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RESOLVED LES SOLUTIONS FOR LOCAL SCOUR MODELLING

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Summary. Observations of the impulsive phenomena of turbulence by Kline et al. [1967] aroused new interest in the knowledge of turbulent wall structures, and in its application to the incipient motion of sediments. On the other hand, studies of sediment dynamics, at a sediment scale, can not be avoided if satisfying explanations are sought on some evidence concerning morphological phenomena, even if they cover spatial scales much larger than grain scale. This is particularly true for local scour processes as the turbulent characteristics of the near-wall flow significantly differ from those of developed channel flows and, therefore, the understanding of the sediment transport phenomena requires detailed knowledge of the flow.
In this paper we present the results of a numerical investigation of the flow field around a 45° wing-wall bridge abutment in three different scour conditions: beginning of the process, development phase and equilibrium stage. The flow field was computed using a wall-resolving large eddy simulation (a simulation where the near-wall viscous sub-layer is directly resolved) and the bathymetric data were taken from physical experiments with an equivalent geometry. The use of a LES solution instead of a more standard solution from a RANS model, where only the 1st and 2nd order statistics are resolved, allows for detailed analysis of the near-wall flow field, and of the consequent stresses (normal and tangential) on the bottom bed; results are interpreted with respect to potential effects on the sediment stability. In particular, the importance of the instantaneous flow field and its intermittency on the space-time distribution of the stresses at the bottom wall is shown, as the probability distributions of stresses in the scour hole significantly differ from those of a developed channel flow.
Results of the present study may be helpful to formulate new physical-based local scour models.