

Absorption coefficients of colored dissolved organic matter (CDOM) along US GEOTRACES North Atlantic Transect from the R/V Knorr KN199-04 cruise in the subtropical N. Atlantic in 2010 (U.S. GEOTRACES NAT project)

Website: <https://www.bco-dmo.org/dataset/3869>

Data Type: Cruise Results

Version: 1

Version Date: 2013-01-31

Project

» [U.S. GEOTRACES North Atlantic Transect](#) (U.S. GEOTRACES NAT)

Program

» [U.S. GEOTRACES](#) (U.S. GEOTRACES)

Contributors	Affiliation	Role
McClain, Charles	National Aeronautics and Space Administration (NASA)	Principal Investigator
Chaves, Joaquin	National Aeronautics and Space Administration (NASA)	Co-Principal Investigator
Kinkade, Danie	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

Absorption coefficients of colored dissolved organic matter (CDOM) along US GEOTRACES North Atlantic Transect from the R/V Knorr KN199-04 cruise in the subtropical N. Atlantic in 2010 (U.S. GEOTRACES NAT project).

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Coverage

Spatial Extent: N:38.3307 E:-9.66 S:17.3497 W:-24.4998

Temporal Extent: 2010-10-16 - 2010-11-02

Dataset Description

Optical absorption coefficient of chromophoric dissolved organic matter (aCDOM) on samples collected during Geotraces 2010 (kn199-04).

Note: These data are considered preliminary. As per PI: "CDOM data will be, unfortunately, sent as "preliminary" since our efforts to develop a satisfactory salinity correction did not yield convincing results. We will have to reanalyze the data from the stored samples. The relative magnitudes of the samples are probably OK, which is probably good, if anybody wants to use the data as a conservative tracer, but absolute magnitudes are suspect. Lots of negative values might be a good hint."

The following metadata was extracted from the original file header:

```
/begin_header
/investigators=Charles_McClain_Joaquin_Chaves
/affiliations=NASA
/contact=joaquin.chaves@nasa.gov
/experiment=GEOTRACES
/cruise=kn199-4
/station=NA
/data_file_name=kn199-4_CDOM_reportBCDMO.csv
/documents=CDOM_protocols.pdf
/calibration_files=NA
/data_type=bottle
/data_status=preliminary
/start_date=20101016
/end_date=20101103
/start_time=15:10:00[GMT]
/end_time=00:19:00[GMT]
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/south_latitude=17.3497[DEG]
/east_longitude=-9.66[DEG]
/west_longitude=-24.4998[DEG]
/water_depth=-999
/measurement_depth=-999
/secchi_depth=-999
/wind_speed=-999
/cloud_percent=-999
/wave_height=-999
!
!The field "replicates" indicates how many replicate samples were
!averaged to produce the reported value
!
/missing=-999
/delimiter=comma
```

Acquisition Description

Methods for the Collection and Measurement of the Spectral Absorption Coefficient ($a_g\lambda$) of Chromophoric

Dissolved Organic Matter (CDOM):

Seawater samples for the measurement of chromophoric dissolved organic matter (CDOM) absorption (a_g) are filtered under a gentle vacuum (<5 in Hg) through precombusted (6 hours at 450 °C) Whatman GF/F glass fiber filters and collected directly into pre-cleaned and pre-combusted sample glass bottles. Samples for determination of CDOM spectral absorption coefficients are stored under refrigeration at 4 °C. In the laboratory, CDOM samples are warmed to room temperature and filtered through 0.2 µm Whatman Nuclepore polycarbonate filters or Gelman Supor (polyethersulfone) filters prior to analysis (Mitchell et al. 2000). Filtration samples through GF/F filters is necessary for coastal ocean waters due to the high particle load that quickly clog Nuclepore and Supor filters. Absorption spectra of CDOM are measured using a multiple pathlength, liquid core waveguide (MPLCW) system (World Precision Instruments, Inc., Sarasota, FL) with UV oxidized Milli-Q water as a reference (Miller et al., 2002). CDOM absorbance spectra are measured between 370 and 725 nm at 1 nm intervals normalized to the reference spectrum.

Processing Description

Data Processing:

CDOM absorbance spectra are measured on a multiple pathlength, liquid core waveguide between 370 and 725 nm at 1 nm intervals normalized to the reference spectrum. For seawater samples, an absorbance correction to account for the different refractive indices of Milli-Q water and seawater is applied. The correction is based on previously measured solutions of known salinity devoid of CDOM. The corresponding spectral absorbance correction for a given salinity is subtracted from the observed spectrum of a sample of the same salinity.

