Ammonia and urea-derived-N oxidation rates measured using 15N additions from San Pedro Ocean Time-series (SPOT) measured between 2014 to 2016

Website: https://www.bco-dmo.org/dataset/774602
Data Type: Other Field Results
Version: 2
Version Date: 2020-08-20

Project
» Collaborative Research: New Approaches to New Production (N-SPOT)

Contributors	Affiliation	Role
Santoro, Alyson E.	University of California-Santa Barbara (UCSB)	Principal Investigator
Capone, Douglas G.	University of Southern California (USC)	Co-Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Ammonia and urea-derived-N oxidation rates measured using 15N additions from San Pedro Ocean Time-series (SPOT) measured between 2014 to 2016. Water samples were collected using a Niskin bottle rosette equipped with a CTD. Rates of water column ammonia and urea-derived-N oxidation were measured from bottle incubations.

Table of Contents

Coverage

Spatial Extent: **Lat**:33.55 **Lon**:-118.4
Temporal Extent: 2014-09-10 - 2016-08-10

Methods & Sampling

From 2014 to 2015, water samples were collected using a 12 x 12 L Niskin bottle rosette equipped with a conductivity, temperature, and density (CTD) instrument package (SBE 9plus, Sea-Bird Electronics, Bellevue, Washington, USA), including dissolved oxygen (SBE 43) and photosynthetically available radiation (PAR, LI-COR, Biospherical Instruments Inc., San Diego, California, USA) sensors. Due to CTD failure, samples collected in 2015 and 2016 were collected primarily using manually triggered Go-Flo bottles and depths were chosen primarily using a profiling natural fluorometer (PNF) system as well as secchi disk.

Rates of water column ammonia and urea-derived-N oxidation were measured from bottle incubations with $^{15}NH_4Cl$ and ^{15}N-urea (Dugdale and Goering 1967; Sigman et al. 2001; McIlvin and Casciotti 2011; Damashek et al. 2016). Isotope samples were analyzed using a Finnigan Delta Plus XP IRMS and Finnigan Delta Plus Advantage IRMS at the University of California Davis Stable Isotope Facility, the Central Appalachians Stable Isotope Facility at the University of Maryland Center for Environmental Science, and the Marine Science Institute

Analytical Laboratory at the University of California, Santa Barbara.

Data Processing Description

BCO-DMO Processing:
- changed date format from mm-dd-yyyy to yyyy-mm-dd;
- replaced blanks (no data) with "nd".

[table of contents | back to top]

Data Files

File
rates.csv (Comma Separated Values (.csv), 3.04 KB) MD5:53d0577df7f112b71d0d84a88f57472e Primary data file for dataset ID 774602

[table of contents | back to top]

Related Publications

Damashek, J., Casciotti, K. L., & Francis, C. A. (2016). Variable Nitrification Rates Across Environmental Gradients in Turbid, Nutrient-Rich Estuary Waters of San Francisco Bay. Estuaries and Coasts, 39(4), 1050–1071. doi:10.1007/s12237-016-0071-7
Methods

Dugdale, R. C., & Goering, J. J. (1967). UPTAKE OF NEW AND REGENERATED FORMS OF NITROGEN IN PRIMARY PRODUCTIVITY1. Limnology and Oceanography, 12(2), 196–206. doi:10.4319/lo.1967.12.2.0196
Methods

McIlvin, M. R., & Casciotti, K. L. (2011). Technical Updates to the Bacterial Method for Nitrate Isotopic Analyses. Analytical Chemistry, 83(5), 1850–1856. doi:10.1021/ac1028984
Methods

Sigman, D. M., Casciotti, K. L., Andreani, M., Barford, C., Galanter, M., & Böhlke, J. K. (2001). A Bacterial Method for the Nitrogen Isotopic Analysis of Nitrate in Seawater and Freshwater. Analytical Chemistry, 73(17), 4145–4153. doi:10.1021/ac010088e
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
date	Date. Format: yyyy-mm-dd	unitless
depth	Depth	meters (m)
nh4_ox_1	Ammonia oxidation rate	nanomoles N per liter per day (nmol N L-1 d-1)
nh4_ox_2	Ammonia oxidation rate	nanomoles N per liter per day (nmol N L-1 d-1)
nh4_ox_3	Ammonia oxidation rate	nanomoles N per liter per day (nmol N L-1 d-1)
urea_ox_1	Urea-derived-N oxidation rate	nanomoles N per liter per day (nmol N L-1 d-1)
urea_ox_2	Urea-derived-N oxidation rate	nanomoles N per liter per day (nmol N L-1 d-1)
urea_ox_3	Urea-derived-N oxidation rate	nanomoles N per liter per day (nmol N L-1 d-1)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	SBE 9plus
Generic Instrument Name	CTD Sea-Bird 9
Dataset-specific Description	From 2014 to 2015, water samples were collected using a 12 x 12 L Niskin bottle rosette equipped with a conductivity, temperature, and density (CTD) instrument package (SBE 9plus, Sea-Bird Electronics, Bellevue, Washington, USA), including dissolved oxygen (SBE 43) and photosynthetically available radiation (PAR, LI-COR, Biospherical Instruments Inc., San Diego, California, USA) sensors. Due to CTD failure, samples collected in 2015 and 2016 were collected primarily using manually triggered Go-Flo bottles and depths were chosen primarily using a profiling natural fluorometer (PNF) system as well as secchi disk.
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	profiling natural fluorometer
Generic Instrument Name	Fluorometer
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

Dataset-specific Instrument Name	Go-Flo bottles
Generic Instrument Name	GO-FLO Bottle
Generic Instrument Description	GO-FLO bottle cast used to collect water samples for pigment, nutrient, plankton, etc. The GO-FLO sampling bottle is specially designed to avoid sample contamination at the surface, internal spring contamination, loss of sample on deck (internal seals), and exchange of water from different depths.

