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Sensitivity of the "Root Bundle Model" to root mechanical properties and root distribution: Implication for shallow landslide stability.

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Root reinforcement is recognized as an important factor for shallow landslides stability. Due to the complexity of root reinforcement mechanisms and the heterogeneity of the root-soil system, the estimation of parameters used in root reinforcement models is difficult, time consuming, and often highly uncertain. For practical applications, it is necessary to focus on the estimation of the most relevant parameters. The objective of the present contribution is to review the state of the art in the development of root reinforcement models and to discuss the sensitivity of the "Root Bundle Model" (RBM) when considering the variability of root mechanical properties and the heterogeneity of root distributions. The RBM is a strain-step loading fiber bundle model extended to include the mechanical and geometrical properties of roots. The model allows the calculation of the force-displacement behavior of a root bundle. In view of new results of field pullout tests performed on coarse roots of spruce (Picea abies) and considering a consistent dataset of root distribution of alpine tree species, we quantify the sensitivity of the RBM and the uncertainty associated with the most important input parameters. Preliminary results show that the extrapolation of force-diameter values from incomplete datasets (i.e. when only small roots are tested and values for coarse roots are extrapolated) may result in considerable errors. In particular, in the case of distributions with root diameters larger than 5 mm, root reinforcement tends to be dominated by coarse roots and their mechanical properties need to be quantified. In addition to the results of the model sensitivity, we present a possible best-practice method for the quantification of root reinforcement in view of its application to slope stability calculations and implementations in numerical models.