The grain-scale mechanisms for landslide instability in unsaturated soils

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The triggering mechanisms of landslides can be related to the dynamics of individual grains within a weakened soil layer, and are governed by a variety of grain-scale processes, including inter-granular forces and water flow in surrounding micro-pores. While previous investigations of landslide releases using discrete element methods (DEM) have mainly focused on “dry” or “fully saturated” granular media, in this study, a grain-scale model is proposed for studying landslide instability in unsaturated soils. Towards this end the microscopic mechanisms, such as, the role of liquid menisci between grains and pore network evolution, are considered. This newly developed DEM method has been employed to investigate the triggering mechanisms of landslides at the scale of the weakened soil layer. The proposed numerical method incorporates inter-granular capillary forces, which can be evaluated through micro-tensile tests of liquid bridges. Moreover, we develop the idea that the balance between these grain-scale weakening mechanisms is a major factor controlling the onsets of landslides at various initial saturation levels.