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Evolution of rock slopes submitted to time scaled alteration: New Insights from three dimensional numerical modelling of the La Clapière slope (Alpes Maritimes, France).

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Gravitational slope failure is a phenomenon involving rock slopes, at various spatial and temporal scales. Nowadays it is widely accepted that different factors have an influence on slope destabilisation, and among them alteration/weathering that can reduce strength resistance. Fields investigations (Lebourg et al., 2011) have been performed on the La Clapière slope (Tinée valley, Alpes Maritimes, France) in order to characterise and quantify this process. A clear link has thus been shown between slope evolution, weathering/alteration and leaching process through a reduction of the cohesion and the increasing of the internal angle of friction.

Previously performed (two dimensional) numerical models of the La Clapière slope have also shown that strength reduction of the rock mass (used to simulate alteration) combined with the influence of first and second order topography lead to deformations compatible with fields observations (Chemenda et al., 2009). But it is obvious that the third dimension has an influence on the failure. Indeed it has also been shown by various authors that topography, through modifications in the stress and stain fields (at various scales) can facilitate the failure. Moreover in many cases, the unstable slope is cut by talwegs, and slope failure occurs between those incisions. Considering some natural examples such as the high Tinée valley (Alpes-Maritimes, France) it seems that the spacing between incisions could determine a critical distance for which failure occurs.

To tackle this question a series of finite-difference numerical models have been performed based on the FLAC3D code (Itasca Consulting Group, 2006), assuming a simplified 3D (also known as "2D and a half") representation (7 x 7 x 1 km) of a theoretical slope with an extension of 1 km in the shallow crust. To determine the influence of spacing between talwegs, incisions have been created in the slope. The distance between those incisions varied from 500 m to 2500 m. Otherwise the depth of those incisions has also been considered through two distinct configurations: a shallow one and a deeper one.

Obtained results tend to show that considering a shallow depth configuration of the incision, the most critical distance (witch facilitate the most failure) raging from 1000 to 1500 m.

Considering the deeper configuration this critical distance between incisions seems to varying from 1500 to 2000 m. Moreover the mechanical resistance of the whole model seems to be lower in this configuration than in the first one.