Particle Image Velocimetry (PIV) data from suspension feeding juvenile Mya arenaria clams

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Project
» A framework to characterize inhalant siphon flows of aquatic benthos (Inhalant flows)

Contributors	Affiliation	Role
Crimaldi, John	University of Colorado (CU)	Principal Investigator
Jiang, Houshuo	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
Jumars, Peter	University of Maine	Principal Investigator
Du Clos, Kevin	University of Maine	Contact
Switzer, Megan	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Dataset Description

Juvenile *Mya arenaria* clams were filmed using the micro PIV setup described below (instruments). Experiments were performed in a glass tank with inner dimensions 44 x 4.5 x 97 mm (width x depth x height). The tank was filled to ~100 ml with filtered seawater (17-19˚C, practical salinity 33) seeded with 3 µm polystyrene beads (Polysciences, Inc., Warrington, PA, USA).

Files are named with animal number first and sequence number second (y<animal #>s<sequence #>.txt)

Download the compressed data file, (mya_arenaria_piv_data.zip, 7.3 MB) here:
http://dmoserv3.bco-dmo.org/data/jumars/mya_arenaria_piv/mya_arenaria_piv_data.zip

Methods & Sampling

Videos were captured at 2000 fps using a FASTCAM SA3 120K monochrome high-speed camera (Photron, Tokyo, Japan) fitted with an infinity-corrected, long-working-distance microscope objective (4x, 18.5 mm working distance) plus a 200 mm focal length objective lens.

Vector fields were calculated using DaVis (LaVision, Goettingen, Germany) with the following parameters: single-frame mode using one pass with 64 x 64 px interrogation windows (50% overlap) followed by four passes with 32 x 32 px interrogation windows (75% overlap).

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Data Files

File
mya_arenaria_piv.csv (Comma Separated Values (.csv), 152 bytes) MD5:6517ece81db6693ace4b2ddbd1346b19 Primary data file for dataset ID 713163

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Parameters

Parameter	Description	Units
x	x coordinate	mm
y	y coordinate	mm
u	velocity in the x-plane direction	meters per second
v	velocity in the y plane direction	meters per second

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Instruments

Dataset-specific Instrument Name	FASTCAM SA3 120K monochrome high-speed camera
Generic Instrument Name	Camera
Dataset-specific Description	FASTCAM SA3 120K monochrome high-speed camera fitted with an infinity-corrected, long-working-distance microscope objective (4x, 18.5 mm working distance) plus a 200 mm focal length objective lens.
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

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Project Information

A framework to characterize inhalant siphon flows of aquatic benthos (Inhalant flows)

Coverage: Laboratory data to be generated at the Darling Marine Center and the University of Colorado

Description from NSF award abstract:
Inhalant siphon flows produced by benthic invertebrates such as clams and tunicates through suspension feeding and respiration can directly affect a wide range of physical and chemical processes in benthic marine ecosystems. These flows are energetically costly and influence the feeding and reproductive biology of the individual. Moreover, an understanding of siphon flows at multiple scales can be widely used not only to address questions of flow fields for other aquatic organisms and exchange processes, but that understanding has direct impacts on a variety of engineering problems such as sewer designs. Despite the importance of these flow fields in biology, relatively little research has been conducted on this topic, specifically on inhalant (vs. exhalant) flows. For this study, the PIs have modeled the flow outside the siphon entrance of several important benthic marine animals and have found radically different results from those commonly assumed.

Given these findings, the PIs propose to test the results of their numerical simulation on inanimate physical models, and then verify their accuracy using live organisms.

The proposed numerical modeling will examine and predict effects of several parameters including inhalant siphon wall thickness, siphon height, disturbances caused by exhalant flows, and sensitivity to ambient flows. Predictions will be initially tested by using inanimate analog models. To provide a broad ecological framework, the PIs will then focus on five model suspension feeders, each of which has been extensively studied, and include a species of benthic shrimp, a tunicate, a soft shelled clam, the parchment worm, and a tube-dwelling amphipod. This suite of species will provide a broad description of intake flows as the combination of feeding systems spans nearly the full range of Reynolds numbers observed in animals that produce siphon flows. The results of this study will improve current understanding the effects of organismal intake flows on near-bed processes such as vertical fluxes of organic and inorganic nutrients, an important aspect of benthic ecology. Direct deliverables will include verified quantitative models of inhalant flows of marine benthos, connecting form and function and detailing fluid mechanical costs of operation.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1260199
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