Dissolved organic matter, water quality, water isotopes, and discharge measurements of the Tapajós River, Brazil from 2016-2023

Website: https://www.bco-dmo.org/dataset/986798
Data Type: Other Field Results
Version: 1
Version Date: 2026-01-20

Project
» RAPID: El Nino Event Impacts on Organic Matter Export and Composition in the Amazon River (ENSO impact on Amazon River DOC and DOM)

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Abstract
This data includes near monthly measurements of discharge, water isotopes, water quality, and dissolved organic matter characteristics from the Tapajós River, Brazil between 2016-2023. Dissolved organic matter was characterized via dissolved organic carbon quantification, optical spectroscopy, fluorescence spectroscopy, parallel factor analysis modeling (PARAFAC), and Fourier transform-ion cyclotron resonance mass spectrometry. Pairing geochemical and molecular-level data reveal both seasonal and inter annual patterns of carbon export to the Amazon River system and processing within the river network.

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Coverage

Location: Tapajós River, Brazil
Spatial Extent: **Lat**:-4.3375 **Lon**:-56.06953

Temporal Extent: 2016-01-28 - 2023-11-30

Methods & Sampling

Water samples were collected near-monthly from the Tapajós River upstream of Itaituba Brazil (-4.3375,-56.06953). Three water samples (1 L) were collected at 0.5 m depth from the river across the channel in equal spacing and combined into a 4 L acid-washed carboy to make a composite sample. The water was filtered through a 0.45 µm capsule filter with a peristaltic pump into acid-rinsed high-density polyethylene (HDPE) bottles. Filtered samples were kept cold during transport and immediately frozen upon transfer to the laboratory and kept in the dark until analysis. Samples for water isotope analysis were collected in 30 mL HDPE bottles that were filled to capacity, free of air, and stored in a dark, cool place prior to analysis.

Data Processing Description

EEMs were corrected for lamp intensity, inner filter effects, and normalized to Raman units. Parallel factor analysis

(PARAFAC) was modeled in MATLAB with the drEEM toolbox for 81 individual EEMs and validated using core consistency diagnostics and splithalf validation , yielding a 5-component model that explained 99.93% of the variance.

Mass spectral peaks (>6σ root-mean-square (RMS) baseline noise) were exported to a peak list and processed using PetroOrg. Molecular formulae were assigned to ions constrained by C4-75H4-150O1-30N0-4S0-2 not exceeding 300 ppb error.

Water isotope data post-processing included amount-linearity correction for OA-ICOS data, memory correction and normalization to the VSMOW-SLAP scale using LIMS for Lasers 2015.

BCO-DMO Processing Description

* Sheet 1 of submitted file "Tapajos_ds1_02-12-25.xlsx" was imported into the BCO-DMO data system for this dataset. Table will appear as Data File: 986798_v1_tapajos_dom.csv (along with other download format options).

* Column names adjusted to conform to BCO-DMO naming conventions designed to support broad re-use by a variety of research tools and scripting languages. [Only numbers, letters, and underscores. Can not start with a number]. Column name dH changed to d2H for clarity as that was how it was described, as d2H (delta2H).

* Date converted to ISO 8601 format

* Location field contained both latitude and longitude in degrees minutes and seconds (e.g. '"4°20'15.0"S 56°04'10.3"W"') which was converted to separate lat_dd lon_dd columns (also converted to decimal degrees)

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Related Publications

Kurek, M. R., Muniz, R., Moura, J. M. S., Peucker-Ehrenbrink, B., Holmes, R. M., McKenna, A. M., & Spencer, R. G. M. (2025). Long-Term and Seasonal Drivers of Organic Matter in the Clearwater Tapajós River and Implications for the Amazon River Basin. Global Biogeochemical Cycles, 39(6). Portico. https://doi.org/10.1029/2025gb008545 https://doi.org/10.1029/2025GB008545
Results

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Related Datasets

IsRelatedTo

Kurek, M. (2025). Long-term and seasonal drivers of organic matter in the clearwater Tapajós River and implications for the Amazon River basin. *OSF*. https://doi.org/10.17605/OSF.IO/USH6Y

Kurek, M., Muniz, R., Moura, J. M., Peucker-Ehrenbrink, B., Holmes, R., McKenna, A., Spencer, R. (2026) **Absorbance and Excitation Emission spectra (EEMs) measurements of the Tapajós River, Brazil from 2016-2023.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2026-01-20 http://lod.bco-dmo.org/id/dataset/986855 [view at BCO-DMO]
Relationship Description: Related datasets from the same study published in Kurek et al. (2025, doi: 10.1029/2025GB008545).

