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Impact of a typical invasive species, *Crepidula fornicata L.*, on the hydrodynamic and transport properties of the benthic boundary layer

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We present experimental results of the impact of a typical invasive species, *Crepidula fornicata L.*, on the hydrodynamic and transport properties of the benthic boundary layer. This invasive species has been introduced in the late 40's early 50's in the Bay of Brest (Brittany, France) but its proliferation really started in the mid-eighties. The present study aims at understanding how this proliferation modifies both the structure and transport properties of the boundary layer above invaded areas. We performed controlled laboratory experiments of turbulent flows over a bed of artificial *Crepidula* shells by using a 20 m long and 20 cm wide hydraulic channel. First, Particle Image Velocimetry (PIV) measurements in different vertical planes are temporally and spatially averaged to extract vertical profiles of $< \overline{u} >$, $< \overline{w} >$ and $< \overline{u'w'} >$ for three different densities of shells. These profiles are then compared successfully with simple 1D vertical models (derived initially for arrays of simple geometrical obstacles) that describe the flow above the shells and inside the canopy formed by the shells. Second, combined PIV and Planar Laser Induced Fluorescence (PLIF) measurements have been performed to investigate the dispersion properties of a passive tracer near the shells, that show that the turbulent Schmidt number is equal to unity in the transition region between the canopy flow and the external free stream. This justifies the use of an exchange velocity based upon the exchanges of momentum to quantify the exchanges of mass across the shear layer at the interface between the in-canopy and the above-canopy flows. This exchange velocity is then directly inferred from the purely 1DV hydrodynamic models and decreases as the shell density increases. Eventually,

PIV measurements in horizontal planes near the bottom are used to extract horizontal maps of the real bottom shear stress: this bottom shear stress, that drives the transport of sediments, is indeed different from the benthic shear stress that is mainly due to the drag behind the shells. At low shell densities, the bottom shear stress maps exhibit strong spatial variations associated with regions of relatively high shear stress just behind the shells (scour regions). These spatial variations as well as the mean value of the bottom shear stress decrease as the shell density increases. This suggests a sheltering effect by the Crepidula shells increasing with the mollusc density.