Videos of coscinodiscus sinking behavior in light and dark conditions from experiments in June 2017

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Project
» Dynamic sinking behavior in diatoms: New insights from individual-based high resolution video observations (Diatom Dynamic Sinking)

Contributors	Affiliation	Role
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Coverage

Temporal Extent: 2017-06-20 - 2017-06-22

Dataset Description

Videos of Coscinodiscus wailesii and Coscinodiscus radiatus diatoms sinking following exposure to various culture and light conditions.

Each date folder contains folders with videos from that date and a scale video.
Videos were recorded at 10 frames per second.

Within each date folder are folders for each treatment. Folder names describe treatment conditions. Media refers to L1 culture media. Light and dark refer to 12 h exposure to light or dark prior to video recording.

Treatments:
6_20_2017 (L1 culture media):
L1 lg C_wailesii_exponential phase
L1 lg C_radiatus_exponential phase

6_21_2017:
C_radiatus Dark_FSW for 24 hrs_from 9 day old media
C_radiatus Dark_L1 for 24 hrs_9 day old media
C_radiatus Light_FSW for 24 hrs_from 9 day old media
C_radiatus Light_L1 for 24 hrs_from 9 day old media
C_radiatus Light_L1 for 24 hrs_from diff stock_very sm cells
C_wailesii_lg_Dark-L1 for 24 hrs
C_wailesii_lg_Dark_FSW for 24 hrs

C_wailesii_lg_light_FSW for 24 hrs

6_22_2017:
C_radiatus_Dark_FSW 48 hrs
C_radiatus_Dark_L1 48 hrs_9 day old media
C_radiatus_Light_FSW 48 hrs
C_radiatus_Light_L1 48 hrs_recently transferred to new L1
C_wailesii_lg_Dark_FSW 48 hrs
C_wailesii_lg_Dark_L1 48 hrs
C_wailesii_lg_Light_FSW 48 hrs

NOTE: The Get Data link will download a 3.2 GB .zip data package with all the video files.

Methods & Sampling

Cultures of two diatom species Coscinodiscus wailesii and Cosciondiscus radiatus were filmed in L1 culture media or after transferring to filtered seawater for 24 or 48 h and exposing to either light or dark conditions for 12 h. Methods are described in more detail in Du Clos et al. in prep.

Data Processing Description

BCO-DMO Processing Notes:

- Folders 6_20_2017, 6_21_2017, and 6_22_2017 have been zipped into the package diatom_videos.zip and served via the "Get Data" button.

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Data Files

File	
diatom_videos.zip	(ZIP Archive (ZIP), 3.20 GB) MD5:afaf55eb0b59d0d5e5f205a6c4125737

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Parameters

Parameters for this dataset have not yet been identified

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Instruments

Dataset-specific Instrument Name	Edgertronic SC1 camera
Generic Instrument Name	Camera
Dataset-specific Description	Camera: Edgertronic SC1 camera (Sanstreak Corp., San Jose, CA, USA) Lens: Nikon 105 mm 1:1 macro lens Resolution: 1280 x 1024 px Frame rate: 10 fps Illumination: LED infrared illuminator
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

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Project Information

Dynamic sinking behavior in diatoms: New insights from individual-based high resolution video observations (Diatom Dynamic Sinking)

Coverage: laboratory studies, Univ. of Texas at Austin, University of South Florida

Description from NSF award abstract:
The sinking of diatoms out of the well-lit upper layers of the ocean is responsible for transport of material to the deep-sea and is an important factor in controlling the overall abundance of this grass of the sea. Their sinking characteristics are important to understand in detail so they can be accurately represented in models of ocean dynamics. It has been assumed that all members of these non-flagellated, microscopic cells sink at approximately the same rate, at a constant rate, and that the direction of motion is downward. However, a re-examination of sinking rates at an individual cell level indicates that all three assumptions are incorrect. Using sophisticated optical and computing techniques, these researchers are examining how individual diatom cells sink, their ability to start and stop, and assessing what fraction can actually ascend. This study will yield new insights into how diatoms interact with their external environment by altering their movement through it. It will also address what fraction of these populations are actually moving upwards, thereby enhancing the movement of nutrients upward into the well-lit portions of the ocean. These are novel insights into how small unicellular species interact with the ocean around them and will significantly enrich our understanding of a problem that had been thought to be well understood. The project will train one graduate student and two undergraduate students in this research. Outreach is also provided by K-12 activities bringing holographic instruments into the classroom, and a public lecture series at our institute.

Diatom sinking rates are important life history characteristics that control both loss rates and nutrient flux to the cell surface. Positive buoyancy (m per hour rates) is an attribute of the largest diatom cells and plays a role in a vertical migration life history strategy. However, rates in smaller diatoms are typically described from a modified Stokes equation and are generally assumed to uniform and downward. The investigators previously observed that a species sinking rate is not monotonic within a sample but is distributed around a mean value, may be both upward and downward, and is under cellular control from near-zero to maximum velocity over second time scales. Thus, ascending behavior can be limited to a small portion of a population with a substantial downward rate. The goal of this project is to determine how widespread these characteristics are, determine the role of this unique start-stop sinking behavior, and examine how pervasive positive buoyancy is using a series of carefully controlled laboratory studies and a broad suite of diatom species. These characteristics will be considered within a framework of the complex form/function patterns that occur in diatoms. Boundary layers around cells differ vastly during the stop/start sequence and can be directly visualized by our techniques. Nutrient diffusion to the cell is accelerated during fast sinking; the investigators hypothesize that diffusion to cellular surfaces has been underestimated by using a constant bulk sinking rate. This work is only possible with the advent of high resolution cameras and advanced processing that allows particle and fluid flow to be quantified in a dynamic water column.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1537546

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