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Large Eddy Simulation of the flow in 90° angled open-channel confluences with discordant beds

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The aim of the present contribution is to investigate the effect of difference in bed elevations of the tributary and main channel in a 90° angled open-channel confluence onto the hydrodynamics.

Large Eddy Simulations (LES) are used to investigate the three-dimensional complex flow patterns for four different discordance ratios ($\Delta z_T/h_d$ = 0, 0.1, 0.25 and 0.4), with geometries previously studied by other authors, whose data will be used for comparison purposes. The values of the ratio between the upstream main channel discharge and the total combined discharge varies between 0.083 and 0.917. With LES, it is possible to resolve a portion of the turbulent motions, which is beneficial to the accuracy of the simulations.

This contribution develops further analysis on some findings of the aforementioned studies, mostly regarding the role of the bed discordance on the recirculation zone dimensions and on the influence of the tributary flow on the main stream. Points of interest are the orientation of the tributary's inflow angle and the dimensions of the separation zone. These parameters are important for the longitudinal momentum balance, which determines the head losses occurring at the confluence. Additionally, the distribution of Turbulent Kinetic Energy (TKE) and bed shear stresses are studied. Previous studied indicated that the presence of a bed discordance has a pronounced effect on these points of interest. The present contribution elaborates these findings and adds knowledge from time-resolved simulations.

Since in a LES the flow and turbulence are for the most part resolved, it enables a thorough study of the hydrodynamics in an open-channel confluence, of which the understanding of the physical phenomena occurring in natural confluences will benefit.