

# Calibrated dissolved oxygen time series at the Ocean Observatories Initiative's Irminger Sea Array from 2014 to 2022

**Website:** <https://www.bco-dmo.org/dataset/998868>

**Data Type:** Other Field Results

**Version:** 1

**Version Date:** 2026-05-19

## Project

» [CAREER: Constraining the high-latitude ocean carbon cycle: Leveraging the Ocean Observatories Initiative \(OOI\) Global Arrays as marine biogeochemical time series](#) (OOI Global BGC time series)

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## Abstract

This dataset contains calibrated, full water-column dissolved oxygen time series collected at the Ocean Observations Initiative (OOI) Global Irminger Sea Array (59.97°N, 39.51°W) from September 2014 to July 2022 from profiling and fixed-depth assets. Optodes on the wire-following profilers (WFP) were calibrated using the “deep isotherm approach”, which assumes that oxygen remains stable on a deep isotherm over time. We used bottle-calibrated profiles from turn-around cruises to determine the oxygen concentration on a deep, stable isotherm. Oxygen optodes on the WFP were then calibrated to this concentration as they passed through this isotherm during each profile. This calibration was then passed on to oxygen data collected by gliders transiting the array. Starting in 2018, we include surface mixed-layer dissolved oxygen data that were calibrated based on turn-around cruise measurements at the beginning and end of each sensor deployment. This dataset contains calibrated oxygen data from surface moorings, wire-following profilers, and gliders at their original sampling intervals as well as a blended product that combines oxygen products from all calibrated assets. An overview of the data collection and post-processing required for oxygen optode calibration is included. This dataset is presented for end-users that require field-calibrated oxygen data products that are currently not provided by OOI through its standard data dissemination.

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## Coverage

**Location:** Subpolar North Atlantic (60° N, 39.5° W) from the surface to depths of 2600 m

**Spatial Extent:** **Lat:**59.972 **Lon:**-39.506

**Temporal Extent:** 2014-09-11 - 2022-01-03

## Dataset Description

Primary award supporting the dataset is OCE-2338450 (CAREER: Constraining the high-latitude ocean carbon cycle: Leveraging the Ocean Observatories Initiative (OOI) Global Arrays as marine biogeochemical time series), other awards supporting the data are: OCE-1946072, and OCE-1755574 (Collaborative Research: The Annual Cycle of the Biological Carbon Pump in the Subpolar North Atlantic).

The dataset serves the .csv, matlab and netcdf format of the blended oxygen product for increased reuse purposes.

## Methods & Sampling

The data presented here were collected by the OOI Global Irminger Sea Array Apex Surface Mooring (SUMO), Apex Wire Following Profiler Mooring (WFP), and Mobile Assets (gliders). Unprocessed data are available at the OOI THREDDS Data Server and OOI Raw Data Archive. Links and DOIs of the instruments and servers can be found under the related datasets section below.

The SUMO 1-m oxygen sensor makes measurements continuously at 0.5 Hz while the 12-m oxygen sensor makes burst measurements at 0.5 Hz for 3 minutes every 15 minutes. The WFP (~170-2600 m) collects a profile every 20 hours with a vertical sampling resolution of  $2.3 \pm 0.15$  dbar. While operational, gliders (0-200 m or 0-1000 m) collected profiles approximately 3 times a day with typical vertical sampling resolutions ranging from 0.2 to 7 dbar across deployments.

## Data Processing Description

We synthesized DO data from the Aanderaa oxygen optodes deployed on the wire-following profiler (WFP), gliders, and surface mooring (SUMO) fixed-depth oxygen sensors to create an intercalibrated, depth-resolved oxygen time series over the full water column throughout the period from January 2015-January 2022. The data QA/QC and calibration approaches applied here build upon community-developed best practices for processing OOI oxygen data (Palevsky, Clayton, et al., 2023) and recommendations for calibration of moored oxygen optodes (Miller et al., 2024), while also incorporating additional steps that our team found were necessary to produce the highest-quality possible final dataset.

We summarize here the methods followed to calibrate each of the individual oxygen assets included in the synthesis data product, with further details provided in the Supplementary Information of Fogaren et al. 2026. We used shipboard DO measurements to produce calibrated oxygen depth profiles for each of the turn-around cruises from 2014 to 2022 (Fogaren & Palevsky, 2023). Data from these profiles were used to determine DO concentrations on a stable deep isotherm ( $3.1\theta$ ,  $1926 \pm 71$  dbar) that was not impacted by wintertime ventilation. WFP oxygen data, which measure this deep isotherm on every profile, were calibrated to the measurements on this deep isotherm (building on the approach of Takeshita et al., 2013 and Palevsky & Nicholson, 2018). This calibration was passed on to oxygen data collected by gliders transiting the array based on matchups between temporally and spatially aligned glider and WFP profiles when the glider was within the vicinity of the WFP (<4 km). For the second half of the analysis period, beginning in July 2018, we also include surface mixed-layer dissolved oxygen data collected from optodes deployed at 1 m and 12 m on the Apex surface mooring in the oxygen sensor calibration process. These mixed-layer DO data were separately calibrated based on turn-around cruise measurements at the beginning and end of each sensor deployment and showed good agreement with surface mixed-layer oxygen measurements from the gliders calibrated using the deep isotherm-based method (residual mean  $\pm$  standard deviation =  $1.6 \pm 4.6$   $\mu\text{mol kg}^{-1}$ ).