The spectral absorption coefficients, $a_g(\lambda)$ (m-1) are obtained by

$$a_g(\lambda) = 2.303A(\lambda) / L,$$

where $A(\lambda)$ is the absorbance at wavelength λ and L is the pathlength in meters. Absorption data are also corrected for baseline offsets by subtracting the average absorption value between 690-700nm.

BCO-DMO Processing Notes:

- One data file sent by Chaves in excel spreadsheet format on 2013.01.31
- Update (v1) sent on 2013.02.01 included station numbers
- Update (v2) sent on 2013.02.01 corrected column/row alignment

Edits made:

- Parameter header names were renamed to BCO-DMO convention
- Blank data fields and data reported as -999 were edited to 'nd'
- Edited time to remove colons and drop unused seconds
- Edited precision of lat/lon to four decimals.
- Edited precision of absorption coefficients to three decimals.
- Transposed rows and columns in file to view values vertically rather than horizontally. Created column for 'wavelength' to accommodate original parameter names and column for absorption coefficient 'absp_coef' to hold values. Removed header information from the file. Where necessary, the information was incorporated into BCO-DMO metadata fields and retained entirely as 'additional information'.

Note: Correspondence with the PI on 2013.01.12, necessitated editing the header note indicating NASA's pump. Therefore, this comment was retained in the header has been edited to the following text:

#samples from station 1 with 0 depth were collected with WHOI's GEOTRACES pump
#sample numbers for stations > 1 with depth = 0 were collected with NASA's

#surface peristaltic pump

Note: Further correspondence with the PI on 2013.03.06, edited sample 5880 (station 3 cast 6) to 5280.

Additional GEOTRACES Processing: After the data were submitted to the International Data Management Office, BODC, the office noticed that important identifying information was missing in many datasets. With the agreement of BODC and the US GEOTRACES lead PIs, BCO-DMO added standard US GEOTRACES information, such as the US GEOTRACES event number, to each submitted dataset lacking this information. To accomplish this, BCO-DMO compiled a 'master' dataset composed of the following parameters: station_GEOTrc, cast_GEOTrc (bottle and pump data only), event_GEOTrc, sample_GEOTrc, sample_bottle_GEOTrc (bottle data only), bottle_GEOTrc (bottle data only), depth_GEOTrc_CTD (bottle data only), depth_GEOTrc_CTD_rounded (bottle data only), BTL_ISO_DateTime_UTC (bottle data only), and GeoFish_id (GeoFish data only). This added information will facilitate subsequent analysis and inter comparison of the datasets.

Bottle parameters in the master file were taken from the GT-C_Bottle_GT10, GT-C_Bottle_GT11, ODF_Bottle_GT10, and ODF_Bottle_GT11 datasets. Non-bottle parameters, including those from GeoFish tows, Aerosol sampling, and McLane Pumps, were taken from the Event_Log_GT10 and Event_Log_GT11 datasets. McLane pump cast numbers missing in event logs were taken from the Particulate Th-234 dataset submitted by Ken Buesseler.

A standardized BCO-DMO method (called "join") was then used to merge the missing parameters to each US GEOTRACES dataset, most often by matching on sample_GEOTrc or on some unique combination of other parameters.

If the master parameters were included in the original data file and the values did not differ from the master file, the original data columns were retained and the name of the parameters were changed from the PI-submitted names to the standardized master names. If there were differences between the PI-supplied parameter values and those in the master file, both columns were retained. If the original data submission included all of the master parameters, no additional columns were added, but parameter names were modified to match the naming conventions of the master file.

See the dataset parameters documentation for a description of which parameters were supplied by the PI and which were added via the join method.

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Related Publications

Miller, R. L., Belz, M., Castillo, C. D., & Trzaska, R. (2002). Determining CDOM absorption spectra in diverse coastal environments using a multiple pathlength, liquid core waveguide system. *Continental Shelf Research*, 22(9), 1301–1310. doi:10.1016/s0278-4343(02)00009-2 [https://doi.org/10.1016/S0278-4343\(02\)00009-2](https://doi.org/10.1016/S0278-4343(02)00009-2) [details]

