

Effect of subsurface flow and soil depth on shallow landslide prediction

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Abstract

Shallow landslide often occurs in areas of this topography where subsurface soil water flow paths give rise to excess pore-water pressures downslope. Recent hillslope hydrology studies have shown that subsurface topography has a strong impact in controlling the connectivity of saturated areas at the soil-bedrock interface. In this study, the physically based SHALSTAB model was used to evaluate the effects of three soil thicknesses (i.e. average soil layer, soil thickness to weathered soil and soil thickness to bedrock soil layer) and subsurface flow reflecting three soil thicknesses on shallow landslide prediction accuracy. Three digital elevation models (DEMs; i.e. ground surface, weathered surface and bedrock surface) and three soil thicknesses (average soil thickness, soil thickness to weathered rock and soil thickness to bedrock) at a small hillslope site in Jinbu, Kangwon Prefecture, eastern part of the Korean Peninsula, were considered. Each prediction result simulated with the SHALSTAB model was evaluated by receiver operating characteristic (ROC) analysis for modelling accuracy. The results of the ROC analysis for shallow landslide prediction using the ground surface DEM (GSTO), the weathered surface DEM and the bedrock surface DEM (BSTO) indicated that the prediction accuracy was higher using flow accumulation by the BSTO and weathered soil thickness compared to results. These results imply that 1) the effect of subsurface flow by BSTO on shallow landslide prediction especially could be larger than the effects of topography by GSTO, and 2) the effect of weathered soil thickness could be larger than the effects of average soil thickness and bedrock soil thickness on shallow landslide prediction. Therefore, we suggest that using BSTO dem and weathered soil layer can improve the accuracy of shallow landslide prediction, which should contribute to more accurately predicting shallow landslides.

Key words: Shallow landslide, bedrock topographic, soil thickness, subsurface flow

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