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Assessing the accuracy of the Second Military Survey for the Doren Landslide (Vorarlberg, Austria)

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Reconstruction of the early and long-term evolution of landslide areas is especially important for determining the proportion of anthropogenic influence on the evolution of the region affected by mass movements. The recent geologic and geomorphological setting of the prominent Doren landslide in Vorarlberg (Western Austria) has been studied extensively by various research groups and civil engineering companies. Civil aerial imaging of the area dates back to the 1950's. Modern monitoring techniques include aerial imaging as well as airborne and terrestrial laser scanning (LiDAR) providing us with almost yearly assessment of the changing geomorphology of the area.
However, initiation of the landslide occurred most probably earlier than the application of these methods, since there is evidence that the landslide was already active in the 1930's. For studying the initial phase of landslide formation one possibility is to get back on information recorded on historic photographs or historic maps. In this case study we integrated topographic information from the map sheets of the Second Military Survey of the Habsburg Empire that was conducted in Vorarlberg during the years 1816–1821 (Kretschmer et al., 2004) into a comprehensive GIS. The region of interest around the Doren landslide was georeferenced using the method of Timár et al. (2006) refined by Molnár (2009) thus providing a geodetically correct positioning and the possibility of matching the topographic features from the historic map with features recognized in the LiDAR DTM.
The landslide of Doren is clearly visible in the historic map. Additionally, prominent geomorphologic features such as morphological scarps, rills and gullies, mass movement lobes and the course of the Weißach rivulet can be matched. Not only the shape and character of these elements can be recognized and matched, but also the positional accuracy is adequate for geomorphological studies. Since the settlement structure is very stable in the region, and in the historical map sheets the individual buildings were also mapped, it is possible to match several buildings with their present-day counterparts. We used matched geomorphologic features and buildings for deriving RMSE values, which range around 26 m.
Orientation of major scarps and conspicuous geomorphologic features derived from the historic map and on the LiDAR DTM show a good correlation which confirms the long-term existence of these elements. Evidence from field geologic measurements provide the possible link of these elements to structural geologic features. Furthermore there is strong indication for that the landslide had been in a somewhat other state in the 19th century and the scarp retreat rate could have increased in the second half of the 20th century.

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