An objective map of global dissolved oxygen anomaly data based on World Ocean Database (2018) from 1965 to 2015

Website: https://www.bco-dmo.org/dataset/816978
Data Type: Other Field Results
Version: 2
Version Date: 2021-04-20

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

Contributors	Affiliation	Role
Ito, Takamitsu	Georgia Institute of Technology (GA Tech)	Principal Investigator
Deutsch, Curtis A.	University of Washington (UW)	Co-Principal Investigator
Long, Matthew H.	National Center for Atmospheric Research (NCAR)	Co-Principal Investigator
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
An objective map of global dissolved oxygen anomaly data based on World Ocean Database (2018) from 1965 to 2015.

Table of Contents

Coverage

Spatial Extent: **N**:90 **E**:180 **S**:-90 **W**:-180
Temporal Extent: 1965 - 2015

Dataset Description

A results paper for this dataset is in preparation for the Geoscience Data Journal as Ito T. (2021) Optimal interpolation of global dissolved oxygen: 1965-2015.

Methods & Sampling

This dataset provides a gridded map of dissolved oxygen for the global oceans using optimal interpolation method solely based on the Winker O2 measurements from the World Ocean Database 2018. The resulting gridded product includes full-depth map of dissolved oxygen from 1965 to 2015 with uncertainty estimates. The uncertainty can come from unresolved small-scale and high frequency variability and mapping errors. The multi-decadal trend of global dissolved oxygen is in the range of -281 to -373 Tmol/decade (95% confidence interval) with the median of -328 Tmol/decade. This estimate is more conservative than previous works. In optimal interpolation, the grid points far from the observations are essentially assigned to the climatology. The

results from this study likely provide a lower bound estimate of the global oxygen loss.

Further methodology details are included in the publication in preparation for the Geoscience Data Journal as Ito T. (2021) Optimal interpolation of global dissolved oxygen: 1965-2015.

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.

Data Processing Description

BCO-DMO Data Manager Processing Notes:
* Version 2 replaces version 1 on 2021-04-20. Version 1 of this dataset is still available as an archived copy at https://doi.org/10.26008/1912/bco-dmo.816978.1.
* Replaced version 1 data file o2_aan_mcl1950-2016_0147_QC3.nc with new version 2 file o2_aan_mcl1965-2015_rev1.nc.

Major updates in this version (2) compared to Version 1:
** The new dataset includes error estimates for each grid cell due to mapping error, unresolved small-scale and high-frequency variability
** The new data set includes full water column data. (The previous version was from the surface to 1,000m depth.)
** Time range has changed from 1965 to 2015.

[table of contents | back to top]

Data Files

File
Global Upper Ocean Dissolved Oxygen Anomaly Dataset filename: o2_aan_mcl1965-2015_rev1.nc (NetCDF, 7.63 GB) MD5:296308efbcc55c3e57857f415c2e541f 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 Parameter name,description,units: depth,"depth from the surface ocean","m" lat,"latitude","degrees_north" lon,"longitude","degrees_east" o2,"objective map of dissolved oxygen anomaly","micro-molO2/L" o2_R2,"coefficient of determination for objective map","ND" o2_rmse,"root mean square error of objective map","micro-molO2/L" o2_se_hfvar,"standard error due to high frequency variability","micro-molO2/L" o2_se_sgn,"standard error due to sub-grid scale noise","micro-molO2/L" .nc header information: netcdf o2_aan_mcl1965-2015_rev1 { dimensions:

File

```
 lon = 360 ;
 lat = 180 ;
 depth = 102 ;
 bnds = 2 ;
 time = 51 ;
variables:
 double lon(lon) ;
  lon:standard_name = "lon" ;
  lon:long_name = "longitude" ;
  lon:units = "degrees_east" ;
  lon:_FillValue = -99999. ;
 double lat(lat) ;
  lat:standard_name = "lat" ;
  lat:long_name = "latitude" ;
  lat:units = "degrees_north" ;
  lat:_FillValue = -99999. ;
 double depth(depth) ;
  depth:standard_name = "depth" ;
  depth:long_name = "depth from the surface ocean" ;
  depth:units = "m" ;
  depth:bounds = "depth_bnds" ;
  depth:_FillValue = -99999. ;
 double depth_bnds(depth, bnds) ;
  depth_bnds:standard_name = "depth" ;
  depth_bnds:units = "m" ;
  depth_bnds:_FillValue = -99999. ;
 double time(time) ;
  time:standard_name = "time" ;
  time:long_name = "days since 0000-01-01 00:00:00" ;
  time:units = "days" ;
  time:_FillValue = -99999. ;
 double o2(time, depth, lat, lon) ;
  o2:long_name = "objective map of dissolved oxygen anomaly" ;
  o2:units = "micro-molO2/L" ;
  o2:_FillValue = -99999. ;
 double o2_rmse(time, depth, lat, lon) ;
  o2_rmse:long_name = "root mean square error of objective map" ;
  o2_rmse:units = "micro-molO2/L" ;
  o2_rmse:_FillValue = -99999. ;
 double o2_R2(time, depth, lat, lon) ;
  o2_R2:long_name = "coefficient of determination for objective map" ;
  o2_R2:units = "ND" ;
  o2_R2:_FillValue = -99999. ;
```

File

```
 double o2_se_hfvar(depth, lat, lon) ;
  o2_se_hfvar:long_name = "standard error due to high frequency variability" ;
  o2_se_hfvar:units = "micro-molO2/L" ;
  o2_se_hfvar:_FillValue = -99999. ;
 double o2_se_sgn(depth, lat, lon) ;
  o2_se_sgn:long_name = "standard error due to sub-grid scale noise" ;
  o2_se_sgn:units = "micro-molO2/L" ;
  o2_se_sgn:_FillValue = -99999. ;


// global attributes:
  :title = "objectively mapped dissolved oxygen based on World Ocean Database 2018" ;
  :Conventions = "CF-1.6" ;
  :CreationDate = "2021/03/29 02:09:06" ;
}
```

[table of contents | back to top]

Related Publications

Ito, T. (2021). Optimal interpolation of global dissolved oxygen: 1965–2015. Geoscience Data Journal, 9(1), 167–176. Portico. https://doi.org/10.1002/gdj3.130
Results

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

[table of contents | back to top]

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

[table of contents | back to top]

Parameters

Parameters for this dataset have not yet been identified

[table of contents | back to top]

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.

[table of contents | back to top]

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

[table of contents | back to top]