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How the spatial variation of tree roots affects slope stability

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It is now widely recognized that plant roots can reinforce soil against shallow mass movement. Although studies on the interactions between vegetation and slope stability have significantly augmented in recent years, a clear understanding of the spatial dynamics of root reinforcement (through additional cohesion by roots) in subalpine forest is still limited, especially with regard to the roles of different forest management strategies or ecological landscapes. The architecture of root systems is important for soil cohesion, but in reality it is not possible to measure the orientation of each root in a system. Therefore, knowledge on the effect of root orientation and anisotropy on root cohesion on the basis of in situ data is scanty. To determine the effect of root orientation in root cohesion models, we investigated root anisotropy in two mixed, mature, naturally regenerated, subalpine forests of Norway spruce (Picea abies), and Silver fir (Abies alba). Trees were clustered into islands, with open spaces between each group, resulting in strong mosaic heterogeneity within the forest stand. Trenches within and between clusters of trees were dug and root distribution was measured in three dimensions. We then simulated the influence of different values for a root anisotropy correction factor in forests with different ecological structures and soil depths. Using these data, we have carried out simulations of slope stability by calculating the slope factor of safety depending on stand structure. Results should enable us to better estimate the risk of shallow slope failure depending on the type of forest and species.