Submitted Abstract

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Abstract

Lidar measurements and UAV photogrammetry provide high-resolution point-clouds well suited for the investigation of slope deformations. Commonly, multitemporal point clouds are registered within a stable reference frame and compared using either cloud-based methods such as C2C, C2M or M3C2 or raster-based methods such as difference DEMs or feature tracking algorithms. All these state-of-the-art methods underestimate the absolute displacement rates of objects and struggle to exploit the full information content hidden in point clouds.

Using three examples of large-scale slope instabilities located in Switzerland, which are actively monitored for reasons of hazard prevention, we go beyond absolute displacement rates when analysing point clouds acquired by terrestrial laser scanning. We used the new method F2S3, enabling direct 3D point cloud comparison in combination with a varying relative referencing of the points clouds. This allows us to analyse every spatial component of the movement, such as spatially highly resolved displacement angles.

Furthermore, we compensate the main displacement of a moving rock compartment using adapted referencing strategies. In simple words, we push the displaced rock compartment back into its original position. This enables us to compare the shape of the rock compartment before and after the displacement. These secondary deformation signals are valuable indicators of the type of displacement process. We can thus identify differences in kinematic behaviour of individual rock compartments, highlight active shear planes within moving rock masses and define the kinematic process driving the slope displacements.

In the case of rock slides, the directions of the 3D displacement vector field, calculated with F2S3, reflect the shape of the underlying sliding planes. Using methods for surface integration, known from applications like shape from shading, we can model the shape of sliding planes. The shape and location of the sliding planes provide crucial information, such as estimations of destabilised rock volumes. All this information significantly contributes to process understanding at the sites investigated and thus supports decision making in hazard management.