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Terrestrial laser scanning for the characterization of moving slopes

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High-resolution 3D images of the topography obtained by long-range terrestrial laser scanning (TLS) are a powerful tool to monitor slope movements. Time-series of TLS images permit to determine differences in the topography between the two acquisitions that can be related to rock slides, rockfalls, scree slope deposits, but also shallow landslides and river flank erosion... On rock surfaces TLS time-series do not only provide information on the displacement vector (velocity and direction of the translational movement), but also on rotational components, like toppling.

The Åknes study site in the Storfjord in Western Norway is a huge rockslide of probably more than 35 million m^3 that is currently monitored and investigated by the Åknes/Tafjord project. The rockslide is in some areas moving by approximately 4 cm/year, but higher displacements are recorded in the uppermost part (7-20 cm/year). TLS images of this fast-moving ridge were acquired in August 2006 and August 2007. The differences between the two images reveal a movement towards the South by approximately 7 to 10 cm.

A detailed analysis provides the translational and rotational displacements for different parts of the rockslide. The average displacement vectors (Trend: 186°; Plunge: 55°; Length: 61 mm) is roughly in the same direction than the mean slope aspect (178°), but much steeper than the mean slope angle (37°). The rotational components of the slope movement (apparent block toppling of 0.026° towards 346°) seem very small, but are coherent with a conceptual model implying rotational sliding in combination

with translational sliding in this upper part. The rotational component is probably induced by the folding of the foliation, which is subvertical near the fast-moving ridge, but becomes more moderately dipping further downslopes. This combination of translational and rotational displacements in the uppermost part of the Åknes rockslide provides an instability model that is coherent with geophysical investigations.