Bacterial abundance, bacterial organic carbon, and total organic carbon from remineralization bioassays conducted on R/V Robert Gordon Sproul cruises along the Southern California coast during July and August 2023

Website: https://www.bco-dmo.org/dataset/953702
Data Type: Cruise Results
Version: 1
Version Date: 2025-02-18

Project
» Postdoctoral Fellowship: OCE-PRF: Smoke on the water: the impacts of wildfire ash deposition on surface ocean biology (Smoke on the water)

Contributors	Affiliation	Role
Baetge, Nicholas	Oregon State University (OSU)	Principal Investigator
Carlson, Craig A.	University of California-Santa Barbara (UCSB)	Scientist
Graff, Jason	Oregon State University (OSU)	Scientist
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Abstract
These data include bacterial abundance, bacterial organic carbon, and total organic carbon from remineralization bioassays conducted to assess bacterioplankton growth and DOC degradation. Experiments were conducted on cruises aboard the R/V Robert Gordon Sproul (SP2319, SP2320) between dates 2023-07-28 and 2023-08-19 along the Southern California coast. Deposition of wildfire ash on the ocean can fertilize microbial production but also has the potential to inhibit microbial growth due to heavy metal toxicity. The data collected from these field experiments can contribute to elevating understanding of wildfire-driven material transfer from the terrestrial system to the ocean and its impact on carbon and energy flow in marine food webs. These data were collected by Dr. Nicholas Baetge, Dr. Allen Milligan, Brian Ver Wey, and Parker Hansen of Oregon State University. Data were also collected by Dr. Craig Carlson, Elisa Halewood, and Keri Opalk of the University of California Santa Barbara

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Coverage

Location: Southern California coast
Spatial Extent: **N**:34.37358 **E**:-118.402 **S**:33.54503 **W**:-120.7948
Temporal Extent: 2023-08-02 - 2023-08-22

Methods & Sampling

All surface seawater was collected just prior to local sunrise from a SBE-911+ Conductivity-Temperature-Depth (CTD, Sea-Bird Scientific) Niskin bottle rosette cast and then transferred or directly filtered into acid-cleaned 20-liter (L) carboys with platinum-cured silicone tubing.

Bacterial growth and dissolved organic carbon (DOC) utilization were estimated in six microbial remineralization experiments following Baetge et al (2021), in which changes in bacterioplankton cell densities, bacterial organic carbon, and TOC were measured over five day incubations. For each experiment, 3-micrometer (µm) filtered surface seawater was directly and gently gravity-filtered through a mixed cellulose ester (MCE) membrane filter (EMD Millipore, 142-millimeters (mm)) in a polycarbonate filtration cartridge (Geotech Environmental Equipment, Inc.) with platinum-cured silicone tubing. The filtrate was then filtered through a 1.2- or a 0.2-µm MCE filter (EMD Millipore, 142 mm) to generate a bacterial inoculum or DOC media, respectively. Experiments were initiated when filtrates were mixed in a ratio of 1:4 bacterial inoculum to DOC media. Mixed seawater either remained unamended or was amended with ash leachate prior to being divided into a modified acid-washed 5 L polycarbonate bottle (Biotainer, Nalgene) (Baetge et al., 2021) and a set of 18 pre-combusted 40-milliliter (ml) EPA vials. Ash leachate DOC was added to experimental treatments at a final amendment concentration of ~4 µmol C/L Bottles and vials were incubated in the dark within ± 2 degrees Celsius (C) of in situ temperatures using wine coolers (YEG-2WS24-HD, YEEGO).

For each experiment, 2 ml samples for bacterial abundance were collected daily from all incubations. Triplicate 40 ml EPA vials were preserved daily as total organic carbon (TOC)samples after acidification to a pH of < 3 with 4 N HCl. Bacterial organic carbon (BOC) samples were collected in triplicate 1 L polycarbonate bottles from the bacterial inoculum and as samples from the 5 L polycarbonate bottles on the second and fifth days of the experiment. Bacterioplankton abundance (cells/L) samples were fixed upon collection with paraformaldehyde to a final concentration of 1%, flash-frozen in liquid nitrogen, and stored at -20 degrees C. Sample volumes for BOC (micromoles C per liter (µmol C/L)) measurements were filtered through two stacked pre-combusted 0.3 µm GF/75 filters (25 mm, Advantec) in inline polypropylene cartridges (Cole-Parmer). At three experimental sites, DOC media (i.e., 0.2 µm filtrate) was also filtered to generate triplicate background correction samples to account for DOC filter adsorption (Graff et al., 2023). All filters were stored in pre-combusted 20 ml borosilicate glass vials (Wheaton) at -20 degrees C, and then later fumed for 24 hours with HCl and dried for 24 hours at 50 degrees C prior to analysis.

