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Landslide susceptibility zonation in layered slopes

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Rainfall-induced landslides can originate as a result of distinct hydro-mechanical processes, such as soil-strength degradation, flow liquefaction (Buscarnera and di Prisco, 2013), groundwater level rise, among others, thus posing challenges for the development of landslide susceptibility zonation models (Lizarraga et al., 2017). Among them is the presence of unsaturated layered deposits, which markedly influences the infiltration process and conditions the timing and location of slope instabilities. This contribution presents a spatially-distributed model for landslide susceptibility in shallow layered slopes. The framework relies on a vectorized finite element (FE) algorithm that performs simulations of vertical infiltration and slope stability in unsaturated soils and provides flexibility to efficiently allocate the computational cost associated with layers of variable thickness and/or complex stratigraphy (Lizarraga and Buscarnera, 2018). To illustrate the capabilities of the proposed methodology, a series of documented shallow landslides that occurred in a region covered by stratified volcanic deposits is analyzed. The results indicate that variations of hydraulic conductivity in adjacent layers promotes the development of transient spikes of pore pressure that can initiate slope failure. Such effects have important implications in the spatio-temporal predictions of landslide triggering and computed failure depths, leading to an improved performance over the landscape when compared with results based on homogeneous slopes. The proposed framework provides an important step towards the development of robust, physically-based models for regional landslide hazard assessment.

References:
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