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Computational slope stability experiments implementing root system morphology in a generic hillslope environment

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Albeit tree root systems are capable to reinforce soils on hillslopes and hold the potential to increase slope stability, the influence of root systems is often disregarded in physically-based slope stability models. In this study, we intend to improve the parameterisation of root reinforcement by analysing the effects of various root system types on slope stability in a fully quantitative way. Therefore, we apply the 2.5D-slip surface model *r.slope.stability* to 23 root system scenarios imposed on a pyramidoid-shaped generic landscape. Shallow and taproot systems, as well as a mixture of both are approximated with paraboloids. Different stand and patch densities are considered for several stand compositions. The slope failure probability (P_f) is derived for each raster cell of the generic landscape. Thereby, internal friction angle and soil cohesion are varied within a given space of parameter values. P_f is defined as the fraction of parameter combinations yielding a factor of safety <1. Root reinforcement is considered through a constant root cohesion imposed on all root systems. Average and standard deviation of P_f are analysed for each scenario. As expected, *r.slope.stability* yields the highest values of P_f for the scenario without roots. In contrast, homogeneous stands with taproot or mixed root systems provide the lowest P_f. Generally, P_f decreases with increasing stand density, whereby stand density appears to exert a more pronounced influence on P_f than patch density. For patchy stands, P_f increases with a decreasing size of the tested slip surfaces. The patterns provided by the computational experiments are largely in accordance with the results of previous studies and in-field observations. The findings of this study will be used to develop strategies towards appropriately parameterising 2.5D-slipsurface models to estimate root reinforcement in real-world case studies.