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Investigating the performance of LiDAR-derived biomass information in hydromechanic slope stability modelling

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Hydromechanic slope stability models are often used to assess the landslide susceptibility of hillslopes. Some of these models are able to account for vegetation related effects when assessing slope stability. However, spatial information of required vegetation parameters (especially of woodland) that are defined by land cover type, tree species and stand density are mostly underrepresented compared to hydropedological and geomechanical parameters. The aim of this study is to assess how LiDAR-derived biomass information can help to distinguish distinct tree stand-immanent properties (e.g. stand density and diversity) and further improve the performance of hydromechanic slope stability models.

We used spatial vegetation data produced from sophisticated algorithms that are able to separate single trees within a stand based on LiDAR point clouds and thus allow an extraordinary detailed determination of the aboveground biomass. Further, this information is used to estimate the species- and stand-related distribution of the subsurface biomass using an innovative approach to approximate root system architecture and development. The hydrological tree-soil interactions and their impact on the geotechnical stability of the soil mantle are then reproduced in the dynamic and spatially distributed slope stability model STARWARS/PROBSTAB.

This study highlights first advances in the approximation of biomechanical reinforcement potential of tree root systems in tree stands. Based on our findings, we address the advantages and limitations of highly detailed biomass information in hydromechanic modelling and physically based slope failure prediction.