Kurek, M., Muniz, R., Moura, J. M., Peucker-Ehrenbrink, B., Holmes, R., McKenna, A., Spencer, R. (2026) **Fourier Transform-Ion Cyclotron Resonance Mass spectrometry (FT-ICR MS) peaks lists from the Tapajós River, Brazil from 2016-2023.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2026-01-20 http://lod.bco-dmo.org/id/dataset/986858 [view at BCO-DMO]
Relationship Description: Related datasets from the same study published in Kurek et al. (2025, doi: 10.1029/2025GB008545).

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Parameters

Parameter	Description	Units
Sample_Name	Discrete sample name	unitless
Date	Sampling date	unitless
Date_ISO	Sampling date in ISO 8601 format	unitless
lat_dd	Sampling site latitude	decimal degrees
lon_dd	Sampling site longitude	decimal degrees
Discharge_on_sampling_day	River discharge on sampling day	cubic meters per second (m3 s-1)
Mean_monthly_discharge	Mean monthly river discharge	cubic meters per second (m3 s-1)
Mean_daily_air_temp	Mean daily air temperature	degrees Celsius (degC)
Daily_precipitation	Daily precipitation	millimeters (mm)
Mean_monthly_air_temp	Mean monthly air temperature	degrees Celsius (degC)

Monthly_precipitation	Monthly total precipitation	millimeters (mm)
DOC	Dissolved Organic Carbon concentration	milligrams per liter (mg L-1)
FI	Fluorescence Index	unitless
a350	Naperian absorbance at 350 nm (m-1, Naperian)	per meter (m-1)
S275_to_295	Spectral slope from 275-295 nm	per nanometer (nm-1)
S350_to_400	Spectral slope from 350-400 nm	per nanometer (nm-1)
SUVA254	Specific UV absorbance at 254 nm (L mg C-1 m-1)	liters per milligram carbon per meter (L mg C-1 m-1)
perc_CHO	Percent CHO-containing molecular formulae (% relative abundance)	percent (%)
perc_CHON	Percent CHOn-containing molecular formulae (% relative abundance)	percent (%)
perc_CHOS	Percent CHOS-containing molecular formulae (% relative abundance)	percent (%)
perc_CHONS	Percent CHONS-containing molecular formulae (% relative abundance)	percent (%)
perc_CA	Percent condensed aromatic molecular formulae (% relative abundance)	percent (%)
perc_PPh	Percent polyphenolic molecular formulae (% relative abundance)	percent (%)
low_OC_HUP_perc	Percent highly unsaturated and phenolic (low O/C) molecular formulae (% relative abundance)	percent (%)
high_OC_HUP_perc	Percent highly unsaturated and phenolic (high O/C) molecular formulae (% relative abundance)	percent (%)
high_OC_Ali_perc	Percent aliphatic (high O/C) molecular formulae (% relative abundance)	percent (%)

low_OC_Ali_perc	Percent aliphatic (low O/C) molecular formulae (% relative abundance)	percent (%)
Assigned_formulae	Number of assigned molecular formulae	unitless
RMS_Error	Root mean squared error or assigned molecular formulae	unitless
Mass	Measured mass	daltons (Da)
H_to_C	H atoms/C atoms (abundance weighted average)	unitless
O_to_C	O atoms/C atoms (abundance weighted average)	unitless
N_to_C_x1000	N atoms/C atoms (abundance weighted average x1000)	unitless
S_to_C_x1000	S atoms/C atoms (abundance weighted average x1000)	unitless
AImod	Modified aromaticity index (abundance weighted average)	unitless
DBE	Double bond equivalents (abundance weighted average)	unitless
DBE_C	Double bond equivalents/C atoms (abundance weighted average)	unitless
NOSC	Nominal oxidation state of C (abundance weighted average)	unitless
perc_IOS	Percent of Island of Stability formulae (% relative abundance)	percent (%)
Water_temp	Water temperature	degrees Celsius (degC)
SpC	Specific Conductivity	microSiemens per centimeter (uS cm-1)
O2sat	Dissolved oxygen (% saturation)	percent (%)

