Surface and mixed-layer averaged diel cycles of O2 and optically-based POC from repeated CTD casts in the North Pacific from 2017-09-05 to 2017-09-25

Website: https://www.bco-dmo.org/dataset/808675
Data Type: Cruise Results
Version: 0
Version Date: 2020-04-09

Project
» Collaborative Research: Measuring Ocean Productivity from the Diurnal Change in Oxygen and Carbon (ProdChangeO2Carb)

Contributors	Affiliation	Role
White, Angelicque E.	Oregon State University (OSU)	Principal Investigator
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Abstract
Time series of Winkler-calibrated mixed-layer averaged dissolved oxygen (Aandera optode) obtained via repeated CTD casts. Mixed-layer averaged particulate beam-attenuation coefficients (cp) calibrated to particulate organic carbon (POC) concentrations derived from repeated CTD casts. The cruise (KM1713) transited from Seward, AK to Honolulu, HI from 3-26 September 2017 onboard the R/V Kilo Moana. Six extended stations (Stn), three in subpolar waters (Stn 1 at 55°N, Stn 2 at 50°N, and Stn 3 at 46°N), one in the transition zone between subpolar and subtropical waters (Stn 4 at 42°N), and two in the subtropical gyre (Stn 5 at 34°N, and Stn 6 at 24°N) were occupied for 2-3 day periods during which continuous measurements of conductivity, temperature, O2, O2/Ar and beam attenuation were measured continuously on surface seawater supplied via the ships' intake line and using CTD profiles of conductivity, temperature, pressure, oxygen, and the particulate beam attenuation coefficient conducted at ~2-hr intervals. An autonomous profiling float was deployed for ~ 2 days at four stations, retrieving CTD and oxygen profiles at approximately 3-hour intervals. Another float with same mission design was deployed near station ALOHA (22.45° N, 158° W) during July 2017 to provide mixed-layer averaged O2 near station 6. When available, the ship followed the trajectory of the profiling float, yielding a near-Lagrangian sampling strategy with the aim to minimize horizontal mixing effects.

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Coverage

Spatial Extent: **N**:55 **E**:-145 **S**:24 **W**:-160
Temporal Extent: 2017-09-05 - 2017-09-25

Dataset Description

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Methods & Sampling

Mixed-layer averaged O2 and optically-based POC from CTD casts

Depth profiles from surface to 200 m were conducted for temperature, salinity, oxygen (Aanderaa Optode) and beam transmission at 660 nm (C-Star, Sea-Bird Scientific). Beam attenuation profiles were corrected for deep water beam attenuation values (average between 190-200 m depth). Mixed-layer averaged O2 and particulate beam attenuation (cp, m-1) were obtained by assuming a mixed-layer depth calculated using the 0.125 kg m−3 potential density change threshold relative to 10 m depth [Kara et al., 2000]. Mixed-layer averaged cp values were then converted to POC concentrations (mg m-3) using Eq. 2.

Data Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- added ISO Date format generated from date and time values
- combined POC and O2 CTD data

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Related Publications

Kara, A. B., Rochford, P. A., & Hurlburt, H. E. (2000). An optimal definition for ocean mixed layer depth. Journal of Geophysical Research: Oceans, 105(C7), 16803–16821. doi:10.1029/2000jc900072
https://doi.org/10.1029/2000JC900072
Methods

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Parameters

Parameter	Description	Units
year	year of observation	unitless
decimal_day_of_year	decimal day of the year in UTC	unitless
ISO_DateTime_UTC	Date and time formatted according to ISO8601 in UTC	yyyy-MM-dd'T'HH:mm:ss'Z'
lon	longitude with negative values indicating West	decimal degrees
lat	latitude with positive values indicating North	decimal degrees
sta	station number	unitless
beam_attenuation_coeff_POC	mixed-layer averaged particulate beam attenuation coefficient (sensor mounted on CTD frame) calibrated to particulate organic carbon concentrations	miligrams Carbon per meter cubed (mg C/m3)
MLD	Mixed layer depth	meter (m)
O2	mixed-layer averaged and Winkler-calibrated O2	millimole per meter cubed (mmol/m3)

