Ammonium, total nitrate and nitrite, nitrite, and flow cytometry profiles in the Eastern Tropical North Pacific from March to April 2018

Website: https://www.bco-dmo.org/dataset/774855
Data Type: Cruise Results
Version: 1
Version Date: 2021-04-06

Project
» Collaborative Research: Mechanisms and Controls of Nitrous Oxide Production in the Eastern Tropical North Pacific Ocean (N2O in ETNP)

Contributors	Affiliation	Role
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Abstract
Ammonium, total nitrate and nitrite, nitrite, and flow cytometry profiles in the Eastern Tropical North Pacific from March to April 2018.

Table of Contents

Coverage

Spatial Extent: **N**:19.6232 **E**:-102.3498 **S**:9.9998 **W**:-114.7916
Temporal Extent: 2018-03-16 - 2018-04-12

Methods & Sampling

All samples were taken using Niskin bottles during CTD casts.

Data Processing Description

Cell abundances: Cell abundances were analyzed using flow cytometry as previously described (Van Oostende et al. 2017). Samples were collected in 5 mL-cryovials from 30-L Niksin bottles and fixed with 0.1% glutaraldehyde and frozen at -80C until later analysis in the shore based laboratory.

Ammonium: Ammonium concentration was measured manually fluorometrically using standard methods (Holmes et al 1999). Water was collected using Niskin sampling bottles. Samples were measured immediately upon retrieval and were not filtered prior to analysis. Five ml volumes were analyzed.

Nitrite: Nitrite concentration was measured manually colorimetrically using standard methods (Strickland and Parsons 1972). Water was collected using Niskin sampling bottles. Samples were measured immediately upon retrieval and were not filtered prior to analysis. Five ml volumes were analyzed.

Nitrite + Nitrate: Nitrite + Nitrate (NOx) concentration was measured using the chemiluminescence method (Garside 1982)
Water was collected using Niskin sampling bottles. Water was dispensed into 12-ml detainer vials and used in incubation experiments. Incubations were terminated by addition of saturated ZnCl2 and returned to the shore based laboratory. After mass spec analysis of the N2 gas in the vials, they were subsampled for analysis of total NOx in solution.

BCO-DMO Processing Notes:

- Combined NH4, NO2, Nitrate+Nitrate and flow cytometer datasets
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- combined the degrees and minutes columns of lat and long values to create lat and lon columns in decimal degrees, rounded columns to 6 digits.

[table of contents | back to top]

Data Files

File
profile_data.csv (Comma Separated Values (.csv), 51.30 KB) MD5:d5811313eb5fca458db3a02cca77bfc3 Primary data file for dataset ID 774855

[table of contents | back to top]

Supplemental Files

File
SR1805_EventLog filename: ETNP_2018_EventLog.xls (Octet Stream, 60.00 KB) MD5:85b1168151387e2d17397dde6b6e9b0a Cruise event log from R/V Sally Ride cruise SR1805 (ETNP 2018).

[table of contents | back to top]

Related Publications

Garside, C. (1982). A chemiluminescent technique for the determination of nanomolar concentrations of nitrate and nitrite in seawater. Marine Chemistry, 11(2), 159–167. doi:10.1016/0304-4203(82)90039-1
Methods

Holmes, R. M., Aminot, A., Kerouel, R., Hooker, B. A., & Peterson, B. J. (1999). A simple and precise method for measuring ammonium in marine and freshwater ecosystems. Canadian Journal of Fisheries and Aquatic Sciences, 56(10), 1801-1808. doi:10.1139/f99-128 https://doi.org/10.1139/cjfas-56-10-1801
Methods

Strickland, J. D. H. and Parsons, T. R. (1972). A Practical Hand Book of Seawater Analysis. Fisheries Research