BCO-DMO Processing Description

- Imported original file "BACTERIA_DOM.csv" into the BCO-DMO system.
- Flagged "NA" as a missing data value; missing data are empty/blank in the final CSV file.
- PI applied rounding to numeric values and provided a new file.
- Saved final data file as "953702_v1_dom_remineralization_bioassays.csv".

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Data Files

File	
953702_v1_dom_remineralization_bioassays.csv	(Comma Separated Values (.csv), 7.76 KB) MD5:b533cada2df3be78923385769c2d9861
Primary data file for dataset ID 953702, version 1	

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Related Publications

Baetge, N., Behrenfeld, M. J., Fox, J., Halsey, K. H., Mojica, K. D. A., Novoa, A., Stephens, B. M., & Carlson, C. A. (2021). The Seasonal Flux and Fate of Dissolved Organic Carbon Through Bacterioplankton in the Western North Atlantic. Frontiers in Microbiology, 12. https://doi.org/10.3389/fmicb.2021.669883
Methods

Baetge, N., Halsey, K.H., Hanan, E.J., Behrenfeld, M.J., Milligan, A.J., Graff, J.R., Hansen, P., Carlson, C.A., Boiteau, R.B., Arrington, E.A., Comstock, J., Halewood, E.R., Harvey, E.L., Nelson, N.B., Opalk, K., Very Wey, B. (in review). Pre-existing in situ conditions shape coastal plankton response to fire-generated ash leachate. Limnology and Oceanography
Results

Gasol, J. M., & Morán, X. A. G. (2015). Flow Cytometric Determination of Microbial Abundances and Its Use to Obtain Indices of Community Structure and Relative Activity. Hydrocarbon and Lipid Microbiology Protocols, 159–187. https://doi.org/10.1007/8623_2015_139
Methods

Graff, J. R., Nelson, N. B., Roca-Martí, M., Romanelli, E., Kramer, S. J., Erickson, Z., Cetinić, I., Buesseler, K. O., Passow, U., Zhang, X., Benitez-Nelson, C., Bisson, K., Close, H. G., Crockford, T., Fox, J., Halewood, S., Lam, P., Roesler, C., Sweet, J., … Siegel, D. A. (2023). Reconciliation of total particulate organic carbon and nitrogen measurements determined using contrasting methods in the North Pacific Ocean as part of the NASA EXPORTS field campaign. Elem Sci Anth, 11(1). https://doi.org/10.1525/elementa.2022.00112
Methods

Halewood, E., Opalk, K., Custals, L., Carey, M., Hansell, D. A., & Carlson, C. A. (2022). Determination of dissolved organic carbon and total dissolved nitrogen in seawater using High Temperature Combustion Analysis. Frontiers in Marine Science, 9. https://doi.org/10.3389/fmars.2022.1061646
Methods

Hansell, D. A. (2005). Dissolved Organic Carbon Reference Material Program. Eos, Transactions American Geophysical Union, 86(35), 318. doi:10.1029/2005eo350003
Methods

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Parameters

Parameter	Description	Units
stn	station number	unitless
lat	latitude	degrees North
lon	longitude	degrees East
dt	datetime (UTC) in ISO 8601 format	unitless
trt	treatment type: control or amendment with (1) Thomas Fire ash leachate, (2) low temperature (<500 degrees C) ash leachate, or (3) high temperature (>500 degrees C) ash leachate	unitless
bact_cells	mean bacterial abundance between replicate samples	cells per milliliter
sd_bact_cells	standard deviation of the mean bacterial abundance between replicate samples	cells per milliliter
boc	bacterial organic carbon	micromoles C per liter (umol C/L)
mean_toc	total organic carbon	micromoles C per liter (umol C/L)
sd_toc	standard deviation of the mean total organic carbon between replicate samples	micromoles C per liter (umol C/L)

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Instruments

Dataset-specific Instrument Name	CCE-440 Elemental Analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	BOC samples were analyzed on a CCE-440 Elemental Analyzer (Exeter Analytics) calibrated with acetanilide standards.
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

Dataset-specific Instrument Name	Guava flow cytometer
Generic Instrument Name	Flow Cytometer
Dataset-specific Description	Bacterial cells were stained with SYBR Green I (ThermoFisher) and enumerated on a Guava flow cytometer (Millipore) (Gasol et al., 2016).
Generic Instrument Description	Flow cytometers (FC or FCM) are automated instruments that quantitate properties of single cells, one cell at a time. They can measure cell size, cell granularity, the amounts of cell components such as total DNA, newly synthesized DNA, gene expression as the amount messenger RNA for a particular gene, amounts of specific surface receptors, amounts of intracellular proteins, or transient signalling events in living cells. (from: http://www.bio.umass.edu/micro/immunology/facs542/facswhat.htm)

