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Modeling the space-time evolution of pore pressure in layered shallow covers

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In most of the available models for the prediction of shallow landslide susceptibility, the potentially unstable soil cover is considered uniform and homogeneous, over an impervious underlying bedrock (see, e.g., Baum et al. 2008; Salciarini et al. 2006, 2012). However, in several case studies, this was proven to be unlikely, for example in the case of pyroclastic soil covers, where two clearly separated layers are detectable (Cascini et al., 2008, 2011). The possibility of taking into account the detailed configuration of the soil cover allows having a more accurate estimate of the potentially unstable volumes, which significantly modify the intensity of the considered phenomena.

To take into account the possibility of having layers in the soil cover with different permeability, the existing routines of the TRIGRS code (Baum et al. 2008) devoted to the hydrologic process modeling have been modified. The closed–form solution by Srivastava & Yeh (1991) implemented into TRIGRS was substituted with the numerical solution of the mass balance equation governing the infiltration process.

A parametric analysis was carried out by varying the permeability ratio between the two layers, with the aim of examining the influence of such parameter on the pore-pressure distribution along the vertical profile. As expected, as the permeability ratio increases, the underlying layer tends to behave as an impervious boundary. This increases the chance that only the most superficial soil layer fails. An analysis of the routine performance and efficiency was also done to investigate the response of the model with different tolerances and different time steps of the integration procedure, and different spatial discretizations along the vertical profile.