Noble gas global observations used in the ECCO noble gas model and simulations decomposed to isolate bubble-mediated gas exchange (Noble gas modeling project)

Website: https://www.bco-dmo.org/dataset/675575
Data Type: Cruise Results
Version:
Version Date: 2017-01-23

Project
» An Inverse and Forward Global Modeling Synthesis of Noble Gases to Better Quantify Biogeochemical Cycles (Noble gas modeling)

Contributors	Affiliation	Role
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Dataset Description

This dataset includes:
1) noble gas observations used in the ECCO noble gas model. They were collected globally at sea and were analyzed by mass spectrometry.
(2) model simulations decomposed to isolate bubble-mediated gas exchange.

Noble Gas Observations:
The observation data is provided in MATLAB format: noblegasDB.mat (download here) (size = 94 KB)
The variables are a MATLAB table 'NGall' and a list of original references 'NGprojects'
The served data is provided in jgofs format with the columns slightly rearranged for database best practices.

Global Model Simulations:

The simulation file is provided in MATLAB format: ECCOv2_NobleGases.mat (download here) (size = 1 GB)

Noble gases and nitrogen were simulated in the Estimating the Circulation & Climate of the Ocean (ECCO) global ocean state estimate utilizing a matrix-free Newton–Krylov (MFNK) scheme to efficiently compute the periodic seasonal solutions for noble gas tracers.

Original simulations:
sim1 = diffusive gas exchange only
sim2 = diffusive gas exchange and bubble injection
sim3 = diffusive gas exchange and bubble exchange

DG = sim1
IG = sim2-sim1
EG = sim3-sim1

For each gas 'G' total gas concentration is calculated as Gsol(S,T) * (AG + BG + CG)

DG is results of the simulation with no bubbles, while IG and EG are the isolated contribution from bubble injection and bubble exchange, respectively.

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Data Files

File
noble_gas_obs.csv (Comma Separated Values (.csv), 437.12 KB) MD5:85b65d7186f90acf86c3676c8e204347
Primary data file for dataset ID 675575

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Related Publications

Hamme, R. C. (2003), Applications of neon, nitrogen, argon and oxygen to physical, chemical and biological cycles in the ocean, Ph.D., University of Washington, Seattle, WA.
https://www.researchgate.net/profile/Roberta_Hamme/publication/33521492_Applications_of_neon_nitrogen_argon_and_oxygen_to_physical_chemical_and_biological_cycles_in_the_ocea
of-neon-nitrogen-argon-and-oxygen-to
Methods

Hamme, R. C., & Emerson, S. R. (2013). Deep-sea nutrient loss inferred from the marine dissolved N2/Ar ratio. Geophysical Research Letters, 40(6), 1149–1153.
doi:10.1002/grl.50275
Methods

Hamme, R. C., & Severinghaus, J. P. (2007). Trace gas disequilibria during deep-water formation. Deep Sea Research Part I: Oceanographic Research Papers, 54(6), 939–950.
doi:10.1016/j.dsr.2007.03.008
Methods

Loose, B., & Jenkins, W. J. (2014). The five stable noble gases are sensitive unambiguous tracers of glacial meltwater. Geophysical Research Letters, 41(8), 2835–2841.
doi:10.1002/2013gl058804 https://doi.org/10.1002/2013GL058804
Methods

Nicholson, D. P., Khatiwala, S., & Heimbach, P. (2016). Noble gas tracers of ventilation during deep-water formation in the Weddell Sea. IOP Conference Series: Earth and Environmental Science, 35, 012019. doi:10.1088/1755-1315/35/1/012019
Methods

Nicholson, D., Emerson, S., Caillon, N., Jouzel, J., & Hamme, R. C. (2010). Constraining ventilation during deepwater formation using deep ocean measurements of the dissolved

gas ratios40Ar/36Ar, N2/Ar, and Kr/Ar. Journal of Geophysical Research, 115(C11). doi:10.1029/2010jc006152 https://doi.org/10.1029/2010JC006152
Methods

