Potential denitrification and N2 fixation from slurry assays from Little Lagoon, Alabama collected from 2012-2013

Website: https://www.bco-dmo.org/dataset/723957

Data Type: Other Field Results

Version: 1

Version Date: 2018-01-16

Project

» Groundwater Discharge, Benthic Coupling and Microalgal Community Structure in a Shallow Coastal Lagoon (LittleLagoonGroundwater)

Contributors	Affiliation	Role
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Abstract

Potential denitrification and N2 fixation from slurry assays from Little Lagoon, Alabama collected from 2012-2013

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Coverage

Spatial Extent: **Lat**:30.241929 **Lon**:-87.773756

Temporal Extent: 2012 - 2013

Dataset Description

Potential denitrification and N2 fixation from slurry assays from Little Lagoon, Alabama.

Acquisition Description

Little Lagoon is a shallow coastal lagoon that is tidally connected to the Gulf of Mexico but has no riverine inputs. The water in the lagoon is replenished solely from precipitation and groundwater inputs primarily on the East end (Su et al. 2012). Because of the rapid development in Baldwin County, a large amount of NO_3^- enters the Little Lagoon system through SGD (Murgulet & Tick 2008). In this region, there can be rapid changes in the depth to groundwater (Fig. 4.1 inset) and episodic SGD inputs to the lagoon (Su et al.2013). Within the lagoon, three sites were selected (East, Mouth, and West) to represent the gradient that exists across the lagoon from the input of groundwater. Sites were sampled on a near-monthly basis from February 2012 to February 2013.

Potential denitrification and N2 fixation from slurry assays

The top 50 mm of sediment at each site were collected in duplicate with a large core (95 mm ID) and homogenized. Potential denitrification rates were measured following the acetylene inhibition technique (Sørensen 1978) but may underestimate denitrification supported by coupled nitrification-denitrification, as this method inhibits nitrification. To triplicate serum vials, approximately 20 g of sediments and filtered (0.7 micron) site water were added at various treatments (control and N addition (100 µM and 500 µM KNO_3 -). Samples were sealed with a butyl rubber stopper, capped and flushed with N_2 gas for 10 minutes. After the addition of C_2H_2 (10% v/v) and a 1-hour incubation, headspace gas samples were injected into evacuated 12 ml Exetainer vials and N_2O production was quantified with a Shimadzu GC-2014 with an electron capture detector (GC-ECD) within 24 hours.

Potential N_2 fixation rates were measured as ethylene (C_2H_4) production from acetylene (C_2H_2) reduction (Welsh et al. 1996) in triplicate from slurry assays containing 20 g of homogenized sediment and filtered (0.7 micron) site water. Rates of N_2 fixation by sulfate reducing bacteria (SRB) were determined after the addition of sodium molybdate as a specific inhibitor of the sulfate reduction process (Hardy et al. 1973, Capone 1993). After C_2H_4 analysis on a Shimadzu gas chromatograph (GC-2014) with flame ionization detection (GC-FID), production rates of C_2H_4 were converted to potential N_2 fixation rates using a C_2H_2:N_2 reduction ratio of 3:1 (Capone 1993).

Additional methodology can be found in:

Bernard, Rebecca & Mortazavi, Behzad & A. Kleinhuizen, Alice. (2015). Dissimilatory nitrate reduction to ammonium (DNRA) seasonally dominates NO_3^- reduction pathways in an anthropogenically impacted sub-tropical coastal lagoon. Biogeochemistry. 125. 47-64. 10.1007/s10533-015-0111-6.

Processing Description

Data were flagged as below detection limits if no measurable rates were returned after calculations. See equations in methodology section of:

Bernard, Rebecca & Mortazavi, Behzad & A. Kleinhuizen, Alice. (2015). Dissimilatory nitrate reduction to ammonium (DNRA) seasonally dominates NO_3^- reduction pathways in an anthropogenically impacted sub-tropical coastal lagoon. Biogeochemistry. 125. 47-64. 10.1007/s10533-015-0111-6.

Statistical Analysis

To test the seasonal flux variability between sites in Little Lagoon, two-way ANOVAs with site and date as independent variables were performed. When data could not be transformed to meet ANOVA assumptions, Wilcoxon/Kruskal-Wallis nonparametric tests were used. When significant differences occurred, Tukey HSD or Steel-Dwass post hoc tests were used to determine significant interactions. A Principal component analysis (PCA) was conducted on all biogeochemical parameters to identify underlying multivariate components that may be influencing N fluxes. Spearman's rho correlation analysis was used to examine the relationship between the principal components and fluxes. Statistical significance of the data set was determined at $\alpha=0.05$ and error is reported as standard error. All statistical analyses were performed in SAS JMP 10 (SAS Institute Inc.).

