An objective map of global dissolved oxygen anomaly data based on World Ocean Database (2013) from 1950 to 2015

Website: https://www.bco-dmo.org/dataset/816978
Data Type: model results
Version: 1
Version Date: 2020-04-23

Project
» Collaborative Research: Combining Theory and Observations to Constrain Global Ocean Deoxygenation (Global Ocean Deoxygenation)

Contributors	Affiliation	Role
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Abstract
An objective map of global dissolved oxygen anomaly data based on World Ocean Database (2013) from 1950 to 2015. These data were published in Ito et al. (2017).

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Coverage

Spatial Extent: **N**:90 **E**:180 **S**:-90 **W**:-180
Temporal Extent: 1950 - 2015

Dataset Description

Dissolved oxygen anomalies are annually-averaged and are objectively mapped onto the global longitude-latitude grid at one-degree resolution and 47 vertical z-levels. The land-sea mask from the World Ocean Atlas 2013 is applied and the data is saved as a MATLAB structure array. While the calculation is performed from 1950 to 2015, the sampling density is relatively poor before 1960 and after 2010. Use caution when using early and recent time periods.

These data were published in Ito et al. (2017).

Acquisition Description

Please read the paper Ito et al. (2017) for a detailed, technical description. Only a brief explanation of the data is provided here.

Time period over which the mean and anomalies are computed:
Based on the World Ocean Database 2013, monthly O2 climatologies are calculated using all the available data from 1950 to 2015, but the outliers (extreme values defined as 3x the standard deviation) are excluded during the data quality control procedure. The removal of outliers affects the climatology and its statistics, so the climatologies are computed twice. The O2 climatology is therefore defined for the period of 1950-2015. The resulting oxygen anomalies are annually averaged and are objectively mapped onto the global longitude-latitude grid at one degree resolution. Finally, the land-sea mask from the World Ocean Atlas 2013 is applied and the data is saved as a MATLAB structure array (MATLAB file).

While the calculation is performed from 1950 to 2015, the sampling density is relatively poor before 1960 and after 2010 (it takes some time for new data to be included). Use caution when using early and recent time periods.

This data is open for all. While it is not necessary, you can email taka.ito (at) eas.gatech.edu if you are using this data and are interested in future updates or bug fixes.

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Data Files

File	Version
Global Upper Ocean Dissolved Oxygen Anomaly Dataset filename: o2_aan_mcl1950-2016_0147_QC3.nc (NetCDF, 778.42 MB) MD5:3a9c8771ff81275967e2a6b425dc08f8 *Global upper ocean dissolved oxygen anomaly data.* *See methodology on "Global Upper Ocean Dissolved Oxygen Anomaly Dataset" page https://www.bco-dmo.org/dataset/816978* *Parameters and units:* *depth,"depth_below_sea","m"* *lat,"latitude","degrees_north"* *lon,"longitude","degrees_east"* *o2,"oxygen_concentration","mmol_o2/m^3"* *time,"Time","years since 1950-12-31 23:15:00"* *netcdf o2_aan_mcl1950-2016_0147_QC3 {* *dimensions:* *lon = 360 ;* *lat = 180 ;* *depth = 47 ;* *time = UNLIMITED ; // (67 currently)* *variables:* *double lon(lon) ;* *lon:standard_name = "longitude" ;* *lon:long_name = "longitude" ;* *lon:units = "degrees_east" ;* *lon:axis = "X" ;* *double lat(lat) ;* *lat:standard_name = "latitude" ;* *lat:long_name = "latitude" ;* *lat:units = "degrees_north" ;* *lat:axis = "Y" ;* *double depth(depth) ;* *depth:standard_name = "depth" ;* *depth:long_name = "depth_below_sea" ;* *depth:units = "m" ;* *depth:positive = "down" ;* *depth:axis = "Z" ;* *double time(time) ;* *time:standard_name = "time" ;* *time:long_name = "Time" ;* *time:units = "years since 1950-12-31 23:15:00" ;* *time:calendar = "standard" ;* *time:axis = "T" ;* *float o2(time, depth, lat, lon) ;* *o2:_FillValue = 9.96921e+36f ;* *o2:missing_value = 9.96921e+36f ;* *o2:standard_name = "oxygen_concentration" ;* *o2:units = "mmol_o2/m^3" ;* *// global attributes:* *:CDI = "Climate Data Interface version 1.8.0 (http://mpimet.mpg.de/cdi)" ;* *:Conventions = "CF-1.6" ;* *:history = "Gridded World Ocean Database 2013 (unit converted, land-sea mask apply)" ;* *:NCO = "20180314" ;* *:nco_openmp_thread_number = 1 ;* *:CDO = "Climate Data Operators version 1.8.0 (http://mpimet.mpg.de/cdo)" ;* *}*	original

