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Modelling of root reinforcement in steep and vegetated slopes

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The quantification of the effects of root reinforcement on stability of vegetated slopes remains a challenge. Often, root reinforcement was considered through contribution to basal shear strength of the soil profile. Only recently lateral tensile strength imparted by roots was considered. Typically, both forms of mechanical contributions are implemented in slope stability models as homogeneous distributed variables along the slope. The quantification of the extent of reinforcement was based on classical models where "root cohesion" depends on the mean root area ratio present in the soil profile and the mean maximal tensile strength of the roots. In practice it is well established that root reinforcement in real slopes is affected by strong heterogeneity in space and time (soil, hydrological conditions) and clearly by vegetation distribution.

In this study we present a new model for the quantification of the local root reinforcement and a new framework for the analysis of vegetated slope stability. Based on the data obtained with high resolution laser scanning (>5 points/m^2), we derived spatially-resolved geometrical information regarding vegetation cover and distribution. We combine this information with a root distribution biomechanical model to quantify spatial distribution of root reinforcement on a slope. The analysis of slope stability are carried out in a model where the mechanical forces acting between neighboring cells are represented by bonds with mechanical properties deduced from the root reinforcement model. The preliminary results of this approach look promising and represent an improvement in delineation and quantification of susceptible and unstable zones in steep and vegetated slopes.