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Stratified object-based image analysis of high-res laser altimetry data for semi-automatic geomorphological mapping in an alpine area

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Classic geomorphological mapping is gradually replaced by (semi) automated techniques to rapidly obtain geomorphological information in remote, steep and/or forested areas. To ensure a high accuracy of these semi-automated maps, there is a need to optimize automated mapping procedures. Within this context, we present a novel approach to semi-automatically map alpine geomorphology using a stratified object-based image analysis approach, in contrast to traditional object-based image analysis. We used a 1 m 'Light Detection And Ranging' (LiDAR) Digital Terrain Model (DTM) from a mountainous area in Vorarlberg (western Austria). From the DTM, we calculated various terrain derivatives which served as input for segmentation of the DTM and object-based classification. We assessed the segmentation results by comparing the generated image objects with a reference dataset. In this way, we optimized image segmentation parameters which were used for classifying karst, glacial, fluvial and denudational landforms. To evaluate our approach, the classification results were compared with results from traditional object-based image analysis. Our results show that landform-specific segmentation parameters are needed to extract and classify alpine landforms in a step-wise manner, producing a geomorphological map with higher accuracy than maps resulting from traditional object-based image analysis. We conclude that the stratified object-based image analysis of high-resolution laser altimetry data substantially improves classification results in the study area. Using this approach, geomorphological maps can be produced more accurately and efficiently than before in difficult-to-access alpine areas. A further step may be the development of specific landform segmentation/classification signatures which can be transferred and applied in other mountain regions.