Assessing the effects of varying geotechnical parameters on shallow landslide susceptibility modelling with TRIGRS

Shallow landslides are typically understood as slides of loose material triggered by intense and prolonged rainfall, mostly associated with limited depths within the regolith. In mountain regions this type of mass movement endangers infrastructure and human living. Moreover the probability of occurrence of shallow landslides is expected to change due to climate change. Today various approaches aiming at assessing shallow landslide susceptibility exist. However, transferable and repeatable approaches to improve better slope system understanding are still lacking. On the one hand shallow landslide susceptibility is connected to rather stable i.e. invariant site-characteristics involving geology, topography and soil by means of statistical modelling. Physically-based models on the other hand are applied on the basis of spatially high-resolved meteorological data and detailed geotechnical and hydrological information on regolith, demanding for exhaustive field mapping. We present a set-up to simulate the effects of varying geotechnical parameters within the regolith (cohesion and inner friction angle) on shallow landslide susceptibility using the Transient Rainfall Infiltration and Grid-based Regional Slope-stability (TRIGRS) model. Basically TRIGRS combines a hydrologic infiltration model and an infinite slope stability model to estimate the factor of safety in time and space. For the set-up presented all hydrologic input parameters are set constant in accordance to material found to be highly susceptible to sliding in the study area (Laternser Valley, Vorarlberg, Austria). Geotechnical parameters affecting slope stability were modified according to value range for the corresponding material from respective literature. By the use of mathematically explicit digital terrain models the set-up is assured to be reproducible. Moreover, the procedure is automatized by using Python scripting. According to the model results, worst case parameter combinations of cohesion and inner friction angle would lead to unstable conditions at slope angles below 30°. This agrees with field mappings. Therefore the TRIGRS approach is considered suitable for modelling shallow landslide susceptibility in the study area.
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