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Sensitivity analysis and calibration of a coupled hydrological/slope stability model (TRIGRS)

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Shallow landslides potentially endanger human living in mountain regions worldwide. In order to prevent impacts of such gravitational mass movements it is necessary to fully understand the processes involved. Shallow landslides are usually understood as gravitational mass movements of the translational, slope-parallel type comprising of a mixture of earth and debris with a maximum depth of 1-2 m. Depending on the degree of saturation the initial sliding can turn into a flow-like movement. Numerous approaches for modelling shallow landslide susceptibility with different degrees of complexity exist. Regardless of the modelling approach it is crucial to provide sufficient field data, mainly on regolith characteristics. As for the TRIGRS (Transient Rainfall Infiltration and Grid-Based Regional Slope-Stability) model, numerous hydraulic and geotechnical parameters have to be known area-wide. Hence, as spatial interpolation of these input parameters is generally problematic in terms of accuracy, calibrating the model accordingly is a crucial step before conducting any simulations. This study presents a sensitivity analysis and the calibration of the coupled hydrological/slope stability model TRIGRS for a study area in Vorarlberg (Austria). The results of the sensitivity analysis show that in case of the stability model cohesion is the driving parameter while for the hydrological model it is the initial depth of the water table and the saturated hydraulic conductivity. The calibration of the stability model was carried out using a landslide inventory assuming completely saturated conditions. The use of geotechnical parameters extracted from literature for mapped soil types generally lead to unlikely stable conditions. In order to simulate mapped landslide initial areas correctly values for soil cohesion had to be adapted. However, the calibration of the stability model generally supports the assumption of saturated conditions. In absence of meteorological or hydrological data the hydrological model was calibrated using the landslide inventory aiming at saturated conditions for the respective landslide initial zones. Simulations conducted with the calibrated input parameters generally lead to conservatively unstable conditions. However, it has to be noted that the TRIGRS model does not account for effects of vegetation on slope hydrology and stability (e.g. interception or root cohesion).
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http://www.uibk.ac.at/geographie/lidar/c3s/c3s.html