Dissolved oxygen time series measured on the Overturning in the Subpolar North Atlantic Program (OSNAP) moorings within the boundary currents of the Labrador and Irminger Seas from summer 2020 to summer 2022

Website: https://www.bco-dmo.org/dataset/986667
Data Type: Cruise Results
Version: 1
Version Date: 2025-10-13

Project
» Collaborative Research: Gases in the Overturning and Horizontal circulation of the Subpolar North Atlantic Program (GOHSNAP) (GOHSNAP)

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Abstract
This dataset contains oxygen time series collected from June 2020 - July 2022 on the Overturning in the Subpolar North Atlantic Program (OSNAP) moorings CF1, CF3, CF4, CF5, CF6, CF7, M1, M2, and M3 moorings in the western Irminger Sea, the C1_b, C2_b, C3_b, K7, K8, K9, K10, and DSOW 2 in the western Labrador Sea, and the LS1, LS3, LS4, LS5, LS6, LS7, and LS8 in the eastern Labrador Sea. Depths of oxygen data collection on the moorings range from as shallow as 50 m to as deep as 3500 m, covering the seasonally-stratified, near-surface waters, Labrador Sea Water, Northeast Atlantic Deep Water, and Denmark Strait Overflow Water masses. These data were collected and calibrated for the Gases in the Overturning and Horizontal circulation of the Subpolar North Atlantic Program (GOHSNAP) for the purpose of calculating oxygen transports in the Labrador Sea. Data were calibrated and corrected for drift using Winkler-calibrated shipboard oxygen casts collected on the mooring recovery and deployment cruises, described in Miller et al. (2024) (Frontiers in Marine Science; 10.3389/fmars.2024.1441976).

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Coverage

Location: Labrador and western Irminger Seas
Spatial Extent: **N**:60.07 **E**:-40.275 **S**:52.685 **W**:-51.9634
Temporal Extent: 2020-06 - 2022-09

Dataset Description

This dataset contains dissolved oxygen time series in two formats: a combined table and individual tables by deployment. The combined table, “986667_v1_oxygen-time-series.csv,” includes the contents of all 60 CSV files contained within Oxygen_time_series-per-deployment.zip, along with deployment metadata from deployment_metadata.csv.

This dataset was supported by GOHSNAP awards NSF OCE-1947829 and OCE-1947970, with additional support from NSF OCE-2038481, OCE-2122579, OCE-2023080, and OCE-1947567.

OSNAP = Overturning in the Subpolar North Atlantic Program
GOHSNAP = Gases in the Overturning and Horizontal circulation of the Subpolar North Atlantic Program

Methods & Sampling

Optodes were deployed on moorings within the boundary currents entering and exiting the Labrador Sea, specifically, the Labrador Current in the western Labrador Sea (moorings C1_b, C2_b, C3_b, K7, K8, K9, K10, DSOW 2, and DSOW5), the West Greenland Current in the eastern Labrador Sea (LS1, LS3, LS4, LS5, LS6, LS7, and LS8), and the East Greenland Current in the western Irminger Sea (moorings CF1, CF3, CF4, CF5, CF6, CF7, M1, M2, and M3). These moorings were part of the Overturning in the Subpolar North Atlantic Program (OSNAP) mooring array. Optodes were set to sample every 15 minutes and were deployed from June 2020 - June 2022. LS1, LS3, LS4, LS5, LS6, LS7, and LS8 in the eastern Labrador Sea. Depths of oxygen data collection on the moorings ranged from as shallow as 50 m to as deep as 3500 m, selected to cover the seasonally-stratified, near-surface waters, Labrador Sea Water, Northeast Atlantic Deep Water, and Denmark Strait Overflow Water masses.

Data Processing Description

Moored optode oxygen time series processing, calibration, and validation protocols are described in detail in Miller et al. (2024; 10.3389/fmars.2024.1441976). All oxygen time series were corrected for the instantaneous pressure response (Bittig et al., 2018; 10.3389/fmars.2017.00429) and "irreversible" drift using calibrated oxygen profiles collected on "cal-dip" casts, which are shipboard conductivity-temperature-depth-oxygen (CTD-oxygen) casts on which the optodes are strapped to the CTD rosette and dual CTD-oxygen and optode-oxygen profiles are obtained, and "cal-casts", calibrated CTD-oxygen casts taken in the vicinity of the in-water optodes both upon mooring deployment and upon mooring recovery. Optodes deployed at depths greater than 1000 m were checked and where applicable, corrected for pressure-related "reversible" drift. Calibrated oxygen time series were validated against cal-cast profiles external to the calibration process as well as BGC-Argo oxygen profiles collated within a 100 km radius of each mooring.