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Parameters

Parameter	Description	Units

station_GEOTRC	GEOTRACES station number; ranges from 1 through 12 for KN199-04 and 1 through 24 for KN204-01. Stations 7 and 9 were skipped on KN204-01. PI-supplied values were identical to those in the intermediate US GEOTRACES master file. Originally submitted as 'station'; this parameter name has been changed to conform to BCO-DMO's GEOTRACES naming conventions.	dimensionless
time_gmt	Time of sampling, reported in GMT.	hhmm
yrday	Year day recorded in GMT time, where Jan 1 is day 1.	ddd
date_gmt	Date, recorded in GMT time.	yyyymmdd
lon	Longitude component of geographic position where samples were collected.	decimal degrees
lat	Latitude component of geographic position where samples were collected.	decimal degrees
depth	Originator's sample depth.	meters
replicates	A number indicating how many replicate samples were averaged to produce the reported value.	dimensionless
wavelength	Wavelength (between 400-700nm) at which measurements were performed at a 1nm data interval.	nanometers
absp_coef	Coefficient of absorption at the given wavelength as defined by: $ag([\lambda]) = 2.303A([\lambda])/L$, where $A([\lambda])$ is the absorbance at wavelength $[\lambda]$ and L is the pathlength in meters.	1/meters
cast_GEOTRC	Cast identifier numbered consecutively within a station. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	dimensionless
event_GEOTRC	Unique identifying number for US GEOTRACES sampling events; ranges from 2001 to 2225 for KN199-04 events and from 3001 to 3282 for KN204-01 events. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	dimensionless
sample_GEOTRC	Unique identifying number for US GEOTRACES samples; ranges from 5033 to 6078 for KN199-04 and from 6112 to 8148 for KN204-01. PI-supplied values were identical to those in the intermediate US GEOTRACES master file. Originally submitted as 'sample'; this parameter name has been changed to conform to BCO-DMO's GEOTRACES naming conventions. Sample numbers from station 1 with 0 depth were collected with WHOI's GEOTRACES pump and samples for stations > 1 from depth = 0.	dimensionless
sample_bottle_GEOTRC	Unique identification numbers given to samples taken from bottles; ranges from 1 to 24; often used synonymously with bottle number. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	dimensionless

bottle_GEOTRC	Alphanumeric characters identifying bottle type (e.g. NIS representing Niskin and GF representing GOFLO) and position on a CTD rosette. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	dimensionless
depth_GEOTRC_CTD	Observation/sample depth in meters; calculated from CTD pressure. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	meters
BTL_ISO_DateTime_UTC	Date and time (UTC) variable recorded at the bottle sampling time in ISO compliant format. Values were added from the intermediate US GEOTRACES master file (see Processing Description). This standard is based on ISO 8601:2004(E) and takes on the following form: 2009-08-30T14:05:00[.xx]Z (UTC time)	YYYY-MM-DDTHH:MM:SS[.xx] [+/-TZ]
cruise_id	Official cruise identifier e.g. KN199-04 = R/V Knorr cruise number 199-04.	dimensionless

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Instruments

Dataset-specific Instrument Name	Pump surface
Generic Instrument Name	Pump surface
Dataset-specific Description	NASA's surface peristaltic pump was used to collect surface samples from station 1. WHOI's GEOTRACES pump was used to collect surface samples from all other stations.
Generic Instrument Description	A source of uncontaminated near-surface seawater pumped onto the deck of the research vessel that can be sampled and analyzed. This pumped seawater supply is from an over-the-side pumping system, and is therefore different from the vessel underway seawater system.

Dataset-specific Instrument Name	spectrophotometer with liquid core waveguide- World Precision Instruments
Generic Instrument Name	Spectrophotometer with Liquid Core Waveguide- WPI
Generic Instrument Description	The World Precision Instruments (WPI) Multiple Pathlength Liquid Core Waveguide (MPLCW) system is an instrument package combining a Liquid Waveguide Capillary Cell (LWCC) and a WPI spectrophotometer via fiber optics. The waveguide is a fiber optic cell that combines an increased optical pathlength (50–500cm) with small sample volume (125–1250µL). Ultra-sensitive absorbance measurements can be performed in the ultraviolet (UV), visible (VIS) and near-infrared (NIR) to detect low sample concentrations in a laboratory or process control environment. (www.whpiinc.com)

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Deployments

KN199-04

Website	https://www.bco-dmo.org/deployment/58066
Platform	R/V Knorr
Report	http://bcodata.whoi.edu/US_GEOTRACES/AtlanticSection/Cruise_Report_for_Knorr_199_Final_v3.pdf
Start Date	2010-10-15
End Date	2010-11-04