Stanley, R. H. R., Jenkins, W. J., Lott, D. E., & Doney, S. C. (2009). Noble gas constraints on air-sea gas exchange and bubble fluxes. Journal of Geophysical Research, 114(C11). doi:10.1029/2009jc005396 https://doi.org/10.1029/2009JC005396
Methods

Well, R., & Roether, W. (2003). Neon distribution in South Atlantic and South Pacific waters. Deep Sea Research Part I: Oceanographic Research Papers, 50(6), 721–735. doi:10.1016/s0967-0637(03)00058-x https://doi.org/10.1016/S0967-0637(03)00058-X
Methods

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Parameters

Parameter	Description	Units
lon	longitude; east is positive	decimal degrees
lat	latitude; north is positive	decimal degrees
depth	sample depth	meters
daten	the date and time in matlab format; the number of days from January 0 0000	days
proj	Indicates the original project that published the data: 1 '[Nicholson et al. 2010]' 2 '[Hamme 2003]' 3 '[Hamme and Emerson, 2013]' 4 '[Well and Roether 2003]' 5 '[Stanley et al. 2009]' 6 '[Hamme and Severinghaus 2007]' 7 '[Loose and Jenkins 2014]'	unitless
Hesat	Helium saturation level; 100*(G/Geq -1)	percent
Nesat	Neon saturation level; 100*(G/Geq -1)	percent
Arsat	Argon saturation level; 100*(G/Geq -1)	percent
Krsat	Krypton saturation level; 100*(G/Geq -1)	percent
Xesat	Xenon saturation level; 100*(G/Geq -1)	percent
N2Arsat	Neon to Argon saturation ratio: ([G1]/[G2])/([G1]eq/[G2]eq)	dimensionless
KrArsat	Krypton to Argon saturation ratio: ([G1]/[G2])/([G1]eq/[G2]eq)	dimensionless

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Instruments

Dataset-specific Instrument Name	isotope ratio mass spectrometer (Finnigan MAT 251 or Delta XL at UW, MAT 253 at UVic)
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Used for Hamme & Emerson (2013) gas measurements
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	Hiden Quadrupole Mass Spectrometer (QMS)
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Used by Stanley et al (2009) to measure noble gasses.
Generic Instrument Description	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

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Deployments

Nicholson_lab

Website	https://www.bco-dmo.org/deployment/675585
Platform	WHOI
Start Date	2011-09-01
End Date	2016-08-31
Description	Modeling studies using data from published literature.

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Project Information

An Inverse and Forward Global Modeling Synthesis of Noble Gases to Better Quantify Biogeochemical Cycles (Noble gas modeling)

Coverage: Global

Extracted from the NSF award abstract:

The noble gases (helium, neon, argon, krypton, xenon) are dissolved in the ocean at concentrations near equilibrium with the atmosphere, have known physical properties, and are abiotic which makes them excellent tracers of the physical processes that cycle gases in the ocean. In addition, each of the gases has unique properties making them sensitive to different physical processes. For this reason, scientists from Woods Hole Oceanographic Institution and Lamont-Doherty Earth Observatory will use inverse and forward modeling of noble gases to improve our knowledge of the physical processes that control the cycle of gases such as carbon dioxide, oxygen, and nitrogen in the ocean. Specifically, they would address the following three processes: (1) parameterize bubble mediated air-sea gas fluxes from breaking waves; (2) identify the background ocean accumulation of dissolved nitrogen gas from biologically mediated denitrification in the deep ocean; and (3) evaluate the strength of the solubility pump using three ocean models. To accomplish their goal, the researchers plan to compile all available noble gas observations prior to constraining gas cycling via simulations performed using three state-of-the-art ocean circulation estimates based on the Community Earth System Model, the Geophysical Fluid Dynamics Laboratory Coupled Climate Model, and the Estimating the Circulation and Climate of the Ocean data assimilated model. From this modeling effort, the researchers will be able to interpret upper ocean oxygen measurements from autonomous sensors, constrain deep ocean denitrification, and evaluate the solubility pump which is needed to assess the anthropogenic uptake of carbon dioxide.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1129644

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