Water and oxygen metabolism flux data from two tidal creeks on Plum Island, Massachusetts during 2012.

Website: https://www.bco-dmo.org/dataset/669348
Data Type: Other Field Results
Version: 1
Version Date: 2016-12-08

Project
» Eutrophication Effects on Sediment Metabolism and Benthic Algal-bacterial Coupling: An Application of Novel Techniques in a LTER Estuary (Benthic_PP_at_TIDE)

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Dataset Description

Two tidal creeks O2, S, T, water fluxes, and O2 metabolism flux.

Methods & Sampling

Water quality measurements are made using two YSI 6-series water quality data logging sonde. maintained by the TIDE project at PIE-LTER. YSI Sonde sensors consist of Clark-type potentiometric Oxygen probe, a conductivity/temperature probe (thermistor) .

Data has been screened for obviously wrong data, including a period in the fertilized creek (Sweeney Right) during which the oxygen probe was buried by mud from a collapsed creek bank. Other than this period, conductivity readings did not indicate any blockages that might affect data quality. Oxygen saturation state (the measured variable using this type of sensor, not concentration) had a linear, time-dependent drift that was similar in each creek based on comparison with high precision handheld sondes (YSI ProDO). Oxygen saturation states were detrended, and then resulting saturation states converted to molal concentration using the oxygen solubility function of Garcia and Gordon 1992 (doi: 10.4319/lo.1992.37.6.1307 and 1993 erratum).

Typical sensor/data problems are:

- For oxygen: Poor/inaccurate conductivity measurements will affect the dissolved oxygen accuracy, tears, nicks, or other wear on the oxygen selective membrane used on the Clark-type electrode.
- For conductivity: Conductivity cell can have detrital material stuck in it, shorting out cell, resulting in lower than expected conductivity.
- For depth: Depth strain gage pressure sensor may come out of the water at low tides resulting in many

"zero" depth readings or sometimes negative values.

YSI Dissolved oxygen % saturation reporting can vary depending upon how the oxygen is calibrated.

For this data Oxygen percent saturation values is reported as DO%YSI at 1 ATM pressure relative to water-saturated air calibration, and additionally as DO%recalc, after detrending. Resulting metabolic fluxes are calculated from resulting oxygen concentrations relative to the saturation concentration at local atmospheric pressure (which in this case varies by less than 2% and can be neglected relative to much larger errors in advective and air-water transfer rates.

Water depth is logged in each creek using a HOBO U20 titanium water depth loggers rated to 30 ft, and combined with 2011 creek geometry transects by Will Kearney (Sergio Fagherazzi's group at BU) in order to calculate cross-sectional areas as well as surface areas through which air-water gas exchange occurs, and tidal exchange of creek water between timesteps. Windspeed from the cited additional database (the Marshview meteorology tower) is scaled to u10 using the wind profile power law approximation. Wind and estimated current velocities are used with a windspeed parameterization to calculate the air-water exchange coefficient of oxygen (kO2) after scaling the Schmidt number of oxygen of temperature and salinity.

Average values used to calculate metabolic fluxes are reported for the mean time period between the timestep at which they are reported and the timestep 10 minutes prior.

The reported values of kO2 are based on the parameterizations of:

- kO2_1 Borges et al. 2004 with both wind and currents (doi: 10.1007/BF02907647)
- kO2_2Borges et al. 2004 without wind
- kO2_3 Nidzieko et al. 2014 with both wind and currents (doi: 10.1007/s12237-013-9765-2)
- kO2_4 Nidzieko et al. 2014 without wind

Net ecosystem metabolism rates (oxygen production minus community respiration in mmol O2 m^-n min^-1) are reported as volumetric, areal, and per unit creek length rates using only kO2_1. Per unit length is likely the most appropriate approach to compare between timepoints in this case as the volume and surface area change rapidly over tidal cycles. Please see Kearns et al. 2016 (Nature Comm.) for additional method details.

References:

Kearns et al. 2016, doi: 10.1038/ncomms12881

This data is also accessible through the LTER database, and has been assigned a database doi: 10.6073/pasta/fe47a9461bd332fae3ac7792af21c2b0

Data Processing Description

BCO-DMO Data Processing Notes:

-reformatted column names to comply with BCO-DMO standards.
-filled in blank cells with "nd"
-reformatted date to "mm/dd/yyyy"
-replaced "NA" with "nd"

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Data Files

File	
tidal_creeks.csv	(Comma Separated Values (.csv), 758.68 KB) MD5:61ab4a3af92057725b6a4d2ed02986c1
Primary data file for dataset ID 669348	

