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A study of model bivalve siphonal currents

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Abstract

We carried out experiments studying the hydrodynamics of bivalve siphonal currents in a laboratory flume. Rather than use living animals, we devised a simple, model siphon pair connected to a pump. Fluorescence-based flow visualization was used to characterize siphon-jet flows for several geometric configurations and flow speeds. These measurements show that the boundary-layer velocity profile, siphon height, siphon pair orientation, and size of siphon structure all affect the vertical distribution of the excurrent flow downstream of the siphon pair and the fraction of excurrent that is refiltered. The observed flows may effect both the clearance rate of an entire population of siphonate bivalves as well as the efficiency of feeding of any individual. Our results imply that field conditions are properly represented in laboratory flume studies of phytoplankton biomass losses to benthic bivalves when the shear velocity and bottom roughness are matched to values found in the field. Numerical models of feeding by a bivalve population should include an effective sink distribution which is created by the combined incurrent-excurrent flow field. Near-bed flows need to be accounted for to properly represent these benthic-pelagic exchanges. We also present velocity measurements made with a laser-Doppler anemometer (LDA) for a single configuration (siphons flush with bed, inlet downstream) that show that the siphonal currents have a significant local effect on the properties of a turbulent boundary layer.