BCO-DMO Data Processing Notes:

- Data reorganized into one table under one set of column names
- Units removed from column names
- Column names reformatted to meet BCO-DMO standards
- Information captured in original column names entered under column Value_Description
- Created column Year to describe to capture the metadata in the file name

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Related Publications

Bernard, R. J., Mortazavi, B., & Kleinhuizen, A. A. (2015). Dissimilatory nitrate reduction to ammonium (DNRA) seasonally dominates NO3 – reduction pathways in an anthropogenically impacted sub-tropical coastal lagoon. Biogeochemistry, 125(1), 47–64. doi:10.1007/s10533-015-0111-6

Capone, D. G. (1993). Determination of nitrogenase activity in aquatic samples using the acetylene reduction procedure. In: Kemp PF, Sherr BF, Sherr EB, Cole JJ (eds) Handbook of methods in aquatic microbiology. Lewis, Boca Raton, 621–631

Hardy, R. W. F., Burns, R. C., & Holsten, R. D. (1973). Applications of the acetylene-ethylene assay for measurement of nitrogen fixation. Soil Biology and Biochemistry, 5(1), 47–81. doi:10.1016/0038-0717(73)90093-X

Murgulet, D., & Tick, G. R. (2008). Assessing the extent and sources of nitrate contamination in the aquifer system of southern Baldwin County, Alabama. Environmental Geology, 58(5), 1051–1065. doi:10.1007/s00254-008-1585-5

Su, N., Burnett, W.C., Eller, K.T., MacIntyre, H.L., Mortazavi, B., Leifer, J., Novoveska, L. (2012). Radon and radium isotopes, groundwater discharge and harmful algal blooms in Little Lagoon, Alabama. Interdisciplinary Studies on Environmental Chemistry, 6, 329–337.

Su, N., Burnett, W.C., MacIntyre, H.L., Liefer, J.D., Peterson, R.N., Viso, R. (2013). Natural radon and radium isotopes for assessing groundwater discharge into Little Lagoon, AL: implications for harmful algal blooms. Estuaries Coasts, 1–18

Sørensen, J. (1978). Denitrification rates in a marine sediment as measured by the acetylene inhibition technique. Appl Environ Microbiol, 36 (1), 139–143

Welsh, D. T., Bourgués, S., de Wit, R., & Herbert, R. A. (1996). Seasonal variations in nitrogen-fixation (acetylene reduction) and sulphate-reduction rates in the rhizosphere of Zostera noltii: nitrogen fixation by sulphate-reducing bacteria. Marine Biology, 125(4), 619–628. doi:10.1007/BF00349243

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Parameters

Parameter	Description	Units
Year	Year ID that samples were taken	unitless
Date	Month and day that samples were taken; MMM-DD	unitless
Value_Description	Description of the measurment taken; description includes relevant units for each sample taken	unitless
Mouth	Denitrification and Nitrogen fixation values collected at the site Mouth; location of site is 30.243683, -87.738407	nanomol of nitrogen per gram per hour
Mouth_SE	Standard error of the values collected at the site Mouth	nanomol of nitrogen per gram per hour
West	Denitrification and Nitrogen fixation values collected at the site West; location of site is 30.247181, -87.767856	nanomol of nitrogen per gram per hour
West_SE	Standard error of the values collected at the site West	nanomol of nitrogen per gram per hour
East	Denitrification and Nitrogen fixation values collected at the site East; location of site is 30.253347, -87.724729	nanomol of nitrogen per gram per hour
East_SE	Standard error of the values collected at the site East	nanomol of nitrogen per gram per hour

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Deployments

LittleLagoon

Website	https://www.bco-dmo.org/deployment/528089
Platform	SmallBoat_FSU
Start Date	2010-04-05
End Date	2013-08-17
Description	The sampling sites were all accessed from small boats, here amalgamated to one deployment called LittleLagoon.

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Project Information

Groundwater Discharge, Benthic Coupling and Microalgal Community Structure in a Shallow Coastal Lagoon (LittleLagoonGroundwater)

Coverage: southern Alabama, east of Mobile

This project investigated the link between submarine groundwater discharge (SGD) and microalgal dynamics in Little Lagoon, Alabama. In contrast to most near-shore environments, it is fully accessible; has no riverine inputs; and is large enough to display ecological diversity (c. 14x 0.75 km) yet small enough to be comprehensively sampled on appropriate temporal and spatial scales. The PIs have previously demonstrated that the lagoon is a hot-spot for toxic blooms of the diatom Pseudo-nitzchia spp. that are correlated with discharge from the surficial aquifer. This project assessed variability in SGD, the dependence of benthic nutrient fluxes on microphytobenthos (MPB) abundance and productivity, and the response of the phytoplankton to nutrient enrichment and dilution. The work integrated multiple temporal and spatial scales and demonstrated both the relative importance of SGD vs. benthic recycling as a source of nutrients, and the role of SGD in structuring the microalgal community. (paraphrased from Award abstract)

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0962008

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