataflow was performed along the lower York River estuary during a *Margalefidinium polykrikoides* bloom in early August, an *Alexandrium monilatum* bloom in early September, and following disappearance of the bloom in mid-September for determinations of pCO2, salinity, temperature, pH, Chla, CDOM, turbidity, DO, and location (lat/long). Cruises were on 24ft Carolina skiffs. Concurrent with the DataFlow sampling, grab sampling was performed at 5 stations within bloom patches (as determined by levels of chlorophyll a), and at 5 stations outside of bloom patches for determinations of DIC, DOC, active Chla (extractable), nutrients (DIN, DON, DIP, DOC), TSS, and CDOM. Locations listed in the dataset were those recorded when grab samples were taken. Data shown are averages and standard errors per station.

High-resolution sampling was performed with a Dataflow system modified from Madden and Day (1992) and as described in Crosswell et al, (2017). The pCO2-DataFlow system is instrumented with a pCO2 analyzer, a multi-parameter datasonde (YSI 6600V2), Wet Labs CDOM sensor, Garmin global positioning system (GPS MAP

546S), and data acquisition system. The system continuously samples surface water (approximately every 30 m at an average speed of 20 knots) from a stern-mounted water intake located 0.5 m below the water surface with a pump, which delivers water in parallel to (1) a showerhead equilibrator and (2) a flow-through cell attached to the YSI which is configured to measure water temperature, salinity, chl-a fluorescence, DO, pH, and turbidity. pCO2 in the equilibration chamber is determined by recirculating a carrier gas at a flow of approximately 1.5 L min-1 through the equilibrator chamber and a nondispersive infrared absorbance detection analyzer (LI-COR, LI-840).

Instruments:
Laboratory analyzed CDOM and chl-a were used to calibrate in situ CDOM and chl-a measurements made during the DataFlow surveys, as described by Anderson et al. (2013). Water column analyses (NO3, NO2, NH4, PO4) were performed with a Lachat QuikChem 8000 automated ion analyzer (Lachat Instruments,Milwaukee, WI, USA); detection limits for NO3−,NH4+, and PO43− are 0.20, 0.36, and 0.16 µM, respectively. DIC was analyzed on an Apollo, model AS-C3 (Apollo SciTech, Newark DE); DOC on a Shimadzu TOC-VCSN combustion analyzer, and extracted chla on a Beckman Coulter DU800 Spectrophotometer.

Known problems/issues:
Missing pCO2 data for August 11 cruise because of instrument failure.

Data Processing Description

BCO-DMO Processing:
- changed date format to YYYY-MM-DD;
- renamed fields.

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Data Files

File
water_column_2020.csv (Comma Separated Values (.csv), 4.36 KB) MD5:2faa43d2843644322a254784d48be678 Primary data file for dataset ID 854194

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Related Publications

Anderson, I. C., Brush, M. J., Piehler, M. F., Currin, C. A., Stanhope, J. W., Smyth, A. R., … Whitehead, M. L. (2013). Impacts of Climate-Related Drivers on the Benthic Nutrient Filter in a Shallow Photic Estuary. Estuaries and Coasts, 37(S1), 46–62. doi:10.1007/s12237-013-9665-5
Methods

Crosswell, J. R., Anderson, I. C., Stanhope, J. W., Van Dam, B., Brush, M. J., Ensign, S., … Paerl, H. W. (2017). Carbon budget of a shallow, lagoonal estuary: Transformations and source-sink dynamics along the river-estuary-ocean continuum. Limnology and Oceanography, 62(S1), S29–S45. doi:10.1002/lno.10631
General

Madden, C. J., & Day, J. W. (1992). An Instrument System for High-Speed Mapping of Chlorophyll a and Physico-Chemical Variables in Surface Waters. Estuaries, 15(3), 421. doi:10.2307/1352789
Methods

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Parameters

Parameter	Description	Units
Date	date when the survey took place; format: YYYY-MM-DD	unitless
Station	sampling location from mouth up estuary; "In" represents within bloom patch; "Out" represents outside of bloom patch.	unitless
Lat	latitude of sample location	decimal degrees North
Lon	longitude of sample location	decimal degrees East
pCO2	partial pressure of CO2 in water	microatmospheres
pCO2_SE	standard error of pCO2	microatmospheres
pH	pH	unitless
pH_SE	standard error of pH	unitless
Chla	in situ chlorophyll a	micrograms per liter
Chla_SE	standard error of Chla	micrograms per liter
DO	dissolved oxygen	milligrams per liter (mg/L)
DO_SE	standard error of DO	milligrams per liter (mg/L)
DIC	dissolved inorganic carbon	milligrams per liter (mg/L)
DIC_SE	standard error of DIC	milligrams per liter (mg/L)
DOC	dissolved organic carbon	micromolar
DOC_SE	standard error of DOC	micromolar
TDN	total dissolved nitrogen	micromolar
TDN_SE	standard error of TDN	micromolar
NO3	nitrate	micromolar
NO3_SE	standard error of NO3	micromolar
NO2	nitrite	micromolar
NO2_SE	standard error of NO2	micromolar
NH4	ammonium	micromolar
NH4_SE	standard error of NH4	micromolar
DIP	dissolved inorganic phosphate	micromolar
DIP_SE	standard error of DIP	micromolar

