



Combined geophysical and remote-sensing investigations to study the kinematics of two clayey landslides in the Trièves area (French Alps)

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The Trièves area is located within the French alpine foreland 40 km south of the town Grenoble. This 300 km² area is covered by a thick Quaternary clay layer (up to 200 m) deposited in a glacially dammed lake during the Würm period. After the glacier melting, rivers have cut deeply into the geological formations, triggering numerous landslides. Our study is focused on two of those, the Avignonet and Harmalière landslides, affecting areas of 2 km² and 1.3 km². Remote-sensing techniques (Lidar, aerial photos and satellite imagery) and GPS measurements were used to characterize the geomorphology and kinematics of these landslides. Seismic noise measurements (H/V technique) were performed to map the clay layer thickness and to determine the palaeo-topography of the seismic substratum, made of compact alluvial layers and Mesozoic bedrock.

Results show major differences between the kinematics of the two landslides, both in displacement rate magnitudes and motion directions, although they developed in the same clay deposits under similar weather conditions. The slow moving Avignonet landslide exhibits sliding velocities between a few cm/yr at the top to 15 cm/yr at its toe, while displacement rates as high as several m/yr have been measured in the more active part of Harmalière. GPS vectors on the Avignonet landslide show a global N100°E movement, down the general hill slope. On the contrary, the Harmalière slide runs out to the SE, making an angle of 25 to 30° with the direction of the general hill slope. Our study pointed out the presence of a ridge of compact formations at the Avignonet landslide toe, preventing an eastward deep active sliding. To the South, this buttress disappears at the Harmalière toe, favouring sliding in a South-eastern direction, which differs from the general slope orientation to the East, with a fast regression of the headscarp. The paleo-topography, on which the clay layers deposited, then appears to play a key role in the development of landslides in this area.