Board of Canada Bulletin 157, 2nd Edition, 310 p.
Methods

Van Oostende, N., Fawcett, S. E., Marconi, D., Lueders-Dumont, J., Sabadel, A. J. M., Woodward, E. M. S., … Ward, B. B. (2017). Variation of summer phytoplankton community composition and its relationship to nitrate and regenerated nitrogen assimilation across the North Atlantic Ocean. Deep Sea Research Part I: Oceanographic Research Papers, 121, 79–94. doi:10.1016/j.dsr.2016.12.012
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
Date	Date yyyy-mm-dd	unitless
Local_Time	Local time (hh:mm). Note: Local time zones changed between CTD23 and CTD24 and again between CTD66 and CTD67.	unitless
UTC_Time	UTC time (hh:mm)	unitless
Station	Station designation	unitless
Latitude	Latitude of CTD cast, south is negative	decimal degrees
Longitude	Longitude of CTD cast, west is negative	decimal degrees
CTD	cast number	unitless
Niskin	bottle number	unitless
Depth	sampe depth	meters (m)
Ammonium	ammonium (NH4) concentration	nanomolar (nM)
Nitrite	nitrite (NO2) concentration	micromolar (uM)
Nitrite_Nitrate	Nitrite plus nitrate concentration	micromolar (uM)
Chlpos	chlorophyll positive	cells per milliliter
HetBact	Heterotrophic bacterial cells	cells per milliliter
PEneg	Phycoerythrin negative cells	cells per milliliter
PEpos	Phyoerythrin positive cells	cells per milliliter
Picoeuk	Picoeukaryote cells	cells per milliliter
Prochl	Prochlorococcus cells	cells per milliliter
Syn	Synechococcus cells	cells per milliliter
Air_Temp	Air temperature	degrees celsius (°C)
Log_Taker	Person in charge of the log for that event.	unitless
Events_Notes	Event type, brief description of event	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Teledyne Instruments Chemiluminescence NO/NOx Analyzer
Generic Instrument Name	Chemiluminescence NOx Analyzer
Dataset-specific Description	Chemiluminescence was measured on 200 µl samples using a Teledyne Instruments Chemiluminescence NO/NOx Analyzer – 10 Model 200E (NOx Box)
Generic Instrument Description	The chemiluminescence method for gas analysis of oxides of nitrogen relies on the measurement of light produced by the gas-phase titration of nitric oxide and ozone. A chemiluminescence analyzer can measure the concentration of NO/NO2/NOX. One example is the Teledyne Model T200: https://www.teledyne-api.com/products/nitrogen-compound-instruments/t200

Dataset-specific Instrument Name	CTD Sea-Bird 9
Generic Instrument Name	CTD Sea-Bird 9
Dataset-specific Description	CTD: Sea-Bird 9. CTD data processed with Seasave V7.26.7.107
Generic Instrument Description	The Sea-Bird SBE 9 is a type of CTD instrument package. The SBE 9 is the Underwater Unit and is most often combined with the SBE 11 Deck Unit (for real-time readout using conductive wire) when deployed from a research 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, fluorometer, altimeter, etc.). Note that in most cases, it is more accurate to specify SBE 911 than SBE 9 since it is likely a SBE 11 deck unit was used. more information from Sea-Bird Electronics

Dataset-specific Instrument Name	BD Accuri C6 Flow Cytometer
Generic Instrument Name	Flow Cytometer
Dataset-specific Description	A BD Accuri C6 Flow Cytometer was used for the enumeration.
Generic Instrument Description	Flow cytometers (FC or FCM) are automated instruments that quantitate properties of single cells, one cell at a time. They can measure cell size, cell granularity, the amounts of cell components such as total DNA, newly synthesized DNA, gene expression as the amount messenger RNA for a particular gene, amounts of specific surface receptors, amounts of intracellular proteins, or transient signalling events in living cells. (from: http://www.bio.umass.edu/micro/immunology/facs542/facswhat.htm)

Dataset-specific Instrument Name	Turner Designs fluorometer Model: 7200-000
Generic Instrument Name	Turner Designs 700 Laboratory Fluorometer
Dataset-specific Description	Fluorescence was measured on a Turner Designs fluorometer Model: 7200-000 using a 1 cm cell.
Generic Instrument Description	The TD-700 Laboratory Fluorometer is a benchtop fluorometer designed to detect fluorescence over the UV to red range. The instrument can measure concentrations of a variety of compounds, including chlorophyll-a and fluorescent dyes, and is thus suitable for a range of applications, including chlorophyll, water quality monitoring and fluorescent tracer studies. Data can be output as concentrations or raw fluorescence measurements.