BCO-DMO Processing Description

* 60 csv files for the oxygen time series (one per deployment) were zipped and attached to this dataset as supplemental file Oxygen_time_series-per-deployment.zip.
* The tables within the 60 csv files were concatenated into the combined table

In the combined table 986667_v1_oxygen-time-series.csv the following changes were also made:
* Additional metadata added from a supplied file "Metadata_with_added_filenames.xlsx"
* Date converted to ISO 8601 format
* Column "TIME" converted to ISO 8601 DateTime with timezone (UTC) format and renamed "ISO_DateTime_UTC"

Supplemental file "deployment_metadata.csv" added from contents of submitted file "Metadata_with_added_filenames.xlsx"
* Duplicate serial number column removed
* Dates converted to ISO format
* Space removed from value in Filename column "CF6_ 1500m_sn204363.csv" so it matches the provided file

Problem Description

The second calibration factor (G_2) is missing for five optodes, serial numbers 204334, 3312, 3415, 3409, and 52630. Here, either the optode or the temperature-salinity sensors ran out of battery prior to mooring recovery, inhibiting the calculation of G_2 from the recovery cal-cast. Instead, based on the age (and therefore, stability) of these particular optodes, as well as visual inspection of the time series, drift was assumed to be near-constant during the deployment period and G_2 was assigned the same value as G_1.

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Related Publications

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

Una Kim Miller. (2025). optode_processing_examples: v1 (Version v1) [Computer software]. Zenodo. https://doi.org/10.5281/ZENODO.16786204 https://doi.org/10.5281/zenodo.16786204
Methods

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Parameters

Parameter	Description	Units
ISO_DateTime_UTC	Datetime with timezone (ISO 8601 format), UTC	unitless
TEMP	in-situ temperature	degrees Celsius
PTEMP	potential temperature	degrees Celsius

PSAL	practical salinity	Practical Salinity Units (PSU)
PRES	pressure	decibars (dbar)
DOXY	Uncalibrated dissolved oxygen	micromoles per kilogram (umol/kg)
DOXY_drift_corrected	Dissolved oxygen that has been corrected for the instantaneous pressure effect and drift	micromoles per kilogram (umol/kg)
filename	Name of mooring on which the optode was deployed	unitless
serial_number	Optode serial number	unitless
mooring	Name of mooring on which the optode was deployed	unitless
osnap_id	The Overturning in the Subpolar North Atlantic Program (OSNAP) mooring ID	unitless
depth	Depth of optode deployment	meters (m)
location	Region of mooring/optode deployment	unitless
latitude	latitude (Positive north, negative south)	decimal degrees
longitude	longitude (Positive east, negative west)	decimal degrees
deploy_cruise_id	Name of research cruise on which the optode/mooring was deployed. AM is Amudsen, AR is Armstrong, MSM is Maria S Merian	unitless
deploy_date	Date on which the optode/mooring was deployed	unitless
recovery_cruise_id	Name of the research cruise on which the optode/mooring was recovered. AT is Atlantis, M is Meteor, AR is Armstrong	unitless
recovery_date	Date on which the optode/mooring was recovered	unitless
P_c	The pressure correction factor used to correct for the instantaneous pressure effect (see p_fac and correction of instantaneous pressure effect in Miller et al., 2024; 10.3389/fmars.2024.1441976)	unitless

G_1	Gain correction factor 1 used to correct for irreversible drift. Derived from the deployment cruise cal-dip cast for all optodes except those in which reversible drift was detected. In these cases, the deployment cruise cal-cast was used instead. (See cal-dip, cal-cast, irreversible drift, reversible drift, and drift correction steps in Miller et al., 2024; 10.3389/fmars.2024.1441976)	unitless
G_2	Gain correction factor 2 used to correct for irreversible drift. Derived from the recovery cruise cal-cast. (See cal-cast, irreversible drift, and drift correction steps in Miller et al., 2024; 10.3389/fmars.2024.1441976)	unitless
reversible_drift	Flag for the presence and correction of reversible drift (See reversible drift and drift correction steps in Miller et al., 2024; 10.3389/fmars.2024.1441976). 1 is true, 0 is false	unitless

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Instruments

Dataset-specific Instrument Name	Aanderaa 4330 optodes integrated with RBR loggers
Generic Instrument Name	Optode
Generic Instrument Description	An optode or optrode is an optical sensor device that optically measures a specific substance usually with the aid of a chemical transducer.