O2	Dissolved oxygen concentration (mg L-1)	milligrams per liter (mg L-1)
pH	pH	pH scale
FDOM	Total fluorescence of identified peak maxima (Relative Fluorescence Units)	relative fluorescence units (RFU)
C1	Percentage of fluorescence component 1 from the PARAFAC model	percent (%)
C2	Percentage of fluorescence component 2 from the PARAFAC model	percent (%)
C3	Percentage of fluorescence component 3 from the PARAFAC model	percent (%)
C4	Percentage of fluorescence component 4 from the PARAFAC model	percent (%)
C5	Percentage of fluorescence component 5 from the PARAFAC model	percent (%)
d2H	d2H (delta2H) of River water	per mil (0/00)
d18O	d18O (delta18O) of River water	per mil (0/00)
D_excess	Deuterium excess of River water	per mil (0/00)

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Fourier Transform Ion Cyclotron Resonance Mass Spectrometer
Dataset-specific Description	Solid phase extracted water samples were analyzed on a custom-built hybrid linear ion trap ultra-high resolution FT-ICR mass spectrometer equipped with a 21T superconducting solenoid magnet at the National High Magnetic Field Laboratory (Tallahassee, FL). Negatively charged ions from DOM were produced via electrospray ionization (ESI) at a flow rate of 500 nL min-1 via a syringe pump. Typical conditions for ion formation included: emitter voltage, -2.8–3.2 kV; S-lens RF level, 40%; and heated metal capillary temperature, 350 degrees C.
Generic Instrument Description	In Fourier Transform Ion Cyclotron Resonance Mass Spectrometry, the mass-to-charge ratio (m/z) of an ion is experimentally determined by measuring the frequency at which the ion processes in a magnetic field. These frequencies, which are typically in the 100 KHz to MHz regime, can be measured with modern electronics making it possible to determine the mass of an ion to within +/- 0.000005 amu or 5 ppm.

Dataset-specific Instrument Name	Horiba Scientific Aqualog (Horiba Ltd., Kyoto, Japan)
Generic Instrument Name	Horiba Aqualog spectrofluorometer
Dataset-specific Description	UV-visible absorbance spectra were measured at room temperature in a 1-cm quartz cuvette with a Horiba Scientific Aqualog (Horiba Ltd., Kyoto, Japan) at wavelengths of 230–800 nm. Excitation-Emission matrices (EEMs) from fluorescence spectra were measured at room temperature in a 1-cm quartz cuvette using a Horiba Scientific Aqualog (Horiba Ltd., Kyoto, Japan). EEMs were collected at 250– 500 nm excitation wavelengths and 300–600 nm emission wavelengths with 5 and 2 nm intervals, respectively, at integration times ranging from 3 to 6s.
Generic Instrument Description	A benchtop optical spectrometer suitable for measuring coloured dissolved organic matter (CDOM). Outputs include absorbance spectra, fluorescence emission spectra, and fluorescence excitation-emission matrices. This instrument simultaneously measures absorbance spectra and fluorescence Excitation-Emission Matrices. It employs the Absorbance-Transmission Excitation Emission Matrix (A-TEEM) technique to acquire an Excitation Emission Matrix.

Dataset-specific Instrument Name	dual-isotope Cavity Ringdown Spectroscopy (CRDS, 2130i/2140i, Picarro Inc., USA)
Generic Instrument Name	Picarro L2130-I deltaD/delta18O Isotopic Water Analyzer
Dataset-specific Description	For water samples up to sampling dates of August 2017, analyses were conducted in replicate by Off-Axis Integrated Cavity Output Spectroscopy (OA-ICOS, TLWIA 45EP, Los Gatos Inc., USA) with nine injections per sample vial of which five were accepted. The later batch was analyzed, again in replicate, via dual-isotope Cavity Ringdown Spectroscopy (CRDS, 2130i/2140i, Picarro Inc., USA) with six injections per vial (three accepted).
Generic Instrument Description	A portable analyser designed for laboratories or field based isotope analysis. It uses Cavity Ring-Down Spectroscopy (CRDS) to measure the spectral signature of the molecule of interest. The instrument includes a closed-loop temperature and pressure control. The L2130-i can be used in all aspects of the water cycle: water vapor, liquid water, or water trapped in solids. It has a typical precision of 0.25 per mil for d18O and 1.20 per mil for dD in solid samples. Corresponding typical values for liquid samples are 0.011 per mil for d18O and 0.038 per mil for dD.

