Louisiana shelf water column production and respiration measured by change in oxygen in light and dark bottle incubations during four cruises in 2017

Website: https://www.bco-dmo.org/dataset/896385
Data Type: Cruise Results
Version: 1
Version Date: 2023-05-24

Project
» Collaborative Research: A RAPID response to Hurricane Harvey's impacts on coastal carbon cycle, metabolic balance and ocean acidification (HarveyCarbonCycle)

Contributors	Affiliation	Role
Lehrter, John	University of South Alabama; and Dauphin Island Sea Lab (USA-DISL)	Principal Investigator
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Abstract
These data include the measurements of oxygen, temperature, and salinity from incubations to measure rates of oxygen production in the light by primary production and oxygen consumption in the dark by community respiration. Data were collected during four cruises in 2017 during April, July, September and October. The September and October cruises followed the landfall of Hurricane Harvey. Cruises were conducted aboard the R/V Pelican in April (PE17-18), July (PE18-02), and October (PE18-11) and aboard the R/V Acadiana (AC18-12) in September. The study domain included the Louisiana and Texas continental shelf from the Mississippi River Bird's Foot delta to south of Galveston Bay. The objective of this work was to quantify how hurricanes and tropical storms affect metabolic rates and the concentrations of oxygen and DIC/pH. These data assess the water column response in metabolism before and after Hurricane Harvey and were collected by Dr. John Lehrter of the University of South Alabama.

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Coverage

Spatial Extent: **N**:29.6994 **E**:-88.5999 **S**:27.4998 **W**:-95.3041
Temporal Extent: 2017-04-06 - 2017-10-11

Methods & Sampling

Samples for plankton community respiration (WR) measurements were collected from several depths in the water column including the surface layer, the bottom layer, the layer at depth of chlorophyll maximum, midwater oxygen maximum, and midwater oxygen minimum. For each sample collected, three transparent (light) glass bottles and three dark glass bottles were filled directly from the ship's Niskin bottle array (Murrell and Lehrter, 2011). Aliquots were put into acid-cleaned 300 milliliter BOD (biochemical oxygen demand) bottles for light-dark incubation experiments. After initial O_2 measurements were taken (T0), samples were placed in a darkened incubator that maintained surface water temperatures using water supplied continuously from the ship's hull pump. Light bottle treatments were incubated in an outdoor incubator with screening that reduced ambient light by 50%. Dark bottle treatments were also placed in the outdoor incubator but were kept dark by their black liners and caps.

For more detailed methods see Murrell et al. (2013) and Murrell and Lehrter (2011).

Concentrations of O_2 were measured initially and after 24 hours using a Hach or YSI oxygen sensor and temperature probe. Salinity values for each sample were obtained from the ship's CTD (SeaBird 911). Net primary production rates were calculated as the change in O_2 over time in light bottles screened at 50% of ambient sunlight and incubated for 24 hours, expressed in units of millimoles oxygen per cubic meter per day (mmol O_2 m^{-3} d^{-1}). Respiration rates were calculated as the change in O_2 over time in dark bottles incubated for 24 hours, expressed in units of millimoles oxygen per cubic meter per day (mmol O_2 m^{-3} d^{-1}).

Problem report: Some of the incubation bottles had their caps come off during incubations. These values are labeled as NAN (not a number) in the dataset.

Note: Dissolved oxygen data were recorded in mg/L for the April 2017 cruise and in percent saturation for the July and September cruises.

Data Processing Description

Please see the Supplemental Files section for equations in more easily readable format, along with a brief summary of the method for light and dark bottle oxygen assay to measure primary production and respiration

Net primary production, respiration, and gross primary production calculations
Rates were adjusted to initial temperatures using the Arrhenius equation and initial and final temperatures.

