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Mapping, Assessment and Analysis of Large-Scale Landslides Based on Airborne LIDAR Data

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In the context of the integrated risk management of the Austrian Service for Torrent and Avalanche Control (WLV) large-scale landslides – per definition only areas larger than 10 ha – were mapped in a study area in the South of Innsbruck/Tyrol. The large-scale landslides to be identified are mostly very slow and deep-seated including complex processes like mountain slope deformations ("Talzuschübe"). The mapping method for the first time developed in this study is based on hillshades of high-resolution airborne LIDAR data which recently has been made nearly nationwide available for Austria. These data have the advantage faced with other remote-sensing data like orthophotos that dense and high vegetation and other distracting objects on the ground are eliminated. This guarantees everywhere a high visibility of the terrain surface which is very helpful for the detection of landslides. These aspects allowed developing a new systematic approach for the identification and rough classification of large-scale landslides according to their activity. Using an iterative comparison of first results with other existing methods and field observations the methodology was developed as objective as possible. For this reason these landslides are divided in four distinct segments showing typical characteristics like double ridges or a surface of rupture. According to the characteristics and to the importance of these four segments all detected landslides are then assigned to one of the four classes of activity: "active", "likely active", "inactive" or "possibly inactive". Using this method, large-scale landslides were identified in 26 % of the entire study area. The major part of these landslides (65 %) is supposed to be "inactive" and only 0.5 % are classified as "active". In addition some analyses in the context of natural hazard research were carried out to interpret the quantitative occurrence and spatial distribution of the mapped landslides. Glacial overdeepening in valleys and some hydrogeological aspects like very small water permeability are confirmed with a high degree of certainty as enabling factors in contrast to other influencing factors such as vegetation.
It is important to consider that the analyses, calculations and especially the mapped areas themselves are based on some subjective aspects of the classification and the lower details in remote-sensing compared to field investigations. Furthermore, it cannot be excluded wrongly to detect landslides because of similar appearances of some other geomorphological landforms such as block glaciers. The completely new classification presented here demonstrates nevertheless a very suitable method within the limits of remote-sensing data being as objective as possible. It is a useful and important step towards identifying large-scale landslides on the level of indication and it is appropriate for further applications outside the study area.