Dataset-specific Instrument Name	
Generic Instrument Name	UV Spectrophotometer-Shimadzu
Dataset-specific Description	Color (Nitrite concentration) was measured on a Shimadzu UV Spectrophotometer, Model: UV-1800 120V using a 10 cm cell.
Generic Instrument Description	The Shimadzu UV Spectrophotometer is manufactured by Shimadzu Scientific Instruments (ssi.shimadzu.com). Shimadzu manufacturers several models of spectrophotometer; refer to dataset for make/model information.

[table of contents | back to top]

Deployments

SR1805

Website	https://www.bco-dmo.org/deployment/833015
Platform	R/V Sally Ride
Start Date	2018-03-13
End Date	2018-04-16
Description	See additional cruise information from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/SR1805 Cruise DOI: 10.7284/908014

[table of contents | back to top]

Project Information

Collaborative Research: Mechanisms and Controls of Nitrous Oxide Production in the Eastern Tropical North Pacific Ocean (N2O in ETNP)

Coverage: Eastern Tropical North Pacific Ocean (oxygen minimum zone)

NSF Award Abstract:
Nitrous oxide (N2O) is present at very low concentrations in the atmosphere but is an important greenhouse gas and ozone destroying substance. As with other climate-active gases like methane and carbon dioxide, human activities are responsible for most of its production, either directly through fossil fuel burning or agricultural activities. However, about a third of natural N2O emissions come from the ocean, but even these emissions can be indirectly affected by human activities. About half of the ocean source is derived from three specific geographic regions in the Pacific Ocean and Arabian Sea. These three oceanic regions are places where oxygen concentrations are so low in the intermediate depths that metabolic processes requiring the absence of oxygen are able to occur. These regions are called Oxygen Minimum Zones (OMZs) and they have microbiological processes that occur nowhere else in global ocean waters. In the work proposed here, we will investigate how the microbiological pathways of N2O production and consumption are regulated by environmental conditions such as oxygen and nutrient concentration. This work will involve a research expedition to one of the OMZs, the Eastern Tropical Pacific Ocean off the coast of Mexico. On the cruise, we will perform experiments and collect samples for analysis in our home laboratories at Princeton and Stanford Universities. Advising of graduate students and teaching at the graduate and undergraduate levels at both institutions will be linked to this research. This work is particularly timely because global warming has already indirectly affected the size and geographic extent of the OMZs. Greater expanse of low oxygen water could cause N2O production to increase, leading to increased fluxes of N2O to the atmosphere. In the atmosphere, the role of N2O in ozone destruction and as a greenhouse gas could be critical elements of global change.

Nitrous oxide (N2O) is an important greenhouse gas and ozone destroying substance. About a third of natural N2O emissions come from the ocean, and about half of the ocean source is derived from waters with oxygen deficient intermediate waters (oxygen minimum zones, OMZs). Nitrification is recognized as the main source of N2O in the ocean, but denitrification also likely contributes to the net source in and around OMZs. Because nitrification and denitrification are performed by microbes with very different metabolisms and environmental controls, their contributions to N2O production are expected to differ in response to changes in oxygenation and nutrient inputs. Thus it is important to understand the regulation of N2O production by both processes. The main goal of this project is to quantify the environmental regulation of N2O production and consumption pathways in and around OMZs in order to obtain predictive understanding of N2O distributions and fluxes in the ocean. To do this, production and consumption of N2O will be measured using stable isotope tracer incubations at stations located within and outside one of the major OMZs in the Eastern Tropical North Pacific ocean. The dependence of the rate processes on substrate, product, and oxygen concentrations will be determined, and the composition of the microbial assemblages will be assessed to determine whether different microbial components are involved under different environmental conditions. Natural abundance stable isotope and isotopomer measurements of N2O will be interpreted in concert with measured rates to deduce the sources and pathways (nitrification, nitrifier-denitrification, denitrification, and ?hybrid? formation) involved in N2O production and consumption. This work will also involve a novel application of isotopomer measurements of N2O from incubations to identify the placement of 15N from NH4+ and NO2- within labeled N2O pools.

OMZ regions are the sites of unique nitrogen cycling processes that are critical in determining the fixed nitrogen inventory of the ocean. If OMZs expand as predicted due to anthropogenic changes in the coming decades, changes in these chemical distributions may affect the atmospheric flux of nitrous oxide as well as modify overall ocean productivity via changes in the fixed nitrogen inventory. Understanding the regulation and environmental control of the processes responsible for N2O production and consumption is the foundation of understanding their response to global change.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1657663

[table of contents | back to top]