Open Mesocosm Oyster 15N2 and N2O

Website: https://www.bco-dmo.org/dataset/722433
Data Type: experimental
Version: 1
Version Date: 2017-12-31

Project
» Microbial Regulation of Greenhouse Gas N2O Emission from Intertidal Oyster Reefs (Oyster Reef N2O Emission)

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Abstract
Open Mesocosm Oyster 15N2 and N2O

Table of Contents

- Dataset Description
  - Methods & Sampling
  - Data Processing Description
- Data Files
- Parameters
- Instruments
- Project Information
- Funding

Dataset Description

Open Mesocosm Oyster 15N2 and N2O

Methods & Sampling

15N labeled phytoplankton was continuously pumped for three days into 30.5 cm diameter mesocosms containing 10 cm of sediment and 20 liters of overlying water. Three mesocosms contained oysters twelve 7-cm long oysters (O1, O2, O2) and three mesocosms had no oysters and served as controls (C1,C2,C3). Mesoscosms were flow through with a 0.3 day residence time and open to the atmosphere. N2O and 15N2 were measured during the phytoplankton addition period.

Water samples for N2O analysis were collected with a peristaltic pump through a syringe needle directly into 12 ml exetainer that had been flushed with N2 and preserved with KOH to a pH above 12. Approximately six ml sample was collected. N2O concentrations in the headspace were measured on a GC-ECD. Water samples for 15N2 samples were collected with a peristaltic pump through a syringe needle directly into 30 ml serum bottles that had been flushed with He and preserved with KOH to a pH above 12. Approximately eight ml sample was collected. 15N2 was analyzed by GC - Isotope Ratio Mass Spectrometry (IRMS). 15N-Phyto sample was collected by GFF 0.7um filtration of phytoplankton stock solution.

Data Processing Description

N2O concentrations were calculated from N2O calibration curve and corrected for N2O solubility in the aqueous phase using the Bunsen coefficient. 15N2 was normalized to air and air saturated water standards and reported in the delta notation. 15N Phyto enrichment is reported in at% 15N.

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- empty values were replaced with 'nd' (no data).

[table of contents | back to top]

Data Files

File
open_sys_exper.csv (Comma Separated Values (.csv), 633 bytes) MD5:ef444db1d93eb69fcc55f6943230ce12 Primary data file for dataset ID 722433

[table of contents | back to top]

Parameters

Parameter	Description	Units
Hours	Time since phyto feeding start	hours
Phyto_15N	15N enrichment of phytoplankton at% 15N	percent
O1_15N2	Oyster mecosm1 15N enrichment of dissolved N2	permil (/ml)
O1_N2O	Oyster mecosm1 Aqueous N2O concentration	nanomole (nM)
O2_15N2	Oyster mecosm 2 15N enrichment of dissolved N2	permil (/ml)
O2_N2O	Oyster mecosm 2 Aqueous N2O concentration	nanomole (nM)
O3_15N2	Oyster mecosm 3 15N enrichment of dissolved N2	permil (/ml)
O3_N2O	Oyster mecosm 3 Aqueous N2O concentration	nanomole (nM)
C1_15N2	Control mecosm 1 15N enrichment of dissolved N2	permil (/ml)
C1_N2O	Control mecosm 1 Aqueous N2O concentration	nanomole (nM)
C2_15N2	Control mecosm 2 15N enrichment of dissolved N2	permil (/ml)
C2_N2O	Control mecosm 2 Aqueous N2O concentration	nanomole (nM)
C3_15N2	Control mecosm 3 15N enrichment of dissolved N2	permil (/ml)
C3_N2O	Control mecosm 3 Aqueous N2O concentration	nanomole (nM)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Costech Elemental Analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	15N Phyto sample was analyzed on the IRMS coupled to a Costech Elemental Analyzer.
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

Dataset-specific Instrument Name	Agilent 7890B GC with a Poropak Column
Generic Instrument Name	Gas Chromatograph
Dataset-specific Description	N2O was measured on a Agilent 7890B GC with a Poropak Column.
Generic Instrument Description	Instrument separating gases, volatile substances, or substances dissolved in a volatile solvent by transporting an inert gas through a column packed with a sorbent to a detector for assay. (from SeaDataNet, BODC)

Dataset-specific Instrument Name	Thermo Delta V IRMS
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	15N2 was measured on a Thermo Delta V IRMS fitted with a Gas Bench II interface following separation from O2 and Ar on a mol sieve 5A column.
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

[table of contents | back to top]

Project Information

Microbial Regulation of Greenhouse Gas N2O Emission from Intertidal Oyster Reefs (Oyster Reef N2O Emission)

Extracted from the NSF award abstract:

Oyster reefs are biogeochemical hot spots and prominent estuarine habitats that provide disproportionate ecological function. Suspension-feeding eastern oysters, Crassostrea virginica, are capable of improving water quality and diminishing eutrophication by filtering nutrients and particles from the water and depositing them in

the sediments. Remineralization of these deposits may enhance sedimentary denitrification that facilitates nitrogen removal in tidal estuaries. However, the scientific underpinning of oyster reef function has been challenged in various studies. In addition, recent studies of filter feeding invertebrates reported the production of nitrous oxide (N2O), a greenhouse gas, as an end product of incomplete denitrification by gut microbes. C. virginica could be another source of N2O flux from intertidal habitats. Preliminary work indicated substantial N2O production from individual oysters. The estimated N2O production from high density oyster reefs may exceed the N2O flux measured from some estuaries. With the new discovery of N2O emission and uncertainty regarding eutrophication control, the ecological value of oyster reef restoration may become equivocal.

This project will quantify N2O fluxes to understand the factors controlling N2O emission from oyster reefs. Sedimentary N processes will be examined to develop an oyster reef N model to estimate N2O emission from tidal creek estuaries relative to other N cycling processes. The PIs hypothesize that intertidal oyster reefs are a substantial source of N2O emission from estuarine ecosystems and the magnitude of emission may be linked to water quality. If substantial N2O flux from oyster reefs is validated, ecological benefits of oyster reef restoration should be reevaluated. This interdisciplinary research team includes a microbial ecologist, a biogeochemist, an ecologist and an ecosystem modeler. They will utilize stable isotope and molecular microbiological techniques to quantify oyster N2O production, elucidate microbial sources of N2O emission from oysters and sediments, and estimate seasonal variation of N2O fluxes from oyster reefs. Measurements from this study will be integrated into a coupled oyster bioenergetics-sediment biogeochemistry model to compare system level rates of N cycling on oyster reefs as a function of oyster density and water quality. Modeling results will be used to assess the relative trade-offs of oyster restoration associated with N cycling. They expect to deliver the following end products:1) estimation of annual N2O flux from oyster reefs as an additional source of greenhouse gases from estuaries, 2) a better understanding of the environmental and microbial factors influencing N2O and N2 fluxes in tidal estuaries, 3) transformative knowledge for the effect of oyster restoration on water quality enhancement and ecosystem function, 4) direct guidance for oyster restoration projects whose goals include water quality enhancement, and 5) a modeling tool for use in research and restoration planning.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1233372

[table of contents | back to top]