Variables:

- NPP is Net Primary Production
- R is Respiration
- GPP is Gross Primary Production
- NPP_T is Temperature adjusted net primary production
- R_T is Temperature adjusted respiration
- GPP_T is Temperature adjusted gross primary production
- DO_Light is the dissolved oxygen concentration in the light bottles
- DO_Dark is the dissolved oxygen concentration in the dark bottles
- TF = time final
- T0 = time initial

Equations: *(see Supplemental Files section)*
NPP = (DO_Light_TF - DO_Light_T0)/(TF - T0)
R = (DO_Dark_TF - DO_Dark_T0)/(TF - T0)
GPP = NPP - R
NPP_T = NPP*2^((T_T0 - T_TF)./10)
R_T = R*2^((T_T0 - T_TF)./10)
GPP_T = GPP*2^((T_T0 - T_TF)./10)

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Data Files

File	
production_respiration.csv	(Comma Separated Values (.csv), 78.03 KB) MD5:a755199ea3a38340282865ca676a8619
Production and respiration data from light and dark bottle incubations from Louisiana shelf water column	

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Supplemental Files

File	
Rate_calculations_NPP_Resp_GPP.pdf	(Portable Document Format (.pdf), 365.45 KB) MD5:5c20e22c354418d991976a73c6732425
Net primary production, respiration, and gross primary production methods and rate calculations	

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Related Publications

Murrell, M. C., & Lehrter, J. C. (2011). Sediment and Lower Water Column Oxygen Consumption in the Seasonally Hypoxic Region of the Louisiana Continental Shelf. Estuaries and Coasts, 34(5), 912–924. https://doi.org/10.1007/s12237-010-9351-9
Methods

Murrell, M. C., Stanley, R. S., Lehrter, J. C., & Hagy, J. D. (2013). Plankton community respiration, net ecosystem metabolism, and oxygen dynamics on the Louisiana continental shelf: Implications for hypoxia. Continental Shelf Research, 52, 27–38. https://doi.org/10.1016/j.csr.2012.10.010
Methods

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Parameters

Parameter	Description	Units
Cruise	Cruise identification	unitless
Station	Station identification	unitless
Layer	Depth layer of water sample where S=surface, B=bottom, Chla max=midwater chlorophyll a maximum layer, O2 max=midwater oxygen maximum, or O2 min=midwater oxygen minimum	unitless
Latitude	Latitude of sample collection	decimal degrees
Longitude	Longitude of sample collection	decimal degrees

Sample_Collection_Date_Time	Date and time of sample collection in UTC	unitless
Depth_Bottom	Depth of the bottom	meters
Bottle_Number	Sample bottle number from Niskin bottle array	unitless
Bottle_sampling_depth	Sampling depth of Niskin bottle	meters
Salinity	Salinity from CTD sensor	psu
DO_Light_1_T0	Initial dissolved oxygen concentration in Light bottle replicate 1	milligram per liter (mg/L) or percent saturation
DO_Light_2_T0	Initial dissolved oxygen concentration in Light bottle replicate 2	milligram per liter (mg/L) or percent saturation
DO_Light_3_T0	Initial dissolved oxygen concentration in Light bottle replicate 3	milligram per liter (mg/L) or percent saturation
DO_Dark_1_T0	Initial dissolved oxygen concentration in Dark bottle replicate 1	milligram per liter (mg/L) or percent saturation
DO_Dark_2_T0	Initial dissolved oxygen concentration in Dark bottle replicate 2	milligram per liter (mg/L) or percent saturation
DO_Dark_3_T0	Initial dissolved oxygen concentration in Dark bottle replicate 3	milligram per liter (mg/L) or percent saturation
T_Light_1_T0	Initial temperature of Light bottle replicate 1	degrees Celsius
T_Light_2_T0	Initial temperature of Light bottle replicate 2	degrees Celsius
T_Light_3_T0	Initial temperature of Light bottle replicate 3	degrees Celsius
T_Dark_1_T0	Initial temperature of Dark bottle replicate 1	degrees Celsius
T_Dark_2_T0	Initial temperature of Dark bottle replicate 2	degrees Celsius
T_Dark_3_T0	Initial temperature of Dark bottle replicate 3	degrees Celsius

