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Morphodynamic processes around man-made structural interventions

donatella termini and vincenzo sammartano
(donatella.termini@unipa.it)

Morphodynamic processes due to transient transport phenomena can cause severe problems. Transient transport phenomena can be determined by “constrained” sediment boundary conditions. Constrained conditions can arise either from the presence of a rigid-bed upstream a mobile-bed channel reach or from the variation of inflow sediment rate upstream of an alluvial channel reach. The knowledge of the response of the alluvial stream to imposed constrained condition is extremely important. As an example, bed scouring around a hydraulic structure may undermine the stability of the structure itself creating the risk of failure. Consequently, designers are often required to take into account the scouring process and to include adequate protective measures against the local scour. The design of the protective measures, in turn, needs the knowledge of flow velocity field and of geometrical characteristics (maximum depth and length) of scour transient profiles.
The analysis of the erosion process and of the kinematic characteristics of flow downstream hydraulic structures is very complex and many interrelated phenomena have to be taken into account. As consequence, investigations concerning scour phenomena have been usually conducted in laboratory channels. Several empirical and semi-empirical relationships have been proposed to estimate the maximum depth of the scour hole, but little is know about flow hydrodynamics inside the scour hole. The uncertainty regarding the interpretation of sediment transport phenomena during the transients determines some limitations in mathematical modelling of scouring process.
The aim of the present work is to give a contribution for a better understanding on the morphodynamic processes determined by “constrained” upstream sediment conditions along the river reach downstream. The temporal variations of flow hydrodynamics are analysed on the basis of experimental work carried out in a straight channel constructed at the laboratory of the Dipartimento di Ingegneria Idraulica ed Applicazioni Ambientali - Palermo’s University (Italy). Detailed measures of flow velocity field inside the scour hole are presented and a 1-D numerical code, allowing to simulate the transient bed profiles, is also applied.