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An experimental analysis of dispersion and diffusion processes in compound channels

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The analysis of mixing processes in natural streams is very important to understand and predict water contamination and nutrient dispersion. Pollutant behavior is usually modeled by a standard advection-diffusion equation for the concentration. This equation allows an adequate description of the evolution of the passive tracers once the diffusivity tensor has been provided, estimation of which strongly depends on the local character of the flow field.

An experimental campaign based on Particle Image Velocimetry (PIV) measurements of free-surface velocities forms the basis for an analysis of mixing processes which occur in a compound channel flow. The flow mixing is analyzed from a Lagrangian point of view, i.e. in terms of single and multiple particle statistics (absolute and relative dispersion and diffusivity) and of the related mean flow characteristics. In the present study the asymptotic behavior of mixing characteristics for larger times, once the ballistic regime has been attained, has been analyzed in terms of the absolute diffusivity in order to characterize typical values of longitudinal and transversal dispersion coefficients. Different series of experiments (related to the ratio r_h between the main channel flow depth and the floodplain depth, which classifies the flow in Shallow, Intermediate and Deep, and *Fr* the Froude number) have been performed and the asymptotic value of the absolute diffusivity has been evaluated. The present study highlights a stronger dependence of coefficients on the main flow characteristics. The results are compared with several dispersion analyses for both the longitudinal dispersion coefficient and the transverse turbulent mixing coefficient presented in the literature.