

# Size of sinking aggregates of xenic and axenic marine *Prochlorococcus* and *Synechococcus* from roller tank experiments conducted in 2016 and 2017

**Website:** <https://www.bco-dmo.org/dataset/774799>

**Data Type:** experimental

**Version:** 1

**Version Date:** 2019-08-14

## Project

» [Aggregation of Marine Picoplankton](#) (Marine Plankton Aggregation)

Contributors	Affiliation	Role
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## Abstract

Size of sinking aggregates of xenic and axenic marine *Prochlorococcus* and *Synechococcus* from roller tank experiments conducted in 2016 and 2017.

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## Coverage

**Temporal Extent:** 2016-01-01 - 2018-01-01

## Dataset Description

Size of sinking aggregates of xenic and axenic marine *Prochlorococcus* and *Synechococcus* from roller tank experiments conducted in 2016 and 2017.

These data were published in Cruz and Neuer, 2019.

Related Datasets:

\* Picocyanobacteria Sinking Aggregates: Abundances <https://www.bco-dmo.org/dataset/774784>

\* Picocyanobacteria Sinking Aggregates: Sinking Velocities <https://www.bco-dmo.org/dataset/774792>

\* Picocyanobacteria Sinking Aggregates: Excess Densities <https://www.bco-dmo.org/dataset/774806>

## Methods & Sampling

Cultures of *Synechococcus* WH8102 (axenic), *Synechococcus* WH7805 (xenic) and *Prochlorococcus marinus* MED4 (xenic and axenic) were incubated in 1.25 L roller tanks for 7 days in the dark at 3.5 RPM (for further details on roller tanks, see Shanks and Edmondson, 1989). Aggregation was tested with and without the addition of kaolinite clay. All treatments had n = 2 tanks. Aggregates formed were quantified, sized, and their

sinking velocities and excess densities determined.

Aggregation was tested with and without the addition of kaolinite clay (control, 0.5 mg per L of kaolinite clay, 5.0 mg per L of kaolinite clay)

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## Data Files

File
<b>sizes.csv</b> (Comma Separated Values (.csv), 713 bytes) MD5:4c777be4f04f28d1828202fdb7099cd Primary data file for dataset ID 774799

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## Related Publications

Cruz, B. N., & Neuer, S. (2019). Heterotrophic Bacteria Enhance the Aggregation of the Marine Picocyanobacteria Prochlorococcus and Synechococcus. *Frontiers in Microbiology*, 10.

doi:[10.3389/fmicb.2019.01864](https://doi.org/10.3389/fmicb.2019.01864)

*Results*

Shanks, A. L., & Edmondson, E. W. (1989). Laboratory-made artificial marine snow: a biological model of the real thing. *Marine Biology*, 101(4), 463–470. doi:10.1007/bf00541648 <https://doi.org/10.1007/BF00541648>

*Methods*

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## Parameters

Parameter	Description	Units
Culture	Culture name	unitless
Aggregate_ESD_Control1	Aggregate equivalent spherical diameter. Treatment = Control, replicate 1, no kaolinite clay.	millimeters (mm)
Aggregate_ESD_Control2	Aggregate equivalent spherical diameter. Treatment = Control, replicate 2, no kaolinite clay.	millimeters (mm)
Aggregate_ESD_0_5mg_Lkaolinite1	Aggregate equivalent spherical diameter. Treatment = concentration of 0.5 mg per L of kaolinite clay, replicate 1.	millimeters (mm)
Aggregate_ESD_0_5mg_Lkaolinite2	Aggregate equivalent spherical diameter. Treatment = concentration of 0.5 mg per L of kaolinite clay, replicate 2.	millimeters (mm)
Aggregate_ESD_5_0mg_Lkaolinite1	Aggregate equivalent spherical diameter. Treatment = concentration of 5.0 mg per L of kaolinite clay, replicate 1.	millimeters (mm)
Aggregate_ESD_5_0mg_Lkaolinite2	Aggregate equivalent spherical diameter. Treatment = concentration of 5.0 mg per L of kaolinite clay, replicate 2.	millimeters (mm)

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## Instruments

<b>Dataset-specific Instrument Name</b>	SteREO Discovery.V12, Axiocam 105 Color, Carl Zeiss, Germany
<b>Generic Instrument Name</b>	Microscope - Optical
<b>Generic Instrument Description</b>	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".

