Time series of bio-optically determined large particles observed by the wire-following profiler at the Ocean Observatories Initiative's Irminger Sea Array from 2014 to 2022

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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 the depth-resolved large particle signal calculated at the Ocean Observations Initiative (OOI) Global Irminger Sea Array (59.97°N, 39.51°W) from September 2014 to July 2022. Optical backscatter was measured using a dual-channel Sea Bird ECO sensor on the wire-following profiler (170-2600 m; profile every 20 hours). Optical backscatter is used to determine backscatter spikes that are attributed to large particles, following the approach of Briggs et al. (2020). The large particle signal was then binned into 50-m depth bins from 200-2000 m and the mean, median, max, standard deviation, and 95 percentile of the large particle signal were calculated for each depth bin.

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Coverage

Location: Subpolar North Atlantic (60° N, 39.5° W) from depths of 200-2000 m
Spatial Extent: **Lat**:0 **Lon**:0

Methods & Sampling

The data presented here were collected by the Ocean Observatories Initiative at their Irminger Sea Array. Backscatter measurements are from the wire following profiler (WFP, DOI: 10.58046/OOI-GI02HYPM). The WFP (~170-2600 m) collects a profile every 20 hours with a vertical sampling resolution of 2.3 ± 0.15 dbar.

Data Processing Description

We calculate particulate backscatter (bbp) from optical backscatter data collected with a dual-channel Sea Bird ECO sensor as

$$bbp = 2\pi\chi(\beta - \beta sw) \quad \text{Equation 1}$$

where β is the volume scattering function [m-1 sr-1], βsw is the volume scattering function of seawater [m-1 sr-1], and χ is a scaling factor that depends on the configuration of the instrument. βsw is calculated according to Zhang et al. (2009) using instrument configuration values of 700 nm and a water centroid angle (theta) of 142°, along with co-located temperature and salinity values and a default delta value of 0.039. In these calculations, we used the χ value of 1.097 and theta value of 142° that are reported in SBE “Application Note 114,” (2024).

We attribute “spikes” in bbp profiles to large particles. To isolate large particles from bbp, we determined the signal due to small and refractory particles for each profile using an 11-point running minimum filtered followed by an 11-point maximum filter of bbp after Briggs et al. (2020). The large particle signal (bbl) of the bbp signal is then determined as

$$bbl = bbp - (bbs + bbr) \quad \text{Equation 2}$$

where bbs and bbr are the small and refractory components of the bbp signal, respectively. The removal of the small and refractory particle signal for each profile also removes the blank and any drift in the blank over the deployment of the sensor making sensors from different deployments interoperable. After isolating bbl, we binned data from each profile by 50-m intervals from 200 to 2000 m and calculated the mean, median, max, standard deviation, and 95 percentile of the large particle signal. Profiles without at least 10 data points in every bin were removed. Data deeper than 2000 m were not analyzed because of an increase in small and refractory particles that may be attributed to suspended sediment in the region (N. Briggs et al., 2011).

Problem Description

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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Parameters

Parameters for this dataset have not yet been identified

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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
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