



Automatic landslide detection from LiDAR DTM derivatives by geographic-object-based image analysis based on open-source software

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With high-resolution airborne Light Detection and Ranging (LiDAR) data more commonly available, many studies have been performed to facilitate the detailed information on the earth surface and to analyse its limitation. Specifically in the field of natural hazards, digital terrain models (DTM) have been used to map hazardous processes such as landslides mainly by visual interpretation of LiDAR DTM derivatives. However, new approaches are striving towards automatic detection of landslides to speed up the process of generating landslide inventories. These studies usually use a combination of optical imagery and terrain data, and are designed in commercial software packages such as ESRI ArcGIS, Definiens eCognition, or MathWorks MATLAB.

The objective of this study was to investigate the potential of open-source software for automatic landslide detection based only on high-resolution LiDAR DTM derivatives in a study area within the federal state of Burgenland, Austria. The study area is very prone to landslides which have been mapped with different methodologies in recent years. The free development environment R was used to integrate open-source geographic information system (GIS) software, such as SAGA (System for Automated Geoscientific Analyses), GRASS (Geographic Resources Analysis Support System), or TauDEM (Terrain Analysis Using Digital Elevation Models).

The implemented geographic-object-based image analysis (GEOBIA) consisted of (1) derivation of land surface parameters, such as slope, surface roughness, curvature, or flow direction, (2) finding optimal scale parameter by the use of an objective function, (3) multi-scale segmentation, (4) classification of landslide parts (main scarp, body, flanks) by k-mean thresholding, (5) assessment of the classification performance using a pre-existing landslide inventory, and (6) post-processing analysis for the further use in landslide inventories. The results of the developed open-source approach demonstrated good success rates to objectively detect landslides in high-resolution topography data by GEOBIA.