Recalculated and filtered Transmissometer Beam Attenuation Coefficient values for the ODF CTD from the GEOTRACES GP17-OCE cruise aboard R/V Roger Revelle (RR2214) from December 2022 to January 2023

Website: https://www.bco-dmo.org/dataset/949808
Data Type: Cruise Results
Version: 1
Version Date: 2025-01-28

Project
» Autonomous Ocean Carbon Observer Development and Calibration (OCO Development)

Contributors	Affiliation	Role
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Abstract
This dataset contains recalculated and filtered Transmissometer Beam Attenuation Coefficient values for the ODF CTD from the GEOTRACES GP17-OCE cruise aboard R/V Roger Revelle (RR2214) from December 2022 to January 2023. The primary data file provided here contains the average of all optical data profiles at each station for 0-500 meters (m) depth (depth intervals of 5-meters). Data for the full depth of the water column (6000 meters) are also included as supplemental files.

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Coverage

Spatial Extent: **N**:-19.9998 **E**:-75.0972 **S**:-67.0002 **W**:-152.0002
Temporal Extent: 2022-12-04 - 2023-01-24

Methods & Sampling

Calculated Beam Attenuation coefficient from despiked 10-second averaged data sets. The resulting data are further averaged over 5-meter intervals.

Data Processing Description

The data from Transmissometer 1874 was recalculated using

dt=temp-t391 ; calculated difference between water temperature and instrument temperature

cst1874c=(cst1874-0.0024)/cst1874r ; cst1874r is a temperature response function derived from WETLabs thermal cycling tests. ; 0.0024 is the blocked beam voltage on the CTD

cst1874cc=cst1874c+dt/1300 ; corrects for hysteresis in the thermoclone

cst1874tr=cst1874cc/(cst1874_NETVrefUSE) ; transmission ratio ; cst1874_NETVrefUSE is the zero corrected reading the transmissometer would have in particle free seawater.

cp1874=-4*ln(cst1874tr) ; calculation of beam attenuation coefficient

the data from Fluorometer Voltages was offset and multiplied to agree with Seapoint Fluorometer data on the GTC CTD. Relative units.

The following GEOTRACES parameter names have been registered in DOoR:

CTDBEAMCP_T_VALUE_SENSOR::kpdsqt

BCO-DMO Processing Description

- Imported original file "GP17_ODF_CTD_Cast_Profiles_0500.csv" into the BCO-DMO system.
- Converted station, cast, and year columns to integers.
- Calculated ISO date-time field (UTC) from the jdays column.
- Saved the final file as "949808_v1_gp17_odf_ctd_optics_data_cast_profiles_0500.csv".

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Related Publications

Bishop, J. K. B., Amaral, V. J., Lam, P. J., Wood, T. J., Lee, J.-M., Laubach, A., Barnard, A., Derr, A., & Orrico, C. (2022). Transmitted Cross-Polarized Light Detection of Particulate Inorganic Carbon Concentrations and Fluxes in the Ocean Water Column: Ships to ARGO Floats. Frontiers in Remote Sensing, 3. https://doi.org/10.3389/frsen.2022.837938
Methods

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Parameters

Parameter	Description	Units
station	station number	unitless
cast	cast sequence on station	unitless
updn	flag [-1 = downcast; 1 = upcast]	unitless
lat	decimal latitude (north positive)	decimal degrees
lon	decimal longitude (east positive	decimal degrees

year	year	unitless
jdays	ordinal days in 2018	unitless
ISO_DateTime_UTC	Date and time (UTC) in ISO 8601 format	unitless
press	Pressure [Digiquartz]	decibars (db)
depth	Depth [salt water, m]	meters (m)
temp	CTD temperature [ITS-90 deg C]	degrees Celsius
theta	potential temperature [deg C]	degrees Celsius
sal	Salinity - Practical [PSU]	PSU
sigth	potential density anomaly	unitless
cp1874	Particle Beam Attenuation Coefficient [PPM m-1] from SENSOR CST1874 Filtered	parts per million per meter (ppm m-1)
cp1874_sd	Particle Beam Attenuation Coefficient Standard Deviation [PPM m-1] from SENSOR CST1874 Filtered	parts per million per meter (ppm m-1)
flwl_corr	Fluorescence WET Labs ECO-AFL/FL	?
flwl_corr_sd	Fluorescence_sd WET Labs ECO-AFL/FL	?
o2	Oxygen, SBE 43 [umol/kg]	micromoles per kilogram (umol/kg)
trackdist_km	kilometers track distance from station 1	kilometers (km)

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Transmissometer
Dataset-specific Description	Sensor CST1874
Generic Instrument Description	A transmissometer measures the beam attenuation coefficient of the lightsource over the instrument's path-length. This instrument designation is used when specific manufacturer, make and model are not known.

