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Change detection on the Doren landslide, using geological field measurements and laser-scanned data (Vorarlberg, Austria)

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This study focuses on the changes of the Doren landslide based on the comparison of different LIDAR images and geological measurements.
The landslide is located in Vorarlberg province in western Austria south of Doren village. It is the most prominent mass-movement along with other smaller and partly older landslides that formed in the valley of the Weißach River. Geologically, the landslide belongs to the western part of the Eastern Alps, and lies in the Molasse-Basin at the edge of the Austroalpine nappe-system. The geological environment of the landslide is composed by different molasse- and glacial moraine sediments that are affected by large-scale faulting.
Direction of movement of mass-movement units were analysed using laser-scanned DTMs. These directions were compared to the orientation of geological features.
The area is closely monitored since around the year 2000. Our team made geological measurements in 2009. These measurements were compared with digital terrain models (DTM) derived by airborne laser scanning in 2006 and 2007. Additionally, comparative studies were conducted with a DTM derived by terrestrial laser scanning in 2009. Geological measurements include dip of bedding planes and faults inside and outside the region affected by the Doren landslide. The most frequent dip direction is NW-SE.
The active area, as well as the previous landslides in the environment of the active landslide are observable on the DTMs. The direction of their movement is mostly NW-SE. A different movement direction from that direction at the east side of the study area can be observed: it is a NE-SW direction. This orientation is determined by a large-scale sinistral strike-slip fault system. Smaller changes could be observed in every year at the recent active zone. This changes are located at the top and the middle parts of the landslide. All of these four landslides together form an alluvium at the bottom-central part of the landslide area.
The analysis of the DTMs is well comparable with the geological measurements: the NW-SE directions can be observed in the geological measurements as well as in the DTMs.
The DTMs show well-delimited geomorphological features inside the landslide area. Some of them clearly overlap other features. Some are caused by single events and some can be determined as older mass-movements that have been active a few years ago.
This study contains a short period in the history of this landslide, nevertheless actively moving areas and the relationship between the mass movements and the geological structures is well observable. The evolution and movement of the landslide is influenced by the direction of structural geological formations and occurs along major faults.