



## **Stability of vegetated slopes in unsaturated conditions: a numerical study**

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Extreme rainfall events can trigger shallow landslides with failure planes located in soils far from saturated conditions. The stability of shallow soils on very steep slopes under unsaturated conditions can be highly influenced by the vegetation, according to both geo-mechanical and soil-hydrological factors, particularly in regions characterized by a strong climatic seasonality. The root structure of the vegetation reinforces the shallow soils, by providing additional apparent cohesion to the soil. The root water uptake enhances the stability by increasing the frequency of high suction pressure heads in the soil layers explored by the roots. In water controlled eco-systems, such as Mediterranean areas, these two factors are mutually related. Plants develop their root structure in order to optimize the uptake of the water available in the soil, since water availability is limited during the growing season. In this study we present the results of some numerical experiments with the aim to assess the relative importance of these two factors. We simulated the soil water dynamics within homogeneous loamy-sand soils, assuming climatic conditions and root structures typically observed in a deciduous forest of central and southern Italy. An infinite slope stability model is employed for assessing the temporal evolution of the contribute of the soil suction regime to the slope stability, as compared with the contribute of the soil root reinforcement. The results suggest that, during the wet season, the effect of the soil suction state on slope stability is much smaller than that attributable to the mechanical reinforcement provided by the root structure, at least within soil depths explored by the plant roots. Instead, during the growing and dry summer seasons, the soil suction state is far more relevant than the mechanical reinforcement. Thus, accounting for the antecedent soil suction state can be relevant for an appropriate prediction of shallow landslide hazards in those Mediterranean regions, where shallow landslides are triggered by intense convective rainstorms of short duration, occurring more frequently during the growing and dry seasons.