Geophysical Research Abstracts, Vol. 8, 02068, 2006
SRef-ID: 1607-7962/gra/EGU06-A-02068

Turbulent flow over an aggregation of benthic filter-feeders

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We present results from studies of turbulent fluid flow over model bivalves in a laboratory flume. A turbulent boundary layer forms over an aggregation of 3969 model bivalves, each of which incorporates roughness, siphonal flow, and mass filtration. We investigate the effect of the bivalve models on the overlaying turbulent flow, and on the formation of a near-bed concentration boundary layer that determines the composition of the siphon intake flow. Laser-Doppler velocimetry is used to measure fluctuations in the momentum (velocity) field, and laser-induced fluorescence is used to measure scalar (mass) fluctuations. The simultaneous operation of these instruments permits measurements of local turbulent fluxes of mass. The roughness of the bivalve models and the siphonal currents both produce significant changes in the overlaying turbulence structure. We show that the siphon currents act like an additional effective roughness in addition to the physical roughness of the bivalves. Physical and biological implications for numerical modeling of these flows are discussed.