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Deployments

RR2214

Website	https://www.bco-dmo.org/deployment/905754
Platform	R/V Roger Revelle
Report	https://www.bodc.ac.uk/resources/inventories/cruise_inventory/reports/rogerrevelle_rr2214.pdf
Start Date	2022-12-01
End Date	2023-01-25
Description	The U.S. GEOTRACES GP17-OCE expedition departed Papeete, Tahiti (French Polynesia) on December 1st, 2022 and arrived in Punta Arenas, Chile on January 25th, 2023. The cruise took place in the South Pacific and Southern Oceans aboard the R/V Roger Revelle with a team of 34 scientists led by Ben Twining (Chief Scientist), Jessica Fitzsimmons, and Greg Cutter (Co-Chief Scientists). GP17 was planned as a two-leg expedition, with its first leg (GP17-OCE) as a southward extension of the 2018 GP15 Alaska-Tahiti expedition and a second leg (GP17-ANT; December 2023-January 2024) into coastal and shelf waters of Antarctica's Amundsen Sea. The GP17-OCE section encompassed three major transects: (1) a southbound pseudo-meridional section (~152-135 degrees West) from 20 degrees South to 67 degrees South; (2) an eastbound zonal transect from 135 degrees West to 100 degrees West; (3) and a northbound section returning to Chile (100-75 degrees West). Additional cruise information is available from the following sources: R2R: https://www.rvdata.us/search/cruise/RR2214 CCHDO: https://cchdo.ucsd.edu/cruise/33RR20221201 More information can also be found at: https://usgeotraces.ldeo.columbia.edu/content/gp17-oce

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Project Information

Autonomous Ocean Carbon Observer Development and Calibration (OCO Development)

Coverage: Pacific Ocean

NSF Award Abstract
The very fast and dynamic ocean biological carbon pump (OBCP) plays a fundamental role in the global carbon cycle and in setting concentrations of atmospheric carbon dioxide. Photosynthetic organisms that that fuel the OCBP live and die on a week to week basis, and the resulting sinking (or export) of organic and inorganic carbon particles from the surface layer and consumption losses of these particles in deeper waters are

similarly variable. Simply stated, the OCBP is poorly understood due to dependence on short- term, and seasonally and spatially limited ship observations; thus model estimates of its strength and future trajectory are highly uncertain. To address this gap, the investigators will engineer and sea-test two robotic Lagrangian Ocean Carbon Observer (OCO) floats capable of 8 month to multi-year missions, yet able to resolve flux processes on hourly to daily time scales and relay data in real time via satellite telemetry while operating anywhere in the ocean. The development of the OCO enables the identification of specific pathways and controls on the vertical transfer of particulate organic and inorganic carbon (POC and PIC) from the surface ocean to subsurface waters. The project logically follows on from the investigator's development and successful deployment of robotic Lagrangian Carbon Explorer (CE) and Carbon Flux Explorer (CFE) floats, which measure optically POC and PIC concentration and flux variability to depths of 1000 m. A unique capability of the CFE is that it is able to measure the sinking flux of carbon carried by different sizes and classes of particles. The project will merge CFE and CE capabilities to create the OCO. The team will contribute to the development of a STEM workforce by engaging UC Berkeley undergraduates and one graduate student in all phases (development, laboratory, seagoing, and interpretive) of the project and in the class room.

Specifically, CFEs and two new Ocean Carbon Observers (OCOs) that simultaneously measure both particle flux and concentration profiles will be constructed and test-deployed at sea in January 2023. During the times that these autonomous instruments drift at target depths within the upper kilometer (interrupted by transit to the surface for location and real time bidirectional telemetry), they will autonomously quantify the inherent optical properties and size distributions of sinking material captured. Bishop et al. (2016; Biogeosciences 13, 3019-3129, doi:10.5194/bg-13-3109) describe CFE capabilities and methodology for rendering raw OSR imagery to rigorously defined inherent optical measures of particle loading -- attenuance and cross-polarized photon yield. Bourne et al. (2019; Biogeosciences, 16, 1249-1264; doi:10.5194/bg-16-1249-2019) show that attenuance is strongly correlated ($r^2 > 0.86$) with POC and PN sampled at 150 m by sampler-equipped CFEs "(CFE-Cal floats)" over a broad range of particle flux and particle size distributions. Planned further deployment of the CFE-Cal floats to sample sinking material to depths of at least 500 m will enable validation of our calibration of the attenuance proxy and to enable a first calibration of the PIC optical flux proxy. Bourne et al. (2021; Biogeosciences, 18, 3053–3086, doi:10.5194/bg-18-3053-2021) demonstrate the unique capability of CFEs to resolve and quantify the vertical flux carried by different particle size classes in the mesopelagic; furthermore, they describe prototype algorithms that will lead to flux size-distribution analysis in real time on the CFEs. The project will enable fully autonomous long-term deployments of CFE and OCO systems in the global ocean. The involvement a commercial float vendor (MRV Systems) and sensor manufacturer (Seabird Scientific) may lead to a commercialization pathway for the OCO.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1657781
NSF Division of Ocean Sciences (NSF OCE)	OCE-2023315
NSF Division of Ocean Sciences (NSF OCE)	OCE-1736601
NSF Division of Ocean Sciences (NSF OCE)	OCE-2123942

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