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Parameters

Parameter	Description	Units
date	Date of sampling; DD-MM-YYYY	unitless
time	Time of sampling (eastern standard time EST 24 hour); HH:MM	unitless
station	Name of sampling station	unitless
creek_status	Status of creek; either fertilized or reference	unitless
tempYSI	Temperature of water	celsius
spCondYSI	Specific conductivity of water	millisiemen per centimeter
salinityYSI	Salinity of water	part per thousand
densityYSI	Density of water	kilogram per liter
DO_pcnt_YSI	Percent dissolved oxygen saturation of water at 1 atm	percent
DOconcYSI	Dissolved oxygen concentration of water	milligram per liter
depthYSI	Water column depth above sonde pressure transducer	meter
DOsat	Saturation concentration of O2 at 1 atm plus water pressure	micromole per kilogram
DOrecalc_pcnt	Detrended dissolved oxygen percent saturation at 1 atm plus water pressure	percent
DOrecalc	Dissolved oxygen concentration recalculated from detrended DO percent recalc and Dosat	micromole per kilogram
depthPGauge	High accuracy and precision water column depth above creek calculated from pressure and in situ density	meter
CSarea	Cross sectional area of water in creek at given timepoint	meter squared
surfaceArea	Air-water surface area in creek at given timepoint	meter squared
DeltaV	Change in volume between timepoint and previous timepoint	meter cubed per second
u10	Windspeed scaled to 10 m height	meter per second
kO2_1	Air-water exhange flux of O2 parameterization 1 (see methods)	meter per second
kO2_2	Air-water exhange flux of O2 parameterization 2 (see methods)	meter per second
kO2_3	Air-water exhange flux of O2 parameterization 3 (see methods)	meter per second
kO2_4	Air-water exhange flux of O2 parameterization 4 (see methods)	meter per second
NEM_m3	Volumetric net ecosystem metabolism rate of O2	millimole per meter cubed per minute
NEM_m2	Areal net ecosystem metabolism rate of O2	millimole per meter squared per minute
NEM_m	Volumetric net ecosystem metabolism rate of O2	millimole per meter per minute
comments	Comments about specific data	unitless

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Instruments

Dataset-specific Instrument Name	Oxygen saturation sensor
Generic Instrument Name	Oxygen Sensor
Dataset-specific Description	Measured oxygen saturation, not concentration
Generic Instrument Description	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed

Dataset-specific Instrument Name	HOBO U20 titanium water depth logger
Generic Instrument Name	Water Depth Logger
Dataset-specific Description	Rated to 30ft
Generic Instrument Description	For measuring and recording water levels in rivers, streams, and wells.

Dataset-specific Instrument Name	YSI 6-series water quality datalogging sonde
Generic Instrument Name	Water Quality Multiprobe
Dataset-specific Description	Used to take water quality measurements
Generic Instrument Description	An instrument which measures multiple water quality parameters based on the sensor configuration.

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Deployments

Plum_Island

Website	https://www.bco-dmo.org/deployment/669365
Platform	shoreside Massachusetts
Start Date	2012-07-27
End Date	2012-08-15
Description	Plum Island, MA; LTER sites

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Project Information

Eutrophication Effects on Sediment Metabolism and Benthic Algal-bacterial Coupling: An Application of Novel Techniques in a LTER Estuary (Benthic_PP_at_TIDE)

Coverage: Plum Island Estuary, Rowley Massachusetts

Extracted from the NSF award abstract:
This project will address how rates of benthic microalgal production respond to eutrophication and geomorphological changes in human-impacted tidal creeks. Excess nutrient loading increases benthic algal biomass and likely stimulates production rates but the magnitude of nutrient and geomorphological effects on rates of production is unknown. Will changes in benthic algal productivity affect algal-bacterial coupling? Furthermore, how is algal-bacterial coupling affected by geomorphological changes, which may be exacerbated

by excess nutrient loading but can also occur in pristine marshes?

This project will take advantage of the infrastructure of the TIDE project, a long-term saltmarsh eutrophication experiment at the Plum Island Ecosystem - Long Term Ecological Research site in Northeastern Massachusetts. Specifically, the PIs will measure benthic metabolism and examine algal- bacterial coupling in fertilized and ambient nutrient tidal creeks in the first field season. The following field season, they will compare sediment metabolism and carbon dynamics on slumped tidal creek walls (i.e. areas where low marsh has collapsed into the tidal creek) to that on the bottom of tidal creeks. In both years, gross and net production will be determined using an innovative triple oxygen isotope technique and traditional dissolved oxygen and inorganic carbon flux measurements. Comparisons between these methods will be useful in informing studies of sediment metabolism. Lipid biomarkers will be used to characterize the sources of organic matter to creek sediments, and stable isotope analysis of bacterial specific biomarkers to identify the sources of organic carbon utilized by sediment bacteria. The biomarkers will reveal whether sediment bacteria use organic matter substrates, such as benthic microalgal carbon, selectively or in proportion to availability. Overall, results from the proposed study will provide important information about how sediment carbon dynamics in shallow tidal creeks respond to long term eutrophication. Furthermore, findings will enhance understanding of the role of tidal creeks in coastal biogeochemistry.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1233678

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