Dataset-specific Instrument Name	
Generic Instrument Name	Niskin bottle
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	Shimadzu TOC-V or TOC-L
Generic Instrument Name	Total Organic Carbon Analyzer
Dataset-specific Description	Samples for TOC concentration measurements were acidified to a pH of < 3 with 60 µl 4 N HCl and quantified on a Shimadzu TOC-V or TOC-L using the high-temperature combustion method (Halewood et al., 2022). Precision for DOC analysis was ~1 µmol C L-1 and data quality was assessed by measuring Santa Barbara Channel surface and deep water samples that were calibrated against DOC consensus reference material provided by Hansell (2005).
Generic Instrument Description	A unit that accurately determines the carbon concentrations of organic compounds typically by detecting and measuring its combustion product (CO2). See description document at: http://bcodata.whoi.edu/LaurentianGreatLakes_Chemistry/bs116.pdf

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Deployments

SP2320

Website	https://www.bco-dmo.org/deployment/953019
Platform	R/V Robert Gordon Sproul
Start Date	2023-08-14
End Date	2023-08-19
Description	See more information at R2R: https://www.rvdata.us/search/cruise/SP2320

SP2319

Website	https://www.bco-dmo.org/deployment/953028
Platform	R/V Robert Gordon Sproul
Start Date	2023-07-28
End Date	2023-08-10
Description	See more information at R2R: https://www.rvdata.us/search/cruise/SP2319

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Project Information

Postdoctoral Fellowship: OCE-PRF: Smoke on the water: the impacts of wildfire ash deposition on surface ocean biology (Smoke on the water)

Coverage: Pacific Ocean

NSF Award Abstract:
Climate-driven warming is projected to increase the frequency, intensity, and size of wildfires that can have severe environmental, human, and economic impacts, particularly along the U.S. West Coast. These wildfires result in dramatic CO2 emissions and deposition of ash carrying nutrients, organic matter, and trace metals onto the coastal and open ocean. Deposition of wildfire ash on the ocean can alter the carbon and energy flow through marine food webs by fertilizing microbial production or inhibiting microbial growth due to heavy metal toxicity. How the character of both the ash (e.g., chemical quality, fertilizing v. toxic) and the starting microbial community composition (e.g., diversity, size distribution) influences the microbial response to ash-derived material is unknown. This project will address this knowledge gap by investigating the physiological responses of marine plankton off the U.S West Coast to different types of ash generated from local wildfires and plant biomass. This work will advance interdisciplinary science, bridging biological oceanography with terrestrial ecology and biogeochemistry, by generating foundational knowledge of wildfire impacts on surface ocean biology and carbon and energy transfer from land to ocean. Results from this project will enable improved forecasts of changes in marine ecosystems in response to wildfires, which is information pertinent to communities and industries that depend on ocean ecosystem resources, including fisheries. The work will also inform national efforts to mitigate and adapt to the impacts of climate change by addressing whether wildfire-stimulated fertilization and carbon fixation in the ocean can offset CO2 emissions from wildfires. This project will broaden participation and education in ocean science by providing immersive research experiences for multiple undergraduate students and opportunities for them to disseminate their work through scientific conferences and publications. Additionally, a day-long content unit related to the project will be developed and implemented in Oregon State University's annual week-long Microbiology Summer Camp, which provides local high school students with a hands-on learning experience in microbiology.

Specifically, this project consists of mechanistic studies designed to quantitatively describe the physiological responses (e.g., growth, productivity, cellular stoichiometry) of phytoplankton and bacterioplankton to a variety of ash types. The quantity and proportion of nutrients, organic matter, and trace metals leached from ash into seawater likely depends on the quality of the ash, which is influenced by vegetation type and the temperature at which the ash was produced. This study will assess how microbial production and growth are fertilized or inhibited by the composition of ash and will consist of two primary elements. In the first element, ash will be collected from the field and generated in the lab from plant biomass. The ash will then be leached in

seawater and chemically characterized for inorganic and organic matter content. In the second element, seawater incubation experiments will be conducted to quantify physiological and diversity-based responses of naturally occurring phytoplankton and bacterial communities to different ash types. Data generated from this project will contribute to improved predictive models of wildfire-driven material transfer from the terrestrial system to the ocean and its impact on carbon and energy flow in marine food webs.

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-2306993

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