We calculated a daily oxygen concentration along each isobar after removing density and oxygen outliers. To calculate density outliers, density data is detrended along each isobar while below the mixed layer and outliers are determined as data more than 1.5 interquartile ranges above the upper quartile or below the low quartile of the detrended data. After removing density outliers, oxygen data from all glider and WFP deployments are combined and oxygen outliers are determined using the same method used for density outlier detection. A daily mean oxygen value is then computed for each isobar. For full details see Methods and Text S1 and Figure S1-S5 in Fogaren et al. (2026).

## BCO-DMO Processing Description

- \* Moved links and references from methods text to related publications section
- \* Added description on awards related to dataset
- \* Converted Time column name to ISO\_DateTime\_UTC and adjusted formatting from ... to ...

### Problem Description

The use of UV lamps to prevent biofouling on oxygen optodes deployed in the surface ocean started in April 2018. Prior to these biofouling mitigation efforts, surface ocean (SUMO) and (NSIF) optodes experienced biofouling; and therefore, were not calibrated. Gliders are deployed during OOI turn-around cruises each summer. The extent of temporal coverage by gliders varied from year to year with no usable glider data collected for OOI Deployment Year 3 (2017-2018). The wire-following profiler experienced issues resulting in small temporal data gaps in mid 2016, mid 2017 and mid 2018. More substantial data gaps occur in mid 2020, mid 2021 and beginning of 2022.

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### Related Publications

Article has been accepted and is in press. <https://doi.org/10.1029/2025JC023822>

*Results*

Miller, U. K., Fogaren, K. E., Atamanchuk, D., Johnson, C., Koelling, J., Le Bras, I., Lindeman, M., Nagao, H., Nicholson, D. P., Palevsky, H., Park, E., Yoder, M., & Palter, J. B. (2024). Oxygen optodes on oceanographic moorings: recommendations for deployment and in situ calibration. *Frontiers in Marine Science*, 11.

<https://doi.org/10.3389/fmars.2024.1441976>

*Methods*

Palevsky, H., & Nicholson, D. (2018). The North Atlantic Biological Pump: Insights from the Ocean Observatories Initiative Irminger Sea Array. *Oceanography*, 31(1), 42-49.

<https://doi.org/10.5670/oceanog.2018.108>

*Methods*

Palevsky, H., Clayton, S., Atamanchuk, D., Battisti, R., Batryn, J., Bourbonnais, A., Briggs, E. M., Carvalho, F., Chase, A. P., Eveleth, R., Fatland, R., Fogaren, K. E., Fram, J. P., Hartman, S. E., Le Bras, I., Manning, C. C. M., Needoba, J. A., Neely, M. B., Oliver, H., ... Wingard, C. (2022). *OOI Biogeochemical Sensor Data Best Practices and User Guide. Version 1.0.0*. Ocean Observatories Initiative, Biogeochemical Sensor Data Working Group.

<https://doi.org/10.25607/OBP-1865>

*Methods*

Takeshita, Y., Martz, T. R., Johnson, K. S., Plant, J. N., Gilbert, D., Riser, S. C., Neill, C., & Tilbrook, B. (2013). A climatology-based quality control procedure for profiling float oxygen data. *Journal of Geophysical Research: Oceans*, 118(10), 5640-5650. Portico. <https://doi.org/10.1002/jgrc.20399>

<https://doi.org/10.1002/jgrc.20399>

*Methods*

Yoder, M. F., Palevsky, H. I., & Fogaren, K. E. (2024). Net Community Production and Inorganic Carbon Cycling in the Central Irminger Sea. *Journal of Geophysical Research: Oceans*, 129(7). Portico.

<https://doi.org/10.1029/2024jc021027> <https://doi.org/10.1029/2024JC021027>

*Results*

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### Related Datasets

#### IsRelatedTo

Fogaren, K. E., Palevsky, H. I. (2023) **Bottle-calibrated dissolved oxygen profiles from yearly turn-around cruises for the Ocean Observations Initiative (OOI) Irminger Sea Array 2014 - 2022**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-07-19 doi:10.26008/1912/bco-dmo.904721.1 [[view at BCO-DMO](#)]

NSF Ocean Observatories Initiative (2025) **OOI Global Irminger Sea Array CTD and Discrete Water Sampling Data from Mooring Overturning Cruises in the Irminger Sea from 2014-2023 (OOI Cruise Data project)**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-10-24 doi:10.26008/1912/bco-dmo.911407.1 [[view at BCO-DMO](#)]

Ocean Observatories Initiative. (2014). *Irminger Sea Mobile Assets* [Dataset]. Ocean Observatories Initiative. <https://doi.org/10.58046/OOI-GI05MOAS>

