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Prediction of shear strength of unsaturated pyroclastic ashes from water retention curves

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Pyroclastic deposits covering steep slopes, characteristic of large mountainous areas of Campania (southern Italy), are often affected by shallow landslides triggered by rainfall. The equilibrium of such deposits is in fact usually guaranteed by the contribution to soil shear strength offered by soil suction, which decreases when soil approaches saturation. More specifically, soil suction exerts a compressive stress on solid particles, which increases shear strength thanks to friction.
In this study, the model of Lu et al. (2010), which assumes that the fraction of soil suction effectively transmitted to solid particles is proportional to the degree of saturation of the soil, and a recently proposed model, based on the assumption that suction is transmitted to soil solid particles only through their wet external surface (Greco and Gargano, 2015), are applied to predict soil suction stress of pyroclastic ashes from their water retention curve. This latter is modeled by means of the equation of van Genuchten (1980), as well as by means of the model of Romano et al. (2011), which assumes a bimodal distribution of pore dimensions.
Experimental data of shear strength of pyroclastic ashes from various sites in Campania are compared with the values of shear strength predicted with the various tested models. The investigated soils are loose silty sands, characterized by a porosity larger than 0.7, friction angle ranging between 36° and 38°, and small or even null cohesion. In all cases, the best agreement between modeled and experimental shear strength is obtained by means of the model of Greco and Gargano, applied with the adoption of the bimodal water retention model of Romano et al. The obtained results highlight the importance of accurate modeling soil suction stress to correctly predict landslide triggering conditions in slopes covered with shallow unsaturated granular deposits.

References

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