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Study of large-scale deformation induced by gravity on the La Clapière landslide (Saint-Etienne de Tinée, France) using numerical and geophysical approaches

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The large-scale deformation of high mountain slopes finds its origin in many phenomena with very different time-constants. Gravitational effect, tectonic forces, and water infiltration are generally the principal causes. However, it is always very difficult to distinguish which cause is dominant and which are their respective effects. The numerical approach offers the possibility of testing some of these causes, in particular the gravitational effect, coupled or not with surface alteration of the rock. Then, a two-dimensional numerical experiment with ADELI code was carried out to determine the effect of gravitational force on the mechanical behaviour of the" la Clapière" area. The results show that gravitational instability is possible with values of cohesion and an angle of internal friction respectively lower than 2.00 ± 0.01 Mpa and $27.69° \pm 0.14°$. These values are compatible with the geomechanical parameters proposed by Gunzburger (2001) from measurements directly taken on the site. The numerical results show that deformation has led to destabilisation of the massif by a regressive evolution of the landslide from the bottom up to a height of 1800 m, which is actually the top of the La Clapière landslide. This deformation progression only concerns a depth of around 150 ± 50 m, which could be correlated to the sliding surface, as suggested by our electrical data obtained by resistivity investigations and previous studies.