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Deployments

AR46

Website	https://www.bco-dmo.org/deployment/904871
Platform	R/V Neil Armstrong
Start Date	2020-08-07
End Date	2020-09-07

AR69-01

Website	https://www.bco-dmo.org/deployment/904879
Platform	R/V Neil Armstrong
Start Date	2022-06-20
End Date	2022-07-19

AR45

Website	https://www.bco-dmo.org/deployment/933794
Platform	R/V Neil Armstrong
Report	https://doi.org/10.35090/gatech/66767
Start Date	2020-06-23
End Date	2020-08-01

AR69-03

Website	https://www.bco-dmo.org/deployment/933797
Platform	R/V Neil Armstrong
Report	https://cchdo.ucsd.edu/cruise/33VB20220819
Start Date	2022-08-19
End Date	2022-09-24

MSM94

Website	https://www.bco-dmo.org/deployment/990149
Platform	R/V Maria S. Merian
Report	https://www.ldf.uni-hamburg.de/merian/wochenberichte/wochenberichte-merian/msm94-msm97-2/exp-msm94.pdf
Start Date	2020-08-02
End Date	2020-09-06

M184

Website	https://www.bco-dmo.org/deployment/990154
Platform	R/V Meteor
Report	https://www.ldf.uni-hamburg.de/meteor/wochenberichte/wochenberichte-meteor/m181-m190/scr-m184.pdf
Start Date	2022-08-12
End Date	2022-09-15

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Project Information

Collaborative Research: Gases in the Overturning and Horizontal circulation of the Subpolar North Atlantic Program (GOHSNAP) (GOHSNAP)

Coverage: Subpolar North Atlantic

NSF Award Abstract:
Every winter, frigid winds blowing eastward from the North American continent cool the surface waters of the

Labrador Sea, which is situated between Canada and Greenland. As the ocean cools, oxygen and carbon dioxide are mixed from the atmosphere into a thick layer of water that ultimately spreads southward to fill a large volume of the North Atlantic and beyond. The presence of this water mass prevents the North Atlantic anywhere from becoming completely devoid of oxygen. Vertical mixing in the Labrador Sea also redistributes carbon dioxide into the deep ocean, where it can remain for hundreds of years, preventing it from contributing to the greenhouse effect. Yet, the processes governing the uptake of gases by the ocean are not well understood or quantified. Given that, over the last century, the ocean has become steadily more depleted in oxygen while also absorbing a large fraction of anthropogenic carbon dioxide, observing gas exchange processes is essential for understanding and predicting the evolution of the ocean and climate system. The circulation of the Labrador Sea has been monitored since 2014 with an array of instrumented cables extending from the seafloor to nearly the ocean surface. This project adds gas sensors to this array to investigate the rates and processes governing gas exchange. Through this project, a student and postdoc will be trained in interdisciplinary oceanography with a rich network of international collaborators. Responding to the need to increase public ocean literacy, the project scientists will work with University of Rhode Island's Inner Space Center to broadcast live, interactive science sessions to educators at partner high schools and will follow-up with in-person science cafés at three participating schools.

Given the unique role of the Labrador Sea in providing a pathway for oxygen (O2) and carbon dioxide (CO2) to enter the intermediate depths of the ocean, a quantification and mechanistic understanding of the gas uptake and transport in the basin is a leading scientific priority. Oxygenation of Labrador Sea water prevents large-scale hypoxia from developing anywhere in the Atlantic Ocean and anthropogenic CO2 storage in the basin is the highest in the global ocean. The assumption that, in the Atlantic Ocean, O2 and CO2 uptake and their variability are tied to the dynamics of heat loss and the overturning circulation pervades the literature but has never been evaluated on the basis of direct observations. Thus, GOHSNAP (Gases in the Overturning and Horizontal circulation of the Subpolar North Atlantic Program) addresses this gap and the urgent need to better understand interactions between gas uptake, transport, and the overturning circulation. Specifically, this program will provide a continuous 2-year record of the trans-basin, full water column transport of O2 across the southern boundary of the Labrador Sea, leveraging the mooring infrastructure of the US-lead, international Overturning in the Subpolar North Atlantic Program (OSNAP). The addition of O2 sensors at various depths on this array, supplemented by observations collected by autonomous platforms will allow for the quantification of O2 export from the Labrador Sea. The data will further be used to empirically model carbon concentrations and estimate carbon export. Proposed instruments will also measure the mixed layer O2 and pCO2 for two winters, from which air-sea gas exchange will be calculated and compared against analogous observations in the convective interior of the Labrador Sea.

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
NSF Division of Ocean Sciences (NSF OCE)	OCE-1947829
NSF Division of Ocean Sciences (NSF OCE)	OCE-1947970

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