Watershed concentrations of dissolved inorganic carbon, dissolved organic carbon, and particulate organic carbon in the York River Estuary sampled in 2019-2021.

Website: https://www.bco-dmo.org/dataset/962507
Data Type: Other Field Results
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Project
» Alteration of carbon fluxes by intense phytoplankton blooms in a microtidal estuary (LYRE)

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Abstract
We measured the concentrations of dissolved inorganic carbon (DIC), dissolved organic carbon (DOC), and particulate organic carbon (POC) at four stations in the Pamunkey and Mattaponi Rivers, the main freshwater sources to the York River Estuary (YRE), approximately monthly from April 2019 to December 2019, and on selected dates during 2020 and 2021 to capture a wide range of discharge conditions. Sampling locations included the USGS non-tidal gauging stations above the fall line on each river, and a station in the tidal fresh region of each river, approximately halfway between the gauges and the confluence of the two rivers at the head of the YRE. Samples were collected to assess variation in each carbon species with freshwater discharge, changes in concentrations in the tidal fresh zone of the estuary, and carbon loading to the YRE.

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Coverage

Location: York River Estuary, 37°20'53.99"N, 76°38'7.67"W
Spatial Extent: **N**:37.88375 **E**:-77.0254 **S**:37.57818 **W**:-77.33184
Temporal Extent: 2019-04-03 - 2021-03-02

Methods & Sampling

Three of the four stations were accessed by land. The two USGS gauge sites (Pamunkey Gauge, PG; Mattaponi Gauge, MG) were sampled by lowering a bucket from the bridges crossing the rivers at the gauge locations. The other site (Walkerton Landing Bridge, WLB) was sampled from a floating dock. The White House station (WH) was not accessible from the road; this station is a long-term monitoring site of the Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERRVA) and was sampled for us by CBNERRVA staff. Sample dates were the same except for two dates when WH was sampled one day before or after the other sites. Samples were collected from the surface at all stations. Water temperature and salinity were measured in the field with a YSI EXO2 datasonde. Carbon samples were collected in triplicate and filtered immediately in the field at PG, MG, and WLB; samples from WH were kept on ice and returned to the lab for filtration. DIC samples were filtered through 0.2 um polycarbonate filters into 8-mL hungate tubes and refrigerated underwater until analysis on an Apollo SciTech AS-C3 analyzer coupled to a LI-COR LI-7000 infrared gas analyzer. DOC samples were filtered through 0.45 um polyethersulfone filters and frozen prior to analysis on a Shimadzu TOC-V organic carbon analyzer. POC samples were filtered onto pre-combusted 0.7 um glass fiber filters, dried at 60°C, and stored in a dessicator prior to analysis. Beginning in August 2019, samples were fumed with HCl to remove any inorganic carbon. Samples through June 2019 were measured on a Thermo 1110 CHN Analyzer; subsequent samples were measured on a Costech 4010 CHN Analyzer. A series of blank filters were also measured to correct for background POC concentrations.

Data Processing Description

DIC, DOC, and POC were sampled in triplicate at each station; this dataset reports means and standard errors.

BCO-DMO Curation Notes

* Converted Date column to ISO format (YYYY-MM-DD)
* Renamed parameters to comply with database requirements (no spaces, periods or special characters)
* Converted NaN values to blanks
* Served displayed excel values with exception to lat/lon values, after discussion with submitter were processed with a precision of 6 decimal numbers.

Problem Description

Samples were not collected at the tidal fresh stations (WH, WLB) on three dates (2/10/2020, 8/8/2020, and 2/20/2021). The two February dates were opportunistically chosen to capture exceptionally large rain events in the watershed and there was not time to coordinate sampling at WH, so we focused on the gauging stations. Similarly the August date was opportunistically chosen to capture the effects of Hurricane Isaias.

POC samples were not fumed with HCl to remove inorganic carbon prior to August 2019. In that month, paired samples were run with and without fuming. The ratio of POC concentrations in fumed samples to those in unfumed samples varied by station, but the overall average was 0.82. Users may wish to apply this correction to samples prior to August 2019.

