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Influence of vegetation on the triggering mechanism of shallow landslides: a review.

M. Schwarz (1,2) and D. Cohen (3,4)

(1) Bern University of Applied Science, 3052, Zollikofen, Switzerland (email: massimiliano.schwarz@bfh.ch), (2) WSL, Mountain hydrology and torrents, Birmensdorf, Switzerland (massimiliano.schwarz@wsl.ch), (3) Institute for Environmental Sciences, University of Geneva, 7 Route de Drize, 1227 Carouge, Switzerland , (4) Department of Geological and Atmospheric Sciences, Iowa State University, 253 Science I, Ames, IA 50011, USA

Triggering mechanisms of shallow landslides in vegetated slopes are strongly influenced by the presence of roots. The highly heterogeneous distribution of roots in space and time constitutes a major impediment to estimate landslide stability. Mechanical properties of rooted soils have been reported in numerous studies and discussed in the context of slope stability calculations at various scales. Quantifying root reinforcement and its implementation in slope stability calculation, however, is difficult due to the complexity of the mechanical interactions between roots and soil. In this study we present a review on the state of the art approaches used to quantify root reinforcement and we discuss the applicability of a new model (SOSlope) for the simulation of shallow landslides. Based on the general concept of the fiber bundle model, we derived the stress-strain behavior of rooted soils under different types of mechanical solicitations including the effects of the spatial root distribution and the mechanical properties of roots and soil. The model simulates the effects of the spatial and temporal variability of root reinforcement on the stability of a slope. Including the compressive behavior of rooted soils is particularly important to estimate how vegetation stabilizes slopes with protection forest and bioengineered slopes. Results of the model are compared to classical methods for slope stability calculation and to field observations. This study represents an important starting point for the improvement of a multidisciplinary analysis of shallow landslides triggering mechanisms, an important step for the evaluation of planting strategies within the scope of bioengineering measures and for the definition of criteria for a sustainable protection against shallow landslides.