Ocean Observatories Initiative. (2014). *Irminger Sea Profiler Mooring* [Dataset]. Ocean Observatories Initiative. <https://doi.org/10.58046/OOI-GI02HYPM>

Ocean Observatories Initiative. (2014). *Irminger Sea Surface Mooring* [Dataset]. Ocean Observatories Initiative. <https://doi.org/10.58046/OOI-GI01SUMO>

Ocean Observatories Initiative. (n.d.). OOI THREDDS Data Server: Catalog. Retrieved May 19, 2026, from <https://thredds.dataexplorer.oceanobservatories.org/thredds/catalog/ooigoldcopy/public/catalog.html>

Ocean Observatories Initiative. (n.d.). OOI raw data files [Data set]. Retrieved May 19, 2026, from <https://rawdata.oceanobservatories.org/files/>

Palevsky, H. I., Fogaren, K. E., Nicholson, D. P., Yoder, M. (2023) **Supplementary discrete sample measurements of dissolved oxygen, dissolved inorganic carbon, and total alkalinity from Ocean Observatories Initiative (OOI) cruises to the Irminger Sea Array 2018-2019**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-07-19 doi:10.26008/1912/bco-dmo.904722.1 [[view at BCO-DMO](#)]

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## Parameters

Parameter	Description	Units
ISO_DateTime_UTC	date and time (UTC)	unitless
profile_number	profile number	unitless
longitude	longitude	decimal degrees
latitude	latitude	decimal degrees
prs_dbar	pressure	decibar (db)
DO_umolkg	calibrated dissolved oxygen	µmol/kg

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## Instruments

<b>Dataset-specific Instrument Name</b>	Sea-Bird Scientific, Bellevue, WA
<b>Generic Instrument Name</b>	CTD Sea-Bird
<b>Dataset-specific Description</b>	conductivity, temperature, depth (CTD) instruments
<b>Generic Instrument Description</b>	A Conductivity, Temperature, Depth (CTD) sensor package from SeaBird Electronics. This instrument designation is used when specific make and model are not known or when a more specific term is not available in the BCO-DMO vocabulary. Refer to the dataset-specific metadata for more information about the specific CTD used. More information from: <a href="http://www.seabird.com/">http://www.seabird.com/</a>

<b>Dataset-specific Instrument Name</b>	oxygen optodes (Aanderaa, Norway)
<b>Generic Instrument Name</b>	Oxygen Sensor
<b>Generic Instrument Description</b>	An electronic device that measures the proportion of oxygen (O <sub>2</sub> ) in the gas or liquid being analyzed

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## Project Information

### **CAREER: Constraining the high-latitude ocean carbon cycle: Leveraging the Ocean Observatories Initiative (OOI) Global Arrays as marine biogeochemical time series (OOI Global BGC time series)**

#### ***NSF Award Abstract:***

The ocean absorbs a large fraction of the atmospheric carbon dioxide generated by the burning of fossil fuels. Much of this uptake occurs in high latitude (polar) regions of the ocean. However, current monitoring capabilities in the polar ocean are limited. The Ocean Observatories Initiative (OOI) aims to address this need by providing 25 years of continuous physical and biogeochemical sensor data from autonomous platforms in the high latitude ocean. This CAREER project will improve understanding of the marine carbon cycle in the high latitude ocean using OOI data. The science team will use biogeochemical data collected by the OOI sensors to monitor long term changes in carbon cycling processes. In addition, this CAREER project includes educational activities to broaden participation in oceanographic research. The lead scientist will develop a new research seminar course to provide training and research opportunities for undergraduate students. A series of educational videos will be created to showcase the use and application of OOI data. The videos will be used in college level courses at three universities. This project will provide training opportunities for eight undergraduate students, two doctoral students, and one postdoctoral researcher.

This CAREER project will utilize marine biogeochemical time series data from Ocean Observatories Initiative (OOI) locations in the subpolar North Atlantic and subarctic Northeast Pacific to evaluate the relative roles of biological, chemical, and physical processes driving the ocean's carbon sink. The project seeks to improve the usability of OOI biogeochemical (BGC) sensor data and leverage these marine BGC time series data to determine changes in carbon cycling processes in the subpolar North Atlantic and subarctic Northeast Pacific Oceans. This research is key for predicting long term perturbations due to climate change and for understanding how changes in carbon cycling in these regions will influence carbon sequestration. The objectives of this project are to: 1) quantify the rates and drivers of carbon cycling and long-term carbon sequestration in the subpolar North Atlantic and subarctic Northeast Pacific Oceans and 2) determine the mechanistic controls on the ocean carbon sink due to inter-related biological, chemical, and physical processes over >10 years at each array site. The high temporal resolution BGC data collected by the arrays will improve understanding of the sampling resolution needed to capture key carbon cycling processes and test the hypothesis that short-time scale events during spring phytoplankton blooms and strong winter storms play a

significant role in the overall annual carbon cycle. Education activities associated with this CAREER project include a series of educational videos about OOI and use of the data it provides that will be incorporated into undergraduate courses, a new research seminar course for undergraduates, and research opportunities for undergraduate and graduate students as well as a postdoctoral researcher.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-2338450</a>

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