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Instruments

Dataset-specific Instrument Name	Apollo model AS-C3
Generic Instrument Name	Apollo SciTech AS-C3 Dissolved Inorganic Carbon (DIC) analyzer
Dataset-specific Description	DIC was analyzed on an Apollo, model AS-C3 (Apollo SciTech, Newark DE)
Generic Instrument Description	A Dissolved Inorganic Carbon (DIC) analyzer, for use in aquatic carbon dioxide parameter analysis of coastal waters, sediment pore-waters, and time-series incubation samples. The analyzer consists of a solid state infrared CO2 detector, a mass-flow controller, and a digital pump for transferring accurate amounts of reagent and sample. The analyzer uses an electronic cooling system to keep the reactor temperature below 3 degrees Celsius, and a Nafion dry tube to reduce the water vapour and keep the analyzer drift-free and maintenance-free for longer. The analyzer can handle sample volumes from 0.1 - 1.5 milliliters, however the best results are obtained from sample volumes between 0.5 - 1 milliliters. It takes approximately 3 minutes per analysis, and measurement precision is plus or minus 2 micromoles per kilogram or higher for surface seawater. It is designed for both land based and shipboard laboratory use.

Dataset-specific Instrument Name	Lachat QuikChem 8000
Generic Instrument Name	Flow Injection Analyzer
Dataset-specific Description	Water column analyses (NO3, NO2, NH4, PO4) were performed with a Lachat QuikChem 8000 automated ion analyzer (Lachat Instruments, Milwaukee, WI, USA).
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	Wet Labs CDOM sensor
Generic Instrument Name	Fluorometer
Dataset-specific Description	The pCO2-DataFlow system is instrumented with a pCO2 analyzer, a multi-parameter datasonde (YSI 6600V2), Wet Labs CDOM sensor, Garmin global positioning system (GPS MAP 546S), and data acquisition system.
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

Dataset-specific Instrument Name	Garmin GPS MAP 546S
Generic Instrument Name	Global Positioning System Receiver
Dataset-specific Description	The pCO2-DataFlow system is instrumented with a pCO2 analyzer, a multi-parameter datasonde (YSI 6600V2), Wet Labs CDOM sensor, Garmin global positioning system (GPS MAP 546S), and data acquisition system.
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.

Dataset-specific Instrument Name	LI-COR, LI-840
Generic Instrument Name	LI-COR LI-840 NDIR Gas Analyzer
Dataset-specific Description	pCO2 in the equilibration chamber is determined by recirculating a carrier gas at a flow of approximately 1.5 L min-1 through the equilibrator chamber and a nondispersive infrared absorbance detection analyzer (LI-COR, LI-840).
Generic Instrument Description	The LI-COR LI-840 is specifically designed for continuous monitoring of CO2 and H2O over a wide range of environmental conditions. The LI-840 is an absolute, non-dispersive, infrared (NDIR) gas analyzer based on a single, interchangeable optical path, and a dual wavelength infrared detection system.

Dataset-specific Instrument Name	pCO2 analyzer
Generic Instrument Name	pCO2 Sensor
Dataset-specific Description	The pCO2-DataFlow system is instrumented with a pCO2 analyzer, a multi-parameter datasonde (YSI 6600V2), Wet Labs CDOM sensor, Garmin global positioning system (GPS MAP 546S), and data acquisition system.
Generic Instrument Description	A sensor that measures the partial pressure of CO2 in water (pCO2)

Dataset-specific Instrument Name	Shimadzu TOC-VCSN
Generic Instrument Name	Shimadzu TOC-V Analyzer
Dataset-specific Description	DOC was analyzed on a Shimadzu TOC-VCSN combustion analyzer.
Generic Instrument Description	A Shimadzu TOC-V Analyzer measures DOC by high temperature combustion method.