Dataset-specific Instrument Name	
Generic Instrument Name	Shimadzu TOC-L Analyzer
Dataset-specific Description	Filtered water samples were acidified (HCl, pH 2) and DOC concentrations were measured with a Shimadzu TOC-L CPH high temperature catalytic oxidation total organic carbon analyzer (Shimadzu Corp., Kyoto, Japan).
Generic Instrument Description	A Shimadzu TOC-L Analyzer measures DOC by high temperature combustion method. Developed by Shimadzu, the 680 degree C combustion catalytic oxidation method is now used worldwide. One of its most important features is the capacity to efficiently oxidize hard-to-decompose organic compounds, including insoluble and macromolecular organic compounds. The 680 degree C combustion catalytic oxidation method has been adopted for the TOC-L series. http://www.shimadzu.com/an/toc/lab/toc-l2.html

Dataset-specific Instrument Name	
Generic Instrument Name	YSI Professional Plus Multi-Parameter Probe
Dataset-specific Description	In situ water temperature, dissolved oxygen (DO), specific conductivity (SpC), and pH were measured in the center of the river channel at 0.5 m depth with a calibrated YSI Professional Plus multimeter.
Generic Instrument Description	The YSI Professional Plus handheld multiparameter meter provides for the measurement of a variety of combinations for dissolved oxygen, conductivity, specific conductance, salinity, resistivity, total dissolved solids (TDS), pH, ORP, pH/ORP combination, ammonium (ammonia), nitrate, chloride and temperature. More information from the manufacturer.

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Project Information

RAPID: El Nino Event Impacts on Organic Matter Export and Composition in the Amazon River (ENSO impact on Amazon River DOC and DOM)

Coverage: Amazon River basin

NSF Award Abstract:
The Amazon River is one of the largest sources of freshwater and carbon to the ocean. Thus, understanding the factors that influence freshwater delivery from the Amazon River is important for understanding the carbon cycle of the Amazon River and the receiving Atlantic Ocean. El Niño–Southern Oscillation (ENSO) is a periodic event that causes changes in winds and sea surface temperature over the tropical eastern Pacific Ocean and affects climate in the tropics and subtropics. The National Weather Service predicts that El Niño conditions are likely to form across the Pacific during Summer 2023. These conditions are expected to last through February 2024. This event is expected to impact precipitation and air temperatures in the Amazon Basin and freshwater delivery from the Amazon River. This project aims to study the amount and chemical composition of dissolved organic carbon delivered from the Amazon River to the Atlantic Ocean during the 2023-2024 El Niño event. Scientists involved in this project plan to collect samples from late Summer 2023 through late Summer 2024. The study will identify conditions before, during and after this event. This unique set of samples will enable the team of scientists to study how ENSO influences the delivery of organic carbon to the coastal ocean.
This project provides support for an early career researcher and promotes international cooperation and

inclusivity between researchers from the United States of America and researchers in Brazil who are directly impacted by the changing Amazon River.

This project examines how El Niño Southern Oscillation (ENSO) anomalies impact the export of dissolved organic carbon (DOC) and composition of dissolved organic matter (DOM) from the Amazon River to the Atlantic Ocean. Based on recent studies, it has been hypothesized that the upcoming 2023 El Niño event will reduce the annual DOC flux and proportion of exported terrestrial DOM from the Amazon River compared to non-ENSO and La Niña years. This hypothesis will be examined by linking established state-of-the-art optical and molecular-level characterization techniques (e.g., Fourier-transform ion cyclotron resonance mass spectrometry; FT-ICR MS) with DOC flux calculations over the course of an El Niño year. Analyzing both bulk DOC fluxes and the molecular-level composition will reveal how the quantity and quality of DOM export will change monthly in response to reduced precipitation and higher temperature across the Amazon Basin and headwaters. DOC fluxes as well as detailed characterizations (FT-ICR MS, optical, fluorescence analysis) of DOM sampled from the furthest downstream Amazon River gauging station at Óbidos (Brazil) will be directly compared to results obtained from the 2011-2012 La Niña year and the following 2012-2013 hydrologically normal year to determine how global climate anomalies impact the DOC export to marine systems and to create a framework for future predictions. Data obtained from this proposed study will lay the foundations for larger studies investigating how ENSO cycles impact discharge and carbon export from other major tropical-subtropical rivers and ultimately, how ENSO cycles impact global land-ocean carbon export.

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-2333961

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