Analysis of a large deep-seated creeping mass movement using GIS and DEM

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Introduction
In 1939 Ampferer described slow but very large mass movements, which he termed "Nackentälchen". He noted the term had been coined by a safety control and turned into an engineering challenge for drawing attention to the constructive consequences despite the hardly measurable slope deformations. Since then terminology varies in a large extent in international scientific discussions; the term "compound sliding" (according to Hutchinson 1988) or "rock flow" (according to Varnes 1978) will be applied for complex large mass movements.

Figure 1: Map of Austria (grey). Arrow shows the red Valley ("Kaunertal"), Austria, shown as rectangle in Hutchinson 1988) or "rock flow" (according to de deformations.

Despite the hardly measurable slope attention to the constructive consequences (so called valley close-up) and turned it into large mass movements, which he found all over the area.

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Figure 2: Hillshade calculated from an airborne laserscanning based digitalelevation model (hillshade) showing geomorphologic features of the Stupfarri landslide. Light colors show the more even areas. Reference: LIDAR height model, Tyrol government, geoinformation.

Figure 3: Orthophoto of the study site. Red: expansion of the mass movement. (Base: tiris, Province of Tyrol)

Figure 4: Photograph of the study site taken from the ridge. View from the ridge.

Figure 5: Photograph of the study site taken from the ridge. View from the ridge.

Figure 6: Photograph of the study site taken from the ridge. View from the ridge.

Figure 7: Photograph of the study site taken from the ridge. View from the ridge.

Figure 8: Photograph of the study site taken from the ridge. View from the ridge.

Figure 9: Photograph of the study site taken from the ridge. View from the ridge.

Figure 10: Possible shear plane; at this point provided by the schistosity. General schistosity of the study area is very changable. View from the ridge.

Figure 11: Photograph of the study site taken from the ridge. View from the ridge.

Figure 12: Geological Map of the Study Site

Figure 13: Generalized Map of the study site with a visible fracture system and the development of the study area. The red dikes show the boundaries of the mass movement. The black line marks the boundaries of displaced masses. The grey area is the debris fan. The red lines show the lines of the schistosity. Cross Sections A and B show the influence of the schistosity on the morphologic structures of the study area.

Figure 14: Airborne laserscanning based digitalelevation model (hillshade) showing geomorphologic features of the Stupfarri landslide. Light colors show the more even areas. Reference: LIDAR height model, Tyrol government, geoinformation.

Figure 15: Photograph of the study site taken from the ridge. View from the ridge.

Figure 16: Photograph of the study site taken from the ridge. View from the ridge.

Figure 17: Block model of joints sets with generalized surface. Schistosity plane in grey lines, slope plane in green. No single discontinuity is able to form the plane of rupture.

Figure 18: Schematic sketch showing the possibility of sliding on the intersection of J1 and the schistosity plane.