Compiled dataset consisting of published and unpublished global nitrate d15N measurements from from 1975-2018

Website: https://www.bco-dmo.org/dataset/768627
Data Type: Other Field Results
Version: 1
Version Date: 2019-05-28

Project
» Collaborative research: Combining models and observations to constrain the marine iron cycle (Fe Cycle Models and Observations)

Contributors	Affiliation	Role
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Abstract
Nitrate d15N observations were compiled from studies dating from 1975 to 2018. Whenever possible, the data was acquired via the original author, but in other cases the data was estimated from the publication directly. All observations were treated equally, although the failure to remove nitrite when using the "denitrifier method" may bias the nitrate d15N to low values (Rafter et al., 2013). This version of the dataset (1.0) will be updated as new data are published.

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Coverage

Spatial Extent: **N**:83 **E**:180 **S**:-78 **W**:-180
Temporal Extent: 1975 - 2018

Dataset Description

Version Note: This version of the dataset (1.0) will be updated as new data are published.

Methods & Sampling

Data Compilation: Nitrate d15N observations were compiled from studies dating from 1975 to 2018. Whenever possible, the data was acquired via the original author, but in other cases the data was estimated from the publication directly. All observations were treated equally, although the failure to remove nitrite when using the "denitrifier method" may bias the nitrate d15N to low values (Rafter et al., 2013).

For complete methodology, refer to Rafter et al. (2019).

Data Processing Description

Building the neural network model: We utilize an ensemble of artificial neural networks (EANNs) to interpolate this global ocean nitrate d15N database. For model results, see the related dataset: https://www.bco-dmo.org/dataset/768655

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Data Files

File
d15N_OBS.csv (Comma Separated Values (.csv), 538.42 KB) MD5:c1fece117a19c239db49e8a29afaeec7 Primary data file for dataset ID 768627

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Related Publications

Rafter, P. A., & Sigman, D. M. (2015). Spatial distribution and temporal variation of nitrate nitrogen and oxygen isotopes in the upper equatorial Pacific Ocean. Limnology and Oceanography, 61(1), 14–31. doi:10.1002/lno.10152
General

Rafter, P. A., Bagnell, A., Marconi, D., & DeVries, T. (2019). Global trends in marine nitrate N isotopes from observations and a neural network-based climatology. Biogeosciences Discussions, 1–31. doi:10.5194/bg-2018-525
Results

Rafter, P. A., Sigman, D. M., Charles, C. D., Kaiser, J., & Haug, G. H. (2012). Subsurface tropical Pacific nitrogen isotopic composition of nitrate: Biogeochemical signals and their transport. Global Biogeochemical Cycles, 26(1), n/a–n/a. doi:10.1029/2010gb003979 https://doi.org/10.1029/2010GB003979
General

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Parameters

Parameter	Description	Units
Latitude	Latitude in degrees north	degrees North
Longitude	Longitude in degrees East	degrees East
Depth	Depth	meters (m)
nitrate_d15N	The N isotopic composition of nitrate	per mil
nitrate	nitrate	micromoles per kilogram (umol kg-1)
reference	Reference(s)	unitless

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Project Information

Collaborative research: Combining models and observations to constrain the marine iron cycle (Fe Cycle Models and Observations)

NSF Award Abstract:
Tiny marine organisms called phytoplankton play a critical role in Earth's climate, by absorbing carbon dioxide from the atmosphere. In order to grow, these phytoplankton require nutrients that are dissolved in seawater. One of the rarest and most important of these nutrients is iron. Even though it is a critical life-sustaining nutrient, oceanographers still do not know much about how iron gets into the ocean, or how it is removed from seawater. In the past few years, scientists have made many thousands of measurements of the amount of dissolved iron in seawater, in environments ranging from the deep sea, to the Arctic, to the tropical oceans. They found that the amount of iron in seawater varies dramatically from place to place. Can this data tell us about how iron gets into the ocean, and how it is ultimately removed? Yes. In this project, scientists working on making measurements of iron in seawater will come together with scientists who are working on computer models of iron inputs and removal in the ocean. The goal is to work together to create a program that allows our computer models to "learn" from the data, much like an Artificial Intelligence program. This program will develop a "best estimate" of where and how much iron is coming into the ocean, how long it stays in the ocean, and ultimately how it gets removed. This will lead to a better understanding of how climate change will impact the delivery of iron to the ocean, and how phytoplankton will respond to climate change. With better climate models, society can make more informed decisions about how to respond to climate change. The study will also benefit a future generation of scientists, by training graduate students in a unique collaboration between scientists making seawater measurements, and those using computer models to interpret those measurements. Finally, the project aims to increase the participation of minority and low-income students in STEM (Science, Technology, Engineering, and Mathematics) research, through targeted outreach programs.

Iron (Fe) is an important micronutrient for marine phytoplankton that limits primary productivity over much of the ocean; however, the major fluxes in the marine Fe cycle remain poorly quantified. Ocean models that attempt to synthesize our understanding of Fe biogeochemistry predict widely different Fe inputs to the ocean, and are often unable to capture first-order features of the Fe distribution. The proposed work aims to resolve these problems using data assimilation (inverse) methods to "teach" the widely used Biogeochemical Elemental Cycling (BEC) model how to better represent Fe sources, sinks, and cycling processes. This will be achieved by implementing BEC in the efficient Ocean Circulation Inverse Model and expanding it to simulate the cycling of additional tracers that constrain unique aspects of the Fe cycle, including aluminum, thorium, helium and Fe isotopes. In this framework, the inverse model can rapidly explore alternative representations of Fe-cycling processes, guided by new high-quality observations made possible in large part by the GEOTRACES program.

The work will be the most concerted effort to date to synthesize these rich datasets into a realistic and mechanistic model of the marine Fe cycle. In addition, it will lead to a stronger consensus on the magnitude of fluxes in the marine Fe budget, and their relative importance in controlling Fe limitation of marine ecosystems, which are areas of active debate. It will guide future observational efforts, by identifying factors that are still poorly constrained, or regions of the ocean where new data will dramatically reduce remaining uncertainties and allow new robust predictions of Fe cycling under future climate change scenarios to be made, ultimately improving climate change predictions. A broader impact of this work on the scientific community will be the development of a fast, portable, and flexible global model of trace element cycling, designed to allow non-modelers to test hypotheses and visualize the effects of different processes on trace metal distributions. The research will also support the training of graduate students, and outreach to low-income and minority students in local school districts.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1658392

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