Dataset-specific Instrument Name	Beckman Coulter DU800 Spectrophotometer
Generic Instrument Name	Spectrophotometer
Dataset-specific Description	Extracted chla was analyzed on a Beckman Coulter DU800 Spectrophotometer.
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

Dataset-specific Instrument Name	YSI 6600V2
Generic Instrument Name	YSI Sonde 6-Series
Dataset-specific Description	The pCO2-DataFlow system is instrumented with a pCO2 analyzer, a multi-parameter datasonde (YSI 6600V2), Wet Labs CDOM sensor, Garmin global positioning system (GPS MAP 546S), and data acquisition system.
Generic Instrument Description	YSI 6-Series water quality sondes and sensors are instruments for environmental monitoring and long-term deployments. YSI datasondes accept multiple water quality sensors (i.e., they are multiparameter sondes). Sondes can measure temperature, conductivity, dissolved oxygen, depth, turbidity, and other water quality parameters. The 6-Series includes several models. More from YSI.

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Project Information

Alteration of carbon fluxes by intense phytoplankton blooms in a microtidal estuary (LYRE)

Coverage: York River Estuary, Virginia

NSF Award Abstract:
Estuaries, coastal water bodies where rivers mix with ocean water, are hotspots for the processing of carbon and nutrients moving from land to the coastal ocean. Within estuaries land-based nutrient inputs can cause intense blooms of single-celled algae called phytoplankton, which can have significant impacts on the ecosystem. As blooms move down-estuary some of the phytoplankton material is buried on the bottom, and some is decomposed, resulting in low oxygen conditions (hypoxia), harmful to marine life, and production of carbon dioxide (CO2), the major greenhouse gas, which can exchange with the atmosphere. The remaining phytoplankton material can be exported to the ocean. The type and amount of carbon exported from the estuary depend both on its biological activity and physical factors such as fresh water discharge, temperature, and light availability. If phytoplankton production is greater than decomposition, the estuary will take up atmospheric CO2 and export phytoplankton carbon to the coastal ocean. On the other hand, if decomposition is greater than production the estuary will be a source of CO2 to the atmosphere and dissolved CO2 to the coastal ocean. The investigators expect that intense phytoplankton blooms will greatly amplify carbon exchanges with the atmosphere, coastal ocean, and bottom sediments. As intense phytoplankton blooms increase in the future due to increased nutrient inputs and temperature, low oxygen events may become more frequent with potential negative impacts on fisheries and increased export of carbon to the coastal ocean and atmosphere. This study will fill critical gaps identified by the Coastal Carbon Synthesis Program in knowledge of how microtidal estuaries transform and export C to the atmosphere, benthos, and coastal ocean. In addition, there will be a strong teaching and training component to this project, with support for graduate and undergraduate students. The graduate student will be partnered with secondary teachers to gain teaching

experience and enrich the middle school educational programs. Summer undergraduate interns will be recruited for a summer program from Hampton University, a historically Black college. There will be public outreach through participation in existing programs at VIMS.

Estuaries serve as critical hotspots for the processing of carbon (C) as it transits from land to the coastal ocean. Recent attempts to synthesize what is known about sources and fates of C in estuaries have noted large data gaps; thus, the role of estuaries, especially those that are microtidal, as important sources of carbon dioxide (CO2) to the atmosphere and total organic carbon (TOC) and dissolved inorganic carbon (DIC) to the coastal ocean, or as a C sink in bottom sediments, remains uncertain. Intensive phytoplankton blooms are becoming increasingly frequent in many estuaries and are likely to have important and yet unknown impacts on the C cycle. The trophic status of an estuary will determine in large part the species of C exported to the atmosphere, bottom sediments, and coastal ocean. The overarching objective of this project is to identify the impacts of intense phytoplankton blooms on C speciation, net C fluxes and exchanges in the Lower York River Estuary (LYRE), a representative mesotrophic, microtidal mid-Atlantic estuary. Metabolic processes are hypothesized to be spatially and temporally dynamic, driving the speciation, abundance, and fates of C in the LYRE. High spatiotemporal resolution sampling in the LYRE will capture rates of C cycling under both baseline conditions throughout most of the year, and during periods when the estuary is perturbed by widespread and intense, but patchy, late summer phytoplankton blooms. The short-term effects of physical drivers (wind, temperature, salinity, fresh water discharge, nutrient and organic carbon loads) and biological drivers (metabolic rates, bacterial and phytoplankton abundances and composition) on C transformations, speciation, and exchanges will be assessed. Expected longer term variations in the C cycle due to anthropogenic and natural disturbances will be predicted through use of modeling. In addition, laboratory manipulations will examine the impacts of specific organisms dominating intensive phytoplankton blooms on benthic metabolism, processing of organic C by the microbial community, and C fluxes to the water column.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1737258

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