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Using of the Boolean Stochastic Generation method to target field investigations: the Mortisa landslide (eastern Italian Alps) case study

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When designing the geotechnical model of a landslide the information to define the soil profile within the slope is usually inferred from a small amount of data. This is particularly true for large landslides where the study area is vast and the variability of terrains is high. In this framework, a method allowing the best locations for further field investigation campaigns to be identified would be extremely useful. The Boolean Stochastic Generation method (BoSG), which randomly generates different soil distributions of two definite soil types in both 2D and 3D models, is a newly developed algorithm that can guide in this process.

In this work the method has been applied to the Mortisa landslide case study, which is located in the Cortina d'Ampezzo valley (Veneto, Italy), part of the Dolomites UNESCO World Heritage list. The mudslide is 3.5 km long, stretching from 1750 to 1300 m a.s.l., and is located in a highly antrophized area where is damaging some buildings and a national road with its almost continuous movements. In fact, from year 2008, GNSS surveys recorded rates of displacements reaching 1.2 m/year in the most active parts of the landslide; the movements occur on a slip surfaces are located between 20 and 50 m below the surface. From the borecores some wooden samples were extracted allowing to reconstruct the sequence of events that led to the development of the present-day Mortisa slope. Interdigitated layers of gravel in a silty clay matrix originated from subsequent earth and debris flows events since the Lateglacial compose the landslide body, a condition that is particularly apt to be investigated with BoSG.

A BoSG run for the Mortisa landslide was performed calculating 1200 soil configurations and using laboratory test parameters for the silty-clay matrix. The results were stacked in a tridimensional matrix in order to calculate the mean and the standard deviation (SD) of displacements for each element of the model mesh. In this way maps of the SD and of the mean values were generated. The SD map indicates the best location for additional boreholes since the uncertainty on the dynamic of the whole landslide would be greatly reduced by knowing the local soil distribution in key areas. The mean map is a control of expected deformation and it can be useful in the estimation of the life span of an inclinometer in specific locations.

The possibility to determine the areas where further soil investigations would be more significant could be a useful tool for both researchers and practitioners. The results of new investigations could be then used to update the stratigraphy for a further BoSG run in the framework of Bayesian updating techniques.