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## Project Information

### Aggregation of Marine Picoplankton (Marine Plankton Aggregation)

**Coverage:** Bermuda Atlantic Time-Series station

NSF abstract:

Marine phytoplankton are microscopic algae that live in the sunlit zone of the ocean. They play an important role in the uptake of carbon dioxide from the atmosphere through photosynthesis, similar to what plants do on land, and are the basis of the marine food web. However, instead of storing this organic carbon in leaf tissue and roots, marine phytoplankton are grazed by planktonic animals, or die and subsequently sink out of the sunlit zone in the form of aggregates, also called "Marine Snow". These particles not only export the organic carbon contained in their cells to the deep ocean, but also serve as food for animals and bacteria that live in the deep. A considerable portion of these phytoplankton are extremely small, among the tiniest of all organisms known. These extremely small cells have not been thought to play an important role in the formation and sinking of marine snow; however, recent findings challenge this view. This project will investigate how the smallest of these phytoplankton contribute to the rain of sinking particles from the sunlit surface to the deep ocean. This research is important because, in some of the largest expanses of the open oceans, these minute cells dominate the phytoplankton community, and larger plankton organisms are very sparse. The project, through a combination of work in the laboratory and at a field station, will shed light on how these tiny phytoplankton cells make aggregates, which ultimately enable them to sink as "Marine Snow". The project also provides unique opportunities for undergraduate students at Arizona State University, a land-locked public university, to gain experience in working with marine research. The project will serve to educate one PhD student, one MS student in an accelerated BS-MS program, and 8-10 undergraduate students/semester in a unique, inquiry based learning effort termed Microbial Education Training and Outreach (MENTOR). The undergraduate students will also participate in Arizona State University (ASU)'s School of Life Sciences, Undergraduate Research Program (SOLUR), which seeks to increase the participation of minorities in science. They will also contribute towards developing web and classroom materials, based on this project, which will then be distributed through a partnership with the award-winning ASU-sponsored Ask A Biologist K-12 web site.

The oceanic "biological carbon pump", the photosynthetically mediated transformation of dissolved inorganic carbon into particulate and dissolved organic carbon and its subsequent export to deep water, functions as a significant driver of atmospheric carbon uptake by the oceans. The traditional view of the biological carbon pump in the ocean is that of sinking of large aggregates (marine snow) or fecal pellets, which are made up of large, mineral ballasted cells of phytoplankton. However, recent evidence, stemming from in situ investigations of particulate matter, trap studies and modelling studies, have shown that micron-sized phytoplankton such as picocyanobacteria as well as picoeukaryotes can contribute significantly to the sinking of particulate matter. The specific mechanisms behind the sinking of these micrometer sized cells remain elusive as the cells are too small to sink on their own, and mesozooplankton is likely unable to ingest single cells. Intriguingly, recent research by the investigators has shown that the ubiquitous picocyanobacteria *Synechococcus* are able to form aggregates and sink at velocities comparable to those of marine snow. They found that the matrix of the *Synechococcus* aggregates was made of Transparent Exopolymeric Particles (TEP), and that TEP production was enhanced under nutrient limited culture conditions. Interaction with clays and presence of heterotrophic

bacteria also enhanced aggregation and sinking velocity. This study aims to further investigate aggregation of other common picoplankton in the laboratory and aggregation occurring in natural settings at an oligotrophic open ocean site, the Bermuda Atlantic Time-series Site (BATS). Ultimately, this project will increase and refine our understanding of the role of the smallest phytoplankton in aggregation and sinking - information vital to understanding carbon cycling processes in the oceans.

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## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1658527</a>

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