Ciona intestinalis, Mercenaria mercenaria and Mya arenaria velocity fields from PIV experiments (Inhalant flows project)

Website: https://www.bco-dmo.org/dataset/655656
Data Type: experimental
Version:
Version Date: 2016-08-24

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

Contributors	Affiliation	Role
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Coverage

Temporal Extent: 2014-11-11

Dataset Description

This data is available for download: Download .zip file (8 GB).
Columns are as follows: x coordinate (mm), y coordinate (mm), u (m/s), v (m/s), w (m/s)

Related Dataset: Suspension feeder size data

Methods & Sampling

Stereoscopic particle image velocimetry (PIV) was performed using a LaVision (Goettingen, Germany) system with a pulsed ND:YAG laser (emission wavelength 532 nm). Experiments were performed with one suspension feeder in a 30 x 30 x 30 cm tank filled to 27-28 cm with filtered seawater. The water was seeded with hollow glass spheres (d = 9--13 µm; rho = 1.10 ± 0.05 g/cm^-3; LaVision) and maintained at a temperature of 17-19˚C and practical salinity of ~30-32. Approximately 2 x 10^6 Tetraselmis chuii cells were added to the tank at the beginning of each experiment to induce feeding. Experiments lasted <10 h.

The folder names are the date and time of collection of the original set of images ('YearMonthDay - HourMinuteSecond'). Multiple sequences from the same set of images are differentiated with a letter at the end.

Ciona intestinalis: Particle images were collected in single-frame mode at 3.5 Hz. Each folder represents a

sequence of 40 s. A different individual was used on each experiment date except on 12/9/14 and 12/16/14. On these two dates, the first ten sequences are from one individual, and the last ten sequences are from another individual.

Mercenaria mercenaria: Particle images were collected in double-frame mode at 2.5 Hz with the time between frame pairs (dt) ranging from 40-99 ms. Each folder represents a sequence of 40 s. A different individual was used on each experiment date.

Mya arenaria: Particle images were collected in double-frame mode at 2.5 Hz with the time between frame pairs (dt) ranging from 25-80 ms. Each folder represents a sequence of 40 s. A different individual was used on each experiment date.

Data Processing Description

Velocity fields were calculated from particle images using LaVision's DaVis software. Each file within a sequence folder represents the velocity field calculated from a pair of images.

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Data Files

File
susp_feed_PIV.csv (Comma Separated Values (.csv), 170 bytes) MD5:bdd95564493fea6a0474bca871716177 Primary data file for dataset ID 655656

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Parameters

Parameter	Description	Units
species	species used in PIV experiment	unitless
description	desciption of PIV data available in download	unitless
x	x coordinate	mm
y	y coordinate	mm
u	displacement as function of the in-plane X direction	m/s
v	displacement as function of the in-plane Y direction	m/s
w	displacement as function of the in-plane Z direction	m/s

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Camera
Dataset-specific Description	Cameras: LaVision Imager Intense Resolution: 1376 x 1040 px Lenses: Nikon AF Micro Nikkor 60 mm 1:2.8 D 532 nm bandpass filters
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	
Generic Instrument Name	Laser
Dataset-specific Description	New Wave Research Nd:YAG Solo II 15 Hz Wavelength 532 nm
Generic Instrument Description	A device that generates an intense beam of coherent monochromatic light (or other electromagnetic radiation) by stimulated emission of photons from excited atoms or molecules.

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Deployments

Jumars_2014

Website	https://www.bco-dmo.org/deployment/655630
Platform	lab University of Maine
Start Date	2014-11-11
End Date	2015-10-31
Description	PIV experiments

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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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