Rainfall-induced shallow landslide prediction considering the influence of 1D and 3D subsurface flows

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Abstract

Abstract This study aims to compare the performance of TRIGRS (Transient Rainfall Infiltration and Grid-based Regional Slope-stability model) and TiVaSS (Time-variant Slope Stability model) in the prediction of rainfall-induced shallow landslides. TRIGRS employs one-dimensional (1-D) subsurface flow to simulate the infiltration rate, whereas a three-dimensional (3-D) model is utilized in TiVaSS. The former has been widely used in landslide modeling, while the latter was developed only recently. Both programs are used for the spatiotemporal prediction of shallow landslides caused by rainfall. The present study uses the July 2011 landslide event that occurred in Mt. Umyeon, Seoul, Korea, for validation. The performance of the two programs is evaluated by comparison with data of the actual landslides in both location and timing by using a landslide ratio for each factor of safety class (index), which was developed for addressing point-like landslide locations. In addition, the influence of surface flow on landslide initiation is assessed. The results show that the shallow landslides predicted by the two models have characteristics that are highly consistent with those of the observed sliding sites, although the performance of TiVaSS is slightly better. Overland flow affects the buildup of the pressure head and reduces the slope stability, although this influence was not significant in this case. A slight increase in the predicted unstable area from 19.30% to 19.93% was recorded when the overland flow was considered. It is concluded that both models are suitable for application in the study area. However, although it is a well-established model requiring less input data and shorter run times, TRIGRS produces less accurate results.

Keywords *TRIGRS, TiVaSS, Subsurface flow, Surface flow, Shallow landslide, Slope stability*

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