Description	<p>KN199-04 is the US GEOTRACES Zonal North Atlantic Survey Section cruise planned for late Fall 2010 from Lisboa, Portugal to Woods Hole, MA, USA. 4 November 2010 update: Due to engine failure, the scheduled science activities were canceled on 2 November 2010. On 4 November the R/V KNORR put in at Porto Grande, Cape Verde and is scheduled to depart November 8, under the direction of Acting Chief Scientist Oliver Wurl of Old Dominion University. The objective of this leg is to carry the vessel in transit to Charleston, SC while conducting science activities modified from the original plan. Planned scientific activities and operations area during this transit will be as follows: the ship's track will cross from the highly productive region off West Africa into the oligotrophic central subtropical gyre waters, then across the western boundary current (Gulf Stream), and into the productive coastal waters of North America. During this transit, underway surface sampling will be done using the towed fish for trace metals, nanomolar nutrients, and arsenic speciation. In addition, a port-side high volume pumping system will be used to acquire samples for radium isotopes. Finally, routine aerosol and rain sampling will be done for trace elements. This section will provide important information regarding atmospheric deposition, surface transport, and transformations of many trace elements. The vessel is scheduled to arrive at the port of Charleston, SC, on 26 November 2010. The original cruise was intended to be 55 days duration with arrival in Norfolk, VA on 5 December 2010. funding: NSF OCE award 0926423</p> <p>Science Objectives are to obtain state of the art trace metal and isotope measurements on a suite of samples taken on a mid-latitude zonal transect of the North Atlantic. In particular sampling will target the oxygen minimum zone extending off the west African coast near Mauritania, the TAG hydrothermal field, and the western boundary current system along Line W. In addition, the major biogeochemical provinces of the subtropical North Atlantic will be characterized. For additional information, please refer to the GEOTRACES program Web site (GEOTRACES.org) for overall program objectives and a summary of properties to be measured. Science Activities include seawater sampling via GoFLO and Niskin carousels, in situ pumping (and filtration), CTDO2 and transmissometer sensors, underway pumped sampling of surface waters, and collection of aerosols and rain. Hydrography, CTD and nutrient measurements will be supported by the Ocean Data Facility (J. Swift) at Scripps Institution of Oceanography and funded through NSF Facilities. They will be providing an additional CTD rosette system along with nephelometer and LADCP. A trace metal clean Go-Flo Rosette and winch will be provided by the group at Old Dominion University (G. Cutter) along with a towed underway pumping system. List of cruise participants: [PDF] Cruise track: JPEG image (from Woods Hole Oceanographic Institution, vessel operator) Additional information may still be available from the vessel operator: WHOI cruise planning synopsis Cruise information and original data are available from the NSF R2R data catalog. ADCP data are available from the Currents ADCP group at the University of Hawaii: KN199-04 ADCP</p>
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Project Information

U.S. GEOTRACES North Atlantic Transect (U.S. GEOTRACES NAT)

Website: <http://www.geotraces.org/>

Coverage: Subtropical western and eastern North Atlantic Ocean

Much of this text appeared in an article published in OCB News, October 2008, by the OCB Project Office. The first

U.S. GEOTRACES Atlantic Section will be specifically centered around a sampling cruise to be carried out in the North Atlantic in 2010. Ed Boyle (MIT) and Bill Jenkins (WHOI) organized a three-day planning workshop that was held September 22-24, 2008 at the Woods Hole Oceanographic Institution. The main goal of the workshop, sponsored by the National Science Foundation and the U.S. GEOTRACES Scientific Steering Committee, was to design the implementation plan for the first U.S. GEOTRACES Atlantic Section. The primary cruise design motivation was to improve knowledge of the sources, sinks and internal cycling of Trace Elements and their Isotopes (TEIs) by studying their distributions along a section in the North Atlantic (Figure 1). The North Atlantic has the full suite of processes that affect TEIs, including strong meridional advection, boundary scavenging and source effects, aeolian deposition, and the salty Mediterranean Outflow. The North Atlantic is particularly important as it lies at the "origin" of the global Meridional Overturning Circulation. It is well understood that many trace metals play important roles in biogeochemical processes and the carbon cycle, yet very little is known about their large-scale distributions and the regional scale processes that affect them. Recent advances in sampling and analytical techniques, along with advances in our understanding of their roles in enzymatic and catalytic processes in the open ocean provide a natural opportunity to make substantial advances in our understanding of these important elements. Moreover, we are motivated by the prospect of global change and the need to understand the present and future workings of the ocean's biogeochemistry. The GEOTRACES strategy is to measure a broad suite of TEIs to constrain the critical biogeochemical processes that influence their distributions. In addition to these "exotic" substances, more traditional properties, including macronutrients (at micromolar and nanomolar levels), CTD, bio-optical parameters, and carbon system characteristics will be measured. The cruise starts at Line W, a repeat hydrographic section southeast of Cape Cod, extends to Bermuda and subsequently through the North Atlantic oligotrophic subtropical gyre, then transects into the African coast in the northern limb of the coastal upwelling region. From there, the cruise goes northward into the Mediterranean outflow. The station locations shown on the map are for the "fulldepth TEI" stations, and constitute approximately half of the stations to be ultimately occupied.

