Geophysical Research Abstracts
Vol. 16, EGU2014-12849, 2014
EGU General Assembly 2014
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Numerical analysis of the effect of root reinforcement on the triggering of shallow landslides

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Triggering mechanisms of shallow landslides in vegetated slopes are strongly influenced by roots and their distribution. The mechanical properties of rooted soils are reported in numerous studies but are yet to be widely used for slope stability calculations. Quantifying root reinforcement in slope stability calculation, is difficult due to the complexity of soil-root interactions and the lack of knowledge of spatial root distribution. Moreover, the compressibility of rooted soil contributes both to the stiffness of the body of the slope and to the foot of the slope. Thus, they plays a fundamental role in landslide activation. Next to the well-documented contribution of roots to shear and tensile strength of soils, there are no studies that discuss the effects of roots on the compressibility of soils and how this mechanical property influences the triggering and size of shallow landslides. In this study we present the results of the sensitivity analysis of the SOSlope model based on the implementation of recent field and laboratory investigation results on the effects of root reinforcement and water content on the tensile-compressive behavior of rooted soil. The model simulates the effects of the spatial and temporal variability of root reinforcement on the stability of a slope as a function of position, dimension, and tree species. Including the compressive behavior or rooted soils is particularly important to estimate how vegetation stabilizes slopes of protection forests and bioengineered slopes. Results of the model are compared to field observations and discussed in the context of future validations. This study represents an important improvement for strategies within the scope of bioengineering measures and for the management of protection forests against shallow landslides.