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Different scales of erosion processes downstream hydraulic structure

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When the equilibrium of a alluvial stream transporting large sediment loads is disturbed, either as result of the river natural behavior or because of man-made changes, adjustment is needed itself to a new equilibrium condition. Quantitative estimate of the bed deformation and of its temporal evolution is essential in order to define structural protective measures or to consider possible alternative or complementary components in risk analysis projects. If sediment load is lower than the flow is capable of transporting, bed degradation occurs. As an example, riverbed degradation is often observed downstream of dams. Furthermore, the alluvial stream is unable to immediately overcome the variation of sediment boundary conditions and a spatial distance (spatial lag or adaptation length) is required to reach the equilibrium transport capacity. Thus, local scouring around the hydraulic structure could also occur. Local scouring 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 the mechanics, location and geometrical characteristics (maximum depth and length) of scour.
The aforementioned erosion processes develop at different spatial and time scales, but they are strongly interrelated. Thus, in order to define the response of the mobile-bed profile under non-equilibrium situations it is necessary to adequately estimate both of them. But, the analysis of the kinematic characteristics of flow downstream hydraulic structures is very complex and many interrelated phenomena have to be taken into account. In the present work, peculiar results obtained during experimental work conducted in a straight laboratory channel are reported. The temporal variation of local maximum scour depth and the general degradation of the mean bed level further downstream are analyzed and discussed.