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Modelling the effects of a single tree on river bank stability at the scale of single flow events

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This presentation intends to provide a contribution in modelling and understanding the effects of vegetation on bank stability, by including the main hydrological and mechanical effects of a single tree in a fully coupled hydrodynamic – seepage – stability simulation approach. The study site is a riverbank located along the Cecina River (Central Italy). A series of simulations, on an unstable bare bank and a stable vegetated bank, were carried out for a flow event occurred in May 2004.

The modelling phase is divided in two components: (1) hydrodynamic modelling for estimation of near-bank shear stresses; (2) bank dynamic modelling, including hydraulic erosion, seepage, and bank stability submodels. The following main effects of vegetation were included in the seepage and stability components of the simulations: (a) hydrological effects, including canopy interception and evapotranspiration; (b) mechanical effects, including root reinforcement and surcharge.

This set up of simulations has allowed to address some important question such as: (a) quantification of the effects of a single tree in enhancing the stability of the bank; (b) quantification of the contribution of hydrological and mechanical effects. The results confirm that the overall effect of a tree on the top of an eroding bank is to enhance the stability, however in many cases this effect is quite limited and its significance mainly depend on the distance of the tree from the bank top. Hydrological effects are shown to have a significant impact in determining an increase in apparent cohesion. Among the mechanical effects, the surcharge due to the tree is significantly less important than the increased shear strength due to the roots.