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Instruments

Dataset-specific Instrument Name	Optode (Aanderaa Data Instruments, Bergen, Norway)
Generic Instrument Name	Aanderaa Oxygen Optodes
Dataset-specific Description	Dissolved oxygen: Optode (Aanderaa Data Instruments, Bergen, Norway)
Generic Instrument Description	Aanderaa Oxygen Optodes are instrument for monitoring oxygen in the environment. For instrument information see the Aanderaa Oxygen Optodes Product Brochure.

Dataset-specific Instrument Name	C-Star, Sea-Bird Scientific
Generic Instrument Name	WET Labs {Sea-Bird WETLabs} C-Star transmissometer
Dataset-specific Description	Beam attenuation at 660 nm: (C-Star, Sea-Bird Scientific).
Generic Instrument Description	The C-Star transmissometer has a novel monolithic housing with a highly intgrated opto-electronic design to provide a low cost, compact solution for underwater measurements of beam transmittance. The C-Star is capable of free space measurements or flow-through sampling when used with a pump and optical flow tubes. The sensor can be used in profiling, moored, or underway applications. Available with a 6000 m depth rating. More information on Sea-Bird website: https://www.seabird.com/c-star-transmissometer/product?id=60762467717

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Deployments

KM1713

Website	https://www.bco-dmo.org/deployment/808683
Platform	R/V Kilo Moana
Start Date	2017-09-01
End Date	2017-09-26

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Project Information

Collaborative Research: Measuring Ocean Productivity from the Diurnal Change in Oxygen and Carbon (ProdChangeO2Carb)

Coverage: North Pacific Ocean, from ~ 22 N to ~ 55 N, surface and mixed-layer

NSF Award Abstract:

The rate of primary production in the ocean is fundamental to the ocean's food web and the movement of carbon from surface waters to the deep ocean, known as the biological pump. Yet spatial and temporal variations in primary productivity are poorly known because the effort required for the current method of measuring primary productivity is significant, limiting its application, and the method has biases that are difficult to quantify. Using a novel combination of approaches, the investigators will estimate daily primary productivity in the ocean at three ecologically distinct sites. The research will significantly improve understanding of primary productivity variations and their impact on the ocean's biological pump, which will benefit the broader ocean community involved in carbon cycle modeling and benefit society via the impact of ocean primary productivity on atmospheric carbon dioxide uptake and future climate change. The research results will be incorporated into both undergraduate and graduate course curricula and outreach talks at the two institutions. There will be active undergraduate student participation in the project at both Oregon State University and the University of Washington.

Within the last decade, an in-situ primary productivity method based on measuring the isotopic composition of dissolved oxygen (O2) gas has gained traction within the oceanographic community because it yields a primary

production estimate from a simple water sample collection. This method has yielded basin-wide snapshots of primary productivity based on underway sampling of the surface ocean by ships of opportunity. However, accurate estimates of oxygen/particulate organic carbon (O2/POC) produced during primary productivity are needed to convert oxygen-based primary production rates to carbon production. In this project, daily in-situ rates of primary production in the surface ocean at three ocean sites will be estimated from continuous measurements of diurnal cycles in the oxygen/argon dissolved gas ratio and POC and compared to simultaneous in vitro primary productivity estimates. Variations in the O2/POC produced during primary production will be determined. Autonomous float-based estimates of primary production based on measurements of diurnal cycles in O2 and POC will be validated using ship based measurements. Estimates of primary production based on autonomous measurements resulting from this research have the potential to revolutionize our knowledge on the spatial and temporal variations in primary productivity in the ocean.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1849012
NSF Division of Ocean Sciences (NSF OCE)	OCE-1536121

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