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The role of infiltration to landslides initiation in mountainous areas

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In Korea, damages to humans and properties by landslides have increase over the last decade. To mitigate damages by landslides, it is necessary to predict the exact time and place of landslides initiation. Therefore, it is important to clarify the influence of rainfall-infiltration on landslides initiation in Korea, where almost landslides were shallow landslides triggered by heavy rainfalls in summer.

In this study, the influence of rainfall-infiltration on landslide occurrence was assessed by using the Transient Rainfall Infiltration and Grid-based Regional Slope-stability (TRIGRS) model. TRIGRS is a grid-based, deterministic model which consists of an infiltration model and a slope stability model. The infiltration model of TRIGRS, based on a simple Hortonian overland flow, can simulate the corresponding changes of pore water pressures in soils to the change of infiltration rates over the time using a linear simplification of Richards equation. Pore water pressures in each grid simulated by the infiltration model are used as the inputs of the slope stability model, which is based on an infinite-slope analysis.

The Jangheung region, Korea, was selected to assess shallow landslides initiation using TRIGRS. This region was damaged by many landslides during a heavy rainfall occurred on August 6, 1998. As input parameters of this model, soil unit weight, saturated hydraulic conductivity, hydraulic diffusivity, and initial infiltration rates in this region were manually measured. The soil depth and slope angle were taken from DEM, generated from the digital topographic maps in this region using ArcGIS 9.2. Also, the IKONOS 2 imageries (1 m $\times$ 1 m) were taken to identify the locations of the landslides.

The simulation results showed pore water pressures were changed according to infiltration rates over the times, and they also seemed to be significantly affected by topography. Especially, the largest and more rapid changes in pore water pressure were generated at relatively shallow point. Factor of safety also followed the trend like pore water pressures. It was found that when rainfall continuously cumulated even after soil had saturated and infiltration had not occurred, slopes finally became to fail by decreasing of factor of safety. Compared to the IKONOS 2 imageries, there were 64.1% agreement between the simulated and the occurred.

In conclusion, infiltration has a significant role on landslides initiation, and TRIGRS model is thought to be suitable to assess shallow landslide induced by rainfall despite of the limitation of available data. However, TRIGRS should be applied to a homogeneous site with the same soil-hydraulic properties because the modification of Richards equation, an assumption of TRIGRS, should require only one value of saturated hydraulic conductivity. In addition, it should be considered that the simulated factor of safety is not absolute value.