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Data Files

File	
962507_v1_carbon_csv.csv	(Comma Separated Values (.csv), 5.01 KB) MD5:03fa84fe0c5e8a6ca27639163f9a3a53
Primary data file for dataset ID 962507, version 1	

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Parameters

Parameter	Description	Units
Station	Station code (see Methods for full names)	unitless
Lat	Latitude	decimal degrees
Long	Longitude	decimal degrees
Date	Sampling date	unitless
Temp	Water temperature in degrees Celcius	degrees Celsius (°C)
Salinity	Water salinity	practical salinity units (PSU)
DIC_uM	Dissolved inorganic carbon concentration	micromoles per liter (umol/l)
DIC_se	Standard error of DIC replicates	micromoles per liter (umol/l)
DOC_uM	Dissolved organic carbon concentration	micromoles per liter (umol/l)
DOC_se	Standard error of DOC replicates	micromoles per liter (umol/l)
POC_mgl	Particulate organic carbon concentration	milligrams per liter (mg/l)
POC_se	Standard error of POC replicates	milligrams per liter (mg/l)

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Instruments

Dataset-specific Instrument Name	Apollo SciTech AS-C3
Generic Instrument Name	Apollo SciTech AS-C3 Dissolved Inorganic Carbon (DIC) analyzer
Dataset-specific Description	DIC concentrations were measured on an Apollo SciTech AS-C3 analyzer coupled to a LI-COR LI-7000 infrared gas analyzer.
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	LI-COR LI-7000
Generic Instrument Name	LI-COR LI-7000 Gas Analyzer
Dataset-specific Description	DIC concentrations were measured on an Apollo SciTech AS-C3 analyzer coupled to a LI-COR LI-7000 infrared gas analyzer.
Generic Instrument Description	The LI-7000 gas analyzer is a differential, single source, non-dispersive, infrared gas analyzer. It has two solid state detectors, one each for CO2 and H2O, filters at 4.255 microns and 2.595 microns respectively. CO2 is measured in the range 0-3000ppm, with an accuracy of 1 percent nominally. H2O is measured in the range 0-60 mmol per mol, with an accuracy of one 1 percent.

Dataset-specific Instrument Name	Thermo 1110 CHN Analyzer
Generic Instrument Name	Particulate Organic Carbon/Nitrogen Analyzer
Dataset-specific Description	POC concentrations through June 2019 were measured on a Thermo 1110 CHN analyzer.
Generic Instrument Description	A unit that accurately determines the carbon and nitrogen concentrations of organic compounds typically by detecting and measuring their combustion products (CO2 and NO).

Dataset-specific Instrument Name	Costech 4010 CHN Analyzer
Generic Instrument Name	Particulate Organic Carbon/Nitrogen Analyzer
Dataset-specific Description	POC concentrations after June 2019 were measured on a Costech 4010 CHN analyzer.
Generic Instrument Description	A unit that accurately determines the carbon and nitrogen concentrations of organic compounds typically by detecting and measuring their combustion products (CO2 and NO).

Dataset-specific Instrument Name	Shimadzu TOC-V organic carbon
Generic Instrument Name	Shimadzu TOC-V Analyzer
Dataset-specific Description	DOC concentrations were measured on a Shimadzu TOC-V organic carbon analyzer.
Generic Instrument Description	A Shimadzu TOC-V Analyzer measures DOC by high temperature combustion method.

Dataset-specific Instrument Name	YSI EXO2
Generic Instrument Name	YSI EXO multiparameter water quality sondes
Dataset-specific Description	Water temperature and salinity were measured with a YSI EXO2 datasonde.
Generic Instrument Description	Comprehensive multi-parameter, water-quality monitoring sondes designed for long-term monitoring, profiling and spot sampling. The EXO sondes are split into several categories: EXO1 Sonde, EXO2 Sonde, EXO3 Sonde. Each category has a slightly different design purpose with the EXO2 and EXO3 containing more sensor ports than the EXO1. Data are collected using up to four user-replaceable sensors and an integral pressure transducer. Users communicate with the sonde via a field cable to an EXO Handheld, via Bluetooth wireless connection to a PC, or a USB connection to a PC. Typical parameter specifications for relevant sensors include dissolved oxygen with ranges of 0-50 mg/l, with a resolution of +/- 0.1 mg/l, an accuracy of 1 percent of reading for values between 0-20 mg/l and an accuracy of +/- 5 percent of reading for values 20-50 mg/l. Temp ranges are from-5 to +50 degC, with an accuracy of +/- 0.001 degC. Conductivity has a range of 0-200 mS/cm, with an accuracy of +/-0.5 percent of reading + 0.001 mS/cm and a resolution of 0.0001 - 0.01 mS/cm.

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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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