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Vortex dynamics of rectangular lateral cavities in open channel flows: Effects of the aspect ratio on mass transport and residence times[1]

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— Turbulent flows past lateral cavities in rivers and open channels play an important role in many environmental and geophysical applications. Large-scale coherent structures produced in the cavity are the most important mechanisms that control the dispersion and transport of contaminants in streams with transient storage zones. In this work we study the recirculating flow in lateral rectangular cavities with aspect ratios 1.0 and 3.0. We focus on the topology of the flow within the cavity and the dynamics of the shear-layer that forms in the main channel in shallow subcritical flows, using time-resolved Particle Image Velocimetry (PIV) and numerical simulations with coherent-structure resolving turbulent models (DES-LR). Through this investigation we provide new insights on the mechanisms of dispersion and transport of contaminants for each aspect ratio, and analyze the statistics of the mass exchange and residence times in the cavity for both configurations.

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