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Related Publications

Ito, T., Minobe, S., Long, M. C., & Deutsch, C. (2017). Upper ocean O2 trends: 1958-2015. Geophysical Research Letters, 44(9), 4214–4223. doi:10.1002/2017gl073613 https://doi.org/10.1002/2017GL073613
Results

Takamitsu, I. (n.d.). EAS@GT Data Access. Retrieved June 29, 2020, from http://o2.eas.gatech.edu/data.html

Different Version

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Related Datasets

IsDerivedFrom

Boyer, T. P., Antonov, J. I., Baranova, O. K., Garcia, H. E., Johnson, D. R., Mishonov, A. V., O'Brien, T. D., Seidov, D., Smolyar, I. (Igor), Zweng, M. M., Paver, C. R., Locarnini, R. A., Reagan, J. R., Coleman, C., & Grodsky, A. World ocean database 2013. *U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service, National Oceanographic Data Center, Ocean Climate Laboratory.* https://doi.org/10.7289/V5NZ85MT

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Parameters

Parameters for this dataset have not yet been identified

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Project Information

Collaborative Research: Combining Theory and Observations to Constrain Global Ocean Deoxygenation (Global Ocean Deoxygenation)

NSF Abstract:

This project will use a combination of ocean observations and modeling to understand why the dissolved oxygen concentration in the ocean changes on timescales of years to decades. As oceans absorb heat, its oxygen content is expected to decline which will affect marine ecosystems and oxygen-sensitive biochemical reactions. In turn, biochemical processes can affect the oxygen level. Understanding why oceanic oxygen changes remains limited due to sparse data and the fact that it naturally fluctuates. Furthermore, state-of-the-art Earth System Models, used to develop future projections, struggle to skillfully simulate present-day oxygen distributions. Given model biases, there is a clear need to re-calibrate model-based projections based on informed interpretations of available observations. The intellectual merit of this study is to perform a series of computational simulations to quantify linkages between the patterns of climate variability, ocean heating, and oxygen content for different regions. In conjunction with a novel synthesis of available observational data, this modeling study will develop a more comprehensive model for evaluating oxygen variability and change, thereby reducing uncertainty in future projections under climate forcing scenarios. Broader impacts of this study includes education and outreach about decreasing ocean concentrations in the ocean and its disruptive impacts on ocean biogeochemical cycles and marine ecosystems. Two Ph.D. students and a postdoctoral scientist will be trained under the supervision of the PIs.

Ocean deoxygenation is a direct consequence of ocean heat uptake; as ocean waters warm, dissolved oxygen (O2) concentrations decline, with profound influences on marine ecosystem and redox-sensitive biogeochemical cycling. Existing observations are characterized by significant interannual to decadal fluctuations. Natural variability challenges detection and attribution of human-driven trends; however, it can also be interrogated to provide mechanistic insight. State-of-the-art Earth System Models still struggle to skillfully simulate present-day O2 distributions but these models are useful because they invoke mechanistic representations of key processes. The objective of this project is to improve our understanding of the mechanisms behind interannual and decadal variability of O2 globally and regionally. Low- and high-latitude regions exhibit distinct patterns in dissolved oxygen and ocean heat content. In order to isolate the impact of physical and biological controls on O2 variability, a suite of numerical simulations will be conducted, including some with a global eddy-resolving configuration. Combining observational and model-based analyses will enable quantitative assessments about the relation between ocean heat uptake and deoxygenation, and linkages to climate variability and trends.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1737158
NSF Division of Ocean Sciences (NSF OCE)	OCE-1737188
NSF Division of Ocean Sciences (NSF OCE)	OCE-1737282

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