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Exploring mechanisms of root erosion by flood in laboratory experiments

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Riparian vegetation developing on the bare alluvial sediment may strongly contribute to the local stabilization of river bedforms and, in turn to the resulting river morphodynamics. Both seedlings from germinated seeds or woody debris deposits that start taking roots in the gravel sediment eventually develop into vegetation patches depending on the frequency and magnitude of floods. Ultimately, the interaction between river hydrology and vegetation growth time scales depends on the anchoring mechanism of certain root type and age within the non-cohesive alluvial soil. Recently, we started to explore the mechanisms of flow erosion in the presence of vegetation roots at the laboratory scale, in order to help explaining some observations that have been made at the laboratory scale (Perucca et al., this Session) and in the field, that is a restored river reach (Pasquale et al., this Session). In this paper, we propose a conceptual mechanism showing that root erosion by floods depends on root architecture (age and structure), and that uprooting is essentially of two types. The first type is relevant to young vegetation and is mainly due to a balance between flow drag force and resistance to uprooting. The second type concerns more mature vegetation and implies that considerable localized erosion additionally takes place in order to produce uprooting. Such two processes occur at completely different time scales, being quite instantaneous the first, and rather delayed the second. Although made at laboratory scale, the results of our preliminary experiments seem to support the idea ursued by the conceptual model. Future test will aim at better unravel the details of the root erosion dynamics and at formulating a modelling theory therof, the implications of which range from ecohydrology to river restoration practice.