Figure 1. The proposed 2010 Atlantic GEOTRACES cruise track plotted on dissolved oxygen at 400 m depth. Data from the World Ocean Atlas (Levitus et al., 2005) were plotted using Ocean Data View (courtesy Reiner Schlitzer). [click on the image to view a larger version] Hydrography, CTD and nutrient measurements will be supported by the Ocean Data Facility (J. Swift) at Scripps Institution of Oceanography and funded through NSF Facilities. They will be providing an additional CTD rosette system along with nephelometer and LADCP. A trace metal clean Go-Flo Rosette and winch will be provided by the group at Old Dominion University (G. Cutter) along with a towed underway pumping system. The North Atlantic Transect cruise began in 2010 with KN199 leg 4 (station sampling) and leg 5 (underway sampling only) (Figure 2). KN199-04 Cruise Report (PDF) Figure 2. The red line shows the cruise track for the first leg of the US Geotraces North Atlantic Transect on the R/V Knorr in October 2010. The rest of the stations (beginning with 13) will be completed in October-December 2011 on the R/V Knorr (courtesy of Bill Jenkins, Chief Scientist, GNAT first leg). [click on the image to view a larger version] The section completion effort resumed again in November 2011 with KN204-01A,B (Figure 3). KN204-01A,B Cruise Report (PDF) Figure 3. Station locations occupied on the US Geotraces North Atlantic Transect on the R/V Knorr in November 2011. [click on the image to view a larger version] Data from the North Atlantic Transect cruises are available under the Datasets heading below, and consensus values for the SAFe and North Atlantic GEOTRACES Reference Seawater Samples are available from the GEOTRACES Program Office: Standards and Reference Materials ADCP data are available from the Currents ADCP group at the University of Hawaii at the links below:KN199-04 (leg 1 of 2010 cruise; Lisbon to Cape Verde)KN199-05 (leg 2 of 2010 cruise; Cape Verde to Charleston, NC)KN204-01A (part 1 of 2011 cruise; Woods Hole, MA to Bermuda)KN204-01B (part 2 of 2011 cruise; Bermuda to Cape Verde)

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Program Information

U.S. GEOTRACES (U.S. GEOTRACES)

Website: <http://www.geotraces.org/>

Coverage: Global

GEOTRACES is a SCOR sponsored program; and funding for program infrastructure development is provided by the U.S. National Science Foundation. GEOTRACES gained momentum following a special symposium, S02: Biogeochemical cycling of trace elements and isotopes in the ocean and applications to constrain contemporary marine processes (GEOSECS II), at a 2003 Goldschmidt meeting convened in Japan. The GEOSECS II acronym referred to the Geochemical Ocean Section Studies To determine full water column distributions of selected trace elements and isotopes, including their concentration, chemical speciation, and physical form, along a sufficient number of sections in each ocean basin to establish the principal relationships between these distributions and with more traditional hydrographic parameters; * To evaluate the sources, sinks, and internal cycling of these species and thereby characterize more completely the physical, chemical and biological processes regulating their distributions, and the sensitivity of these processes to global change; and * To understand the processes that control the concentrations of geochemical species used for proxies of the past environment, both in the water column and in the substrates that reflect the water column. GEOTRACES will be global in scope, consisting of ocean sections complemented by regional process studies. Sections and process studies will combine fieldwork, laboratory experiments and modelling. Beyond realizing the scientific objectives identified above, a natural outcome of this work will be to build a community of marine scientists who understand the processes regulating trace element cycles sufficiently well to exploit this knowledge reliably in future interdisciplinary studies. Expand "Projects" below for information about and data resulting from individual US GEOTRACES research projects.

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Funding

Funding Source	Award
National Aeronautics & Space Administration (NASA)	NNX09AN94G

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