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Structural geological environment of the Doren landslide (Vorarlberg, Austria) derived from LiDAR DTM analysis

A. Zámolyi (1,2) and B. Székely (3,1)

(1) Dept. of Geophysics and Space Science, Eötvös University, Budapest, Hungary (andras@zamolyi.info), (2) Dept. of Geodynamics and Sedimentology, University of Vienna, Austria, (3) Institute of Photogrammetry and Remote Sensing, Vienna University of Technology, Austria

Geologic maps typically record structural geologic information at a macro-scale. These data are completed by point-wise field observations, such as dip-directions, dip values, and displacement measurements along slickensides. Between these two different scales only geomorphic features provide hints on the general structure, if the lithologic properties allow erosional enhancement of the structural directions.
Often such geomorphic indicators are characterized by a micro-scale relief. Consequently, their recognition and mapping, especially in vegetated areas is extremely difficult with conventional methods. Since LiDAR DTMs, with an accuracy of better than 10 cm, provide high-resolution representation of the geomorphic surface, even if the area is covered by canopy, the analysis of such datasets reveals micro-topographic features.
Our study area at locality of Doren (Vorarlberg, Austria) is situated in the Molasse Zone characterised by various clays, sandstones, and calcareous sandstones. The relief is hilly to mountainous due to the combined effects of the relatively high erodibility of the rocks and the post-glacial surface evolution of the area.
At the locality in question a major landslide has developed that already endangers some infrastructural elements. The landslide is triggered by missing material taken away gradually by the incision of the rivulet Weissach, but also structural geological features contribute to the development of the mass movement.
The 1 meter resolution, high-accuracy LiDAR DTM has been processed to enhance microtopographic features, especially gullies and rills. These linear features were identified in the extended vicinity of the landslide and digitized in vector format.
The resulting polylines were then analysed in various ways: rose diagram calculation and comparison with the general tectonic directions indicated in the 1:100000 scale geological map were carried out.
The microtopographic features show correlation with the major tectonic direction (NE-SW) and with another direction NNW-SSE, indicated as subordinate. Interestingly there is a third, underrepresented orientation of WNW-ESE that is not indicated in the aforementioned geological map.
The place where these three directions seem to meet coincides largely with the area affected by the landslide. According to our working hypothesis at the focal point of the three structural directions the enhanced erodibility of the rocks due to microfractures, and consequently the material of the moderately steep slope may start to creep or even to move if the previous meteorological and hydrologic conditions decrease the stability of the slope.