Phytoplankton cell count data from laboratory cultures of Crocosphaera watsonii, Micromonas commoda, Prochlorococcus marinus, Synechococcus, Gephyrocapsa huxleyi, and Thalassiosira pseudonana collected from September to December 2022

Website: https://www.bco-dmo.org/dataset/991400
Data Type: experimental
Version: 1
Version Date: 2026-01-14

Project
» Phytoplankton Exometabolites (C-CoMP Phytoplankton Exometabolites)

Program
» Center for Chemical Currencies of a Microbial Planet (C-CoMP)

Contributors	Affiliation	Role
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Abstract
Phytoplankton cell count data from laboratory cultures of Crocosphaera watsonii WH8501, Micromonas commoda RCC299, Prochlorococcus MIT9301, Synechococcus WH8102, Gephyrocapsa huxleyi CCMP371, and Thalassiosira pseudonana CCMP1335. Cultures were harvested during the exponential growth phase. Cell count data were used to determine growth rates, and data are used in support of exometabolite data harvested from these cultures (available at BCO-DMO project 984095). Cell count data were collected by Hanna Anderson and Eli Salcedo.

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Coverage

Temporal Extent: 2022-09-17 - 2022-12-05

Methods & Sampling

Axenic cultures included *G. huxleyi* CCMP371, *M. commoda* RCC299, *T. pseudonana* CCMP1335, *Synechococcus* sp. WH8102, *C. watsonii* WH8501, *Prochlorococcus* MIT 9301. *G. huxleyi*, *M. commoda,* and *T. pseudonana* were grown in L1 growth media prepared according to Guillard and Hargraves (1993), and *Synechococcus* was grown in SN media prepared according to Waterbury et al. (1986), all with a base of 0.2-micrometer (µm) filtered coastal seawater collected from Vineyard Sound, MA, United States. *G. huxleyi* media excluded Si. *C. watsonii* was grown in SO media, which followed the SN media recipe but omitted $NaNO_3$, with a base of 75% Sargasso seawater (diluted to 75% with MilliQ). *Prochlorococcus* was grown in Pro99 in a Sargasso seawater base prepared according to Moore et al. (2007). Axenic strains of *C. watsonii*, *G. huxleyi*, *M. commoda*, *Synechococcus*, and *T. pseudonana* were inoculated into 25-millimeter (mm) borosilicate glass culture tubes containing 25 milliliters (mL) of sterile media. Axenic *Prochlorococcus* was inoculated into borosilicate culture tubes containing 35 mL of sterile media. Nine biological replicates were monitored for all strains on a 14:10 hour light-dark cycle, with the exception of *Prochlorococcus*, which was grown on a 13:11 hour light-dark cycle. Isolates were cultured with light intensities ranging from 45-130 µmol photons m^{-2} s^{-1} depending on taxonomy.

Growth was monitored daily by *in vivo* chlorophyll fluorescence on a Turner Designs 10-AU fluorometer. Measurements for all genera except *Prochlorococcus* were made at the same time each day, 3-4 hours after the beginning of the light cycle, to avoid diel changes in cell physiology. Daily sampling times for *Prochlorococcus* varied as cells divide only at night when acclimated to diel conditions, and thus sampling time throughout the day is less likely to influence cell counts. Six (6) replicates of each isolate were harvested by gentle vacuum filtration during exponential growth to maximize metabolite generation. The remaining three cultures were monitored as described above until they reached stationary phase, which occurred between 3-7 days after harvesting, depending on the strain. For all six phytoplankton strains, cells were filtered onto filters (47 mm, 0.2 µm Omnipore filters, Whatman) and the filtrates were collected into combusted (450 degrees Celsius (°C) for at least 4 hours) glass side-arm flasks. The vacuum pump pressure did not exceed ~5" Hg to minimize cell lysis and endometabolite contamination in filtrate samples. Filtrates were transferred into pre-combusted 40 mL amber vials. Culture media blanks (with no algal biomass) for all media types were also filtered using the same method. All filtrate samples were stored upright at -20°C until analysis. Growth rates during the exponential phase were calculated using relative fluorescent units (RFUs) for all strains with the exception of *Prochlorococcus*, where daily cell count data were used, and then averaged across replicates. For all species except *Prochlorococcus*, the final cell yields were evaluated via microscopy. Briefly, 1 to 2 mL of well-mixed cultures were removed immediately prior to harvesting and preserved in paraformaldehyde (for *Synechococcus*; 0.24% final concentration) or neutral Lugol's iodine solution (for all others; 2% final concentration). *Synechococcus* samples were diluted and collected on a filter (black 0.2 µm, 25 mm polycarbonate filters, Whatman) for cell counts using an epifluorescence microscope (63x, oil immersion), while Lugol's-preserved samples were counted using a hemocytometer and light microscope (10x). *Prochlorococcus* cell counts were obtained using flow cytometry. Briefly, flow cytometry samples were run live on a Guava EasyCyte flow cytometer (Cytek Biosciences) for 10,000 counts or 5 minutes each. Cells were excited with a blue 488 nanometer (nm) laser and cell counts, cell size, and chlorophyll content were analyzed using FlowJo.

