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Quality of geomorphological breaklines extracted from airborne laser scanning

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Breaklines are 3D polylines extracted from high-resolution digital terrain models (DTMs), which mark discontinuities of geomorphologic surfaces. Breaklines have manifold applications in the field of geomorphology. First, breaklines are used to refine and maintain the characteristic discontinuity information in the process of DTM filtering and interpolation. Due to the ability of airborne laser scanning to penetrate high vegetation, even the derivation of breaklines under forested areas is feasible. Second, breaklines are used to characterize regions with active surface processes, to detect and locate geologic faults and borders of geomorphologic objects. The knowledge about the quality of the derived breaklines is important to be specified in order to provide adequate input data for different kinds of follow-up applications.
Breaklines from laser scanning data can be either derived directly from the 3D point cloud or from raster DTMs. The accuracy of derived breaklines depends on the acquisition settings and processing steps, whereas the error in each processing step propagates to the total error budget. The critical criteria are the precision and density of the laser scanning point cloud, the resolution and quality of the filtered and interpolated DTM and the target scale for which the breaklines are derived.
In this contribution a quantitative method for assessing the quality of derived breaklines is presented. Different measures such as line shape complexity, 3D line curvature, variation of slope, and residuals derived from comparison with collected reference data are computed and compared to each other. The measures are discussed regarding their explanatory power w.r.t. detection rate, accuracy and precision. Furthermore, the reliability of reference breaklines produced by different human operators by on-screen digitization is investigated. It can be shown that the quality of manually produced reference breaklines strongly depends on the perception of the operator, which affects compatibility, transferability and reproducibility of data sets.