Effect of rainfall patterns on the response of water pressure and slope stability within a small catchment: A case study in Jinbu-Myeon, South Korea

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Abstract

Despite the potentially major influence of rainstorm patterns on the prediction of shallow landslides, this relationship has not yet received significant attention.

In this study, five typical temporal rainstorm patterns with the same cumulative amount and intensity components comprising Advanced (A1 and A2), Centralized (C), and Delayed (D1 and D2) were designed based on a historical rainstorm event occurred in 2006 in Mt. Jinbu area.

The patterns were incorporated as the hydrological conditions into the Transient Rainfall Infiltration and Grid-based Regional Slope-stability Model (TRIGRS), in order to assess their influences on pore pressure variation and changes in the stability of the covering soil layer in the study area.

The results revealed that not only the cumulative rainfall thresholds necessary to initiate landslides, but also the rate at which the factor of safety (FS) decreases and the time required to reach the critical state, are governed by rainstorm pattern. The sooner the peak rainfall intensity occurs, the smaller the cumulative rainfall threshold, and the shorter the time until landslide occurrence. Left-skewed rainfall patterns were found to have a greater effect on landslide initiation. More specifically, among the five different patterns, the Advanced storm pattern (A1) produced the most critical state, as it resulted in the highest pore pressure across the entire area for the shortest duration; the severity of response was then followed by patterns A2, C, D1, and D2.

Thus, it can be concluded that rainfall patterns have a significant effect on the cumulative rainfall threshold, the build-up of pore pressure, and the occurrence of shallow landslides, both in space and time.

Keywords : Landslide, rainstorm pattern, rainfall threshold, slope stability, pore pressure

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