BCO-DMO Processing Description

- Imported original file "rfu_cell_counts.csv" into the BCO-DMO system.
- Saved the final file as "991400_v1_phytoplankton_cell_counts.csv".

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Related Publications

Guillard, R. R. L., & Hargraves, P. E. (1993). Stichochrysis immobilis is a diatom, not a chrysophyte. Phycologia, 32(3), 234–236. doi:10.2216/i0031-8884-32-3-234.1
Methods

Moore, L. R., Coe, A., Zinser, E. R., Saito, M. A., Sullivan, M. B., Lindell, D., Frois-Moniz, K., Waterbury, J., & Chisholm, S. W. (2007). Culturing the marine cyanobacterium Prochlorococcus. Limnology and Oceanography: Methods, 5(10), 353–362. Portico. https://doi.org/10.4319/lom.2007.5.353

Methods

Waterbury, J., Watson, S., Valois, F., and Franks, D. (1986). Biological and ecological characterization of the Marine Unicellular Cyanobacterium Synechococcus. Can. Bull. Fish. Aquat. Sci. 214, 71-120. https://cir.nii.ac.jp/crid/1573105974970382336
Methods

Zhu, Y., Anderson, H. S., Salcedo, E., Miller, S. E., Longnecker, K., Soule, M. C. K., Haley, S. T., Swarr, G. J., Braakman, R., Dyhrman, S. T., & Kujawinski, E. B. (2025). Characterization of Phytoplankton-Excreted Metabolites Mediating Carbon Flux through the Surface Ocean. https://doi.org/10.1101/2025.11.04.686593
Results

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Related Datasets

IsRelatedTo

Zhu, Y., Anderson, H., Gray, L., Longnecker, K., Kujawinski, E., Dyhrman, S. T., Braakman, R. (2025) **Dissolved organic carbon data from laboratory cultures of Crocosphaera watsonii, Micromonas commoda, Prochlorococcus marinus , Synechococcus, Gephyrocapsa huxleyi, and Thalassiosira pseudonana collected from September to December 2022.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-01-16 http://lod.bco-dmo.org/id/dataset/991509 [view at BCO-DMO]

Zhu, Y., Anderson, H., Kujawinski, E., Dyhrman, S. T., Braakman, R., Gray, L. (2026) **Phytoplankton exometabolite concentrations from laboratory cultures of Crocosphaera watsonii, Micromonas commoda, Prochlorococcus marinus, Synechococcus, Gephyrocapsa huxleyi, and Thalassiosira pseudonana collected from September to December 2022.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2026-01-14 http://lod.bco-dmo.org/id/dataset/991360 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
species	phytoplankton strain grown in the experiment	unitless
strain	strain identifier of the phytoplankton species	unitless
day	The day of the experiment the measurement was taken	unitless
replicate	9 biological replicates of each culture, this denotes which replicate the measurement refers to	unitless
RFUs	Relative fluorescence units	unitlesss
cells_per_mL	Number of cells per mL, determined via flow cytometer for Prochlorococcus and via microscopy for all other isolates	cells per milliliter

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Instruments

Dataset-specific Instrument Name	Guava EasyCyte flow cytometer (Cytek Biosciences)
Generic Instrument Name	Flow Cytometer
Dataset-specific Description	flow cytometry samples were run live on a Guava EasyCyte flow cytometer (Cytek Biosciences) for 10,000 counts or 5 minutes each
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	epifluorescence microscope
Generic Instrument Name	Fluorescence Microscope
Dataset-specific Description	Synechococcus samples were diluted and collected on a filter for cell counts using an epifluorescence microscope (63x, oil immersion)
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of fluorescence and phosphorescence instead of, or in addition to, reflection and absorption of visible light. Includes conventional and inverted instruments.

Dataset-specific Instrument Name	light microscope
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Samples were counted using a hemocytometer and light microscope (10x)
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	Turner Designs 10-AU fluorometer
Generic Instrument Name	Turner Designs Fluorometer 10-AU
Dataset-specific Description	Growth was monitored daily by in vivo chlorophyll fluorescence on a Turner Designs 10-AU fluorometer.
Generic Instrument Description	The Turner Designs 10-AU Field Fluorometer is used to measure Chlorophyll fluorescence. The 10AU Fluorometer can be set up for continuous-flow monitoring or discrete sample analyses. A variety of compounds can be measured using application-specific optical filters available from the manufacturer (read more from Turner Designs, turnerdesigns.com, Sunnyvale, CA, USA).