Dataset-specific Instrument Name	Finnigan Delta Plus XP IRMS, Finnigan Delta Plus Advantage IRMS
Generic Instrument Name	Isotope-ratio Mass Spectrometer
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).

Dataset-specific Instrument Name	Niskin bottle
Generic Instrument Name	Niskin bottle
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	secchi disk
Generic Instrument Name	Secchi Disc
Generic Instrument Description	Typically, a 16 inch diameter white/black quadrant disc used to measure water optical clarity

[table of contents | back to top]

Deployments

N-SPOT_Yellowfin_Cruises

Website	https://www.bco-dmo.org/deployment/773571
Platform	R/V Yellowfin
Start Date	2014-09-10
End Date	2016-08-31
Description	R/V Yellowfin cruises completed as part of the project "Collaborative Research: New Approaches to New Production" (N-SPOT) from September 2014 through August 2016. Cruises were conducted in the coastal waters of Southern California at the San Pedro Ocean Time-series (SPOT), located 17 km offshore between Los Angeles Harbor and Catalina Island.

[table of contents | back to top]

Project Information

Collaborative Research: New Approaches to New Production (N-SPOT)

Website: https://dornsife.usc.edu/labs/capone

Coverage: Coastal Waters of Southern California, San Pedro Ocean Time-series (SPOT), located 17 km offshore between Los Angeles Harbor and Catalina Island

NSF Award Abstract:
Coastal marine ecosystems are seasonally dynamic and highly productive. Phytoplankton populations shift from nutrient replete conditions in the spring to nutrient poor conditions in other seasons. The San Pedro Ocean Time-series (SPOT), located 17 km offshore between Los Angeles Harbor and Catalina Island, is a representative and accessible model coastal system with regular sampling and a substantial archive of relevant observations. The SPOT program has cataloged the dynamics, diversity, and productivity of microbial populations since 2000. With rising carbon dioxide (CO2) concentrations and resulting decreases in surface pH, it is critically important to understand the nutrient controls on primary production in coastal waters and the capacity of coastal ecosystems to sequester CO2. This project will examine rates of primary production, nitrogen uptake associated with primary production, and the oxidation of ammonium to nitrate (nitrification), at SPOT over two seasonal cycles. It will also contribute to the development of human resources in the marine sciences through the training of undergraduate and graduate students at the University of Southern California and the University of Maryland. The researchers participate in education outreach activities (e.g. through the Centers for Ocean Sciences Education Excellence programs), and will incorporate findings from this study in those presentations.

This project will investigate primary production and nitrogen (N) dynamics at SPOT and specifically implement an analysis of new production. The new production conceptual model has been a powerful organizing principle in biological oceanography and provides a means to constrain the amount of primary production that may be exported or "sequestered" from the system. Despite qualifications to the definitions of new and regenerated forms of N as originally articulated, the concept has, for the most part, been narrowly applied, specifying nitrate as the primary form of new N, and ammonium as the predominant recycled form. Evidence continues to accumulate that these definitions may warrant expansion. N fixation can be at times a substantial source of new N; similarly, forms of dissolved organic N (e.g., urea) may contribute significantly to recycled production, but the specific organisms taking part in these transformations are still uncertain. Nitrification in the upper water column may also compromise the strict definitions of new and recycled N. Scientists can now probe more deeply into new and regenerated production, and directly identify major agents of these processes using new molecular techniques. This project will quantify new and regenerated production in a coastal ecosystem, illuminating the predominant compounds involved. Rates of primary production, nitrate, ammonium and urea assimilation, N2 fixation, and nitrification will be determined in the upper water column in concert with monthly

SPOT cruises. In tandem, two stable isotope probing (SIP) approaches (conventional SIP for nitrate, ammonium and urea uptake coupled to high throughput sequencing and microarray based Chip-SIP for N2 fixation) will be used to directly identify the major agents involved in these processes, along with the uptake of 13C-urea into nitrifier biomass. The following two hypotheses will be tested:

1. N2 fixation is a substantial source of new N in coastal waters of Southern California supporting export production.

2. Forms of dissolved organic N, and specifically urea, can be substrates for nitrification and contribute substantially to regenerated production.

See the related project "Direct Identification and Characterization of Marine Heterotrophic Nitrogen Fixers by Stable Isotope Probing", funded by OCE-1341178, that involved novel stable isotope probing (SIP) methods.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1437310

[table of contents | back to top]