DO_Light_1_TF	Final dissolved oxygen concentration in Light bottle replicate 1	milligram per liter (mg/L) or percent saturation
DO_Light_2_TF	Final dissolved oxygen concentration in Light bottle replicate 2	milligram per liter (mg/L) or percent saturation
DO_Light_3_TF	Final dissolved oxygen concentration in Light bottle replicate 3	milligram per liter (mg/L) or percent saturation
DO_Dark_1_TF	Final dissolved oxygen concentration in Dark bottle replicate 1	milligram per liter (mg/L) or percent saturation
DO_Dark_2_TF	Final dissolved oxygen concentration in Dark bottle replicate 2	milligram per liter (mg/L) or percent saturation
DO_Dark_3_TF	Final dissolved oxygen concentration in Dark bottle replicate 3	milligram per liter (mg/L) or percent saturation
T_Light_1_TF	Final temperature of Light bottle replicate 1	degrees Celsius
T_Light_2_TF	Final temperature of Light bottle replicate 2	degrees Celsius
T_Light_3_TF	Final temperature of Light bottle replicate 3	degrees Celsius
T_Dark_1_TF	Final temperature of Dark bottle replicate 1	degrees Celsius
T_Dark_2_TF	Final temperature of Dark bottle replicate 2	degrees Celsius
T_Dark_3_TF	Final temperature of Dark bottle replicate 3	degrees Celsius
CruiseStation	Concatenated Cruise and Station	unitless
Time_in_local	Incubation start time (local) when bottles were placed in the on-deck incubator	unitless
Time_out_local	Incubation end time (local) when bottles were taken out of the on-deck incubator	unitless

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Instruments

Dataset-specific Instrument Name	CTD Seabird 911
Generic Instrument Name	CTD Sea-Bird 911
Generic Instrument Description	The Sea-Bird SBE 911 is a type of CTD instrument package. The SBE 911 includes the SBE 9 Underwater Unit and the SBE 11 Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 and SBE 11 is called a SBE 911. The SBE 9 uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 and SBE 4). The SBE 9 CTD can be configured with auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). More information from Sea-Bird Electronics.

Dataset-specific Instrument Name	Niskin bottle
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Samples were collected from several depths in the water column using Niskin bottles
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	O2 probe with thermometer (Hach or YSI)
Generic Instrument Name	Oxygen Sensor
Dataset-specific Description	Concentrations of O2 were measured initially and after 24 hours using a Hach or YSI oxygen sensor and temperature probe.
Generic Instrument Description	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed

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Deployments

PE17-18

Website	https://www.bco-dmo.org/deployment/772116
Platform	R/V Pelican
Start Date	2017-04-05
End Date	2017-04-16

PE18-02

Website	https://www.bco-dmo.org/deployment/784911
Platform	R/V Pelican
Start Date	2017-07-07
End Date	2017-07-21

PE18-11

Website	https://www.bco-dmo.org/deployment/789096
Platform	R/V Pelican
Start Date	2017-09-28
End Date	2017-10-11
Description	Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/PE18-11

AC18-12

Website	https://www.bco-dmo.org/deployment/789093
Platform	R/V Acadiana
Start Date	2017-09-17
End Date	2017-09-21

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Project Information

Collaborative Research: A RAPID response to Hurricane Harvey's impacts on coastal carbon cycle, metabolic balance and ocean acidification (HarveyCarbonCycle)

Coverage: Northwestern Gulf of Mexico

NSF Award Abstract:
Understanding how extreme events, like hurricanes, impact coastal ecosystems and the cycling of elements like carbon and oxygen, is important for improving our ability to predict how the global carbon cycle will respond to climate. This team of investigators, who have already been working together on understanding the carbon cycle in the Gulf of Mexico continental shelves, have important recent data against which to measure the effects of the passage of Hurricane Harvey in August, 2017. They will sample the waters and sediments of the northwestern Gulf of Mexico in September, October, and January to assess Harvey's impacts on a timescale of weeks to months.

The researchers pose three specific questions: 1. Will the region become a major source of carbon dioxide to the atmosphere, releasing carbon accumulated in the bottom water and sediments, and will this potential impact be faster and greater than during normal fall and winter mixing events? Will this process acidify the surface water and for how long? 2. Will the metabolic balance be substantially pushed toward net heterotrophy as a result of the storm in comparison to other years? 3. Can the amount of material delivered or redeposited across the continental shelf by a tropical cyclone be considerably larger than that related to winter storm systems? The PIs will measure water column nutrients, oxygen, organic carbon, and inorganic carbon system parameters; determine water column and benthic metabolic and nutrient flux rates; and sediment organic matter deposition rates. They will also collect end member river samples. They will compare the immediate (mid-Sept) but limited post-hurricane data and one-month post-hurricane, more detailed data with those collected in July and April to study the impacts of the storms. they will also compare 2017-2018 seasonal data to seasonal data over the same region collected in the past (2006-2008 and 2009-2010). They will also compare the impacts of Hurricane Harvey to those of Hurricanes Katrina and Rita (2005) and Tropical Storm Cindy (June 2017). The project will involve graduate and postdoctoral research and work to communicate results to the public.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1760747

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