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Experimental observation of the rule of flexible vegetation on erosion processes

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Vegetation altering hydrodynamic conditions of an open channel flow controls the exchanges of sediment, nutrients and contaminants. Thus, the knowledge of the hydraulic characteristics of flow over vegetation is very important to support the management of fluvial processes. But, the analysis of the hydrodynamic conditions is complex because vegetation is flexible in varying degrees and it oscillates in the flow changing position. Furthermore, because of temporal changing of roughness due to natural vegetative growth, the response of vegetation to the flow can change in time. Many theoretical and experimental investigations have been performed in order to analyze both the mean flow and turbulence structure of open-channel flow (Nezu and Rodi 1986; Lemmin and Rolland 1997; Shvidchenko and Pender 2001; Ghisalberti and Nepf, 2002). Recent experimental runs carried out in laboratory channels with flexible vegetation, realized by using artificial filaments (Kutija and Hong 1996; Ikeda and Kanazawa 1996), investigated some peculiar characteristics of flow turbulence structure and revealed the generation of periodic organized vortices whose center is located slightly above the top of the vegetation layer. On the other hand, recent experimental studies conducted by Termini and Sammartano (2012) in a mobile-bed laboratory channel, and in absence of vegetation, have demonstrated that the formation of coherent turbulence structures plays an important role in sediment transport and in scouring evolution. In particular, ejection and sweep events contribute significantly to erosion, deposition and sediment suspension.
In this paper, in order to give a contribution to the understanding of the rule of vegetation on the analyzed erosion process, experimental results obtained in the same laboratory channel, but with bed covered by flexible vegetation, are presented. Attention is paid to interaction vegetation/erosion both along the vegetated-bed channel reach and downstream of it. In particular, different vegetation patches are experimentally tested and how such vegetation patches serve to obstruct the erosive action of water is discussed.

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