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Project Information

Phytoplankton Exometabolites (C-CoMP Phytoplankton Exometabolites)

Website: https://ccomp-stc.org/

Coverage: Lab study

The Center for Chemical Currencies of a Microbial Planet (C-CoMP) is focused on understanding marine chemical currencies. This project examines exometabolites released from representative taxa of marine phytoplankton to better characterize the composition of labile marine dissolved organic matter and understand the biological sources of these metabolites to the marine environment. Specifically, this project integrates novel metabolomics, genomics, transcriptomics, and proteomics methods to identify extracellular metabolites and link them with their production pathways under environmentally relevant conditions.

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Program Information

Center for Chemical Currencies of a Microbial Planet (C-CoMP)

Website: https://ccomp-stc.org/

Coverage: North Atlantic, BATS, global/other

Functions carried out by microscopic inhabitants of the surface ocean affect every aspect of life on our planet, regardless of distance from the coast. Ocean phytoplankton are responsible for half of the photosynthesis on Earth, the first step in a complex system that annually withdraws 50 billion metric tons of carbon from the atmosphere to sustain their growth. Of this, 25 billion metric tons participate in a rapid cycle in which biologically reactive material is released into seawater and converted back into carbon dioxide by marine bacteria within hours to days. The chemical-microbe network at the heart of this fast cycle remains poorly constrained; consequently, its primary currencies and controls remain elusive; its sensitivities to changing ocean conditions are unknown; and its responses to future climate scenarios are not predictable. The Center for Chemical Currencies of a Microbial Planet (C-CoMP) integrates research, education and knowledge transfer activities to develop a mechanistic understanding of surface ocean carbon flux within the context of a changing ocean and through increased participation in ocean sciences. C-CoMP supports science teams that

merge biology, chemistry, modeling, and informatics to close long-standing knowledge gaps in the identities and dynamics of organic molecules that serve as the currencies of elemental transfer between the ocean and atmosphere. C-CoMP fosters education, outreach, and knowledge transfer activities that engage students of all ages, broaden participation in the next generation of ocean scientists, and extend novel open-science approaches into complementary academic and industrial communities. The Center framework is critical to this mission, uniquely facilitating an open exchange of experimental and computational science, methodological and conceptual challenges, and collaborations that establish integrated science and education partnerships. With expanded participation in ocean science research and ocean literacy across the US society, the next generation of ocean scientists will better reflect the diverse US population.

Climate-carbon feedbacks on the marine carbon reservoir are major uncertainties for future climate projections, and the trajectory and rate of ocean changes depend directly on microbial responses to temperature increases, ocean acidification, and other perturbations driven by climate change. C-CoMP research closes an urgent knowledge gap in the mechanisms driving carbon flow between ocean and atmosphere, with global implications for predictive climate models. The Center supports interdisciplinary science teams following open and reproducible science practices to address: (1) the chemical currencies of surface ocean carbon flux; (2) the structure and regulation of the chemical-microbe network that mediates this flux; and (3) sensitivity of the network and its feedbacks on climate. C-CoMP leverages emerging tools and technologies to tackle critical challenges in these themes, in synergy with existing ocean programs and consistent with NSF’s Big Ideas. C-CoMP education and outreach activities seek to overcome barriers to ocean literacy and diversify participation in ocean research. The Center is developing (1) initiatives to expand ocean literacy in K-12 and the broader public, (2) ocean sciences undergraduate curricula and research opportunities that provide multiple entry points into research experiences, (3) post-baccalaureate programs to transition undergraduates into graduate education and careers in ocean science, and (4) interdisciplinary graduate student and postdoctoral programs that prepare the next generation of ocean scientists. The C-CoMP team includes education faculty who evaluate the impacts of education and outreach activities and export successful STEM initiatives to the education community. C-CoMP is revolutionizing the technologies for studying chemical transformations in microbial systems to build understanding of the outsized impact of microbes on elemental cycles. Open science, cross-disciplinary collaborations, community engagement, and inclusive practices foster strategic advances in critical science problems and STEM initiatives. C-CoMP science, education, and knowledge-transfer themes are efficiently addressed through a sustained network of scientists addressing critical research challenges while broadening the workforce that will tackle multi-disciplinary problems with academic, industrial and policy partners.

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.

The Program's Data Management Plan (DMP) is available as a PDF document.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2019589

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