On the transferability of rule sets for mapping cirques using Object-based feature extraction from LiDAR data

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Cirques are landforms resulting from glacial erosion and may potentially hold climate proxies. After deglaciation they are showcases of vegetation regrowth and they play an important role in the regulation of surface hydrology in mountains. Our objective is to develop an object-based rule-set that decomposes LiDAR DEMs into the three main cirque components: water divide, cirque headwall and cirque floor, and into the smaller cirque components: threshold, moraine and lake, by using stratified segmentation with feature specific parameters and classification rules.

We hypothesise that the performance of classification rules in different areas is dependent on glacial and post-glacial landscape development, which results in differences in cirque altitude and size, and may reflect lithological variations. To test this hypothesis, the rule-set developed for a representative cirque is applied to ten case areas along a South to North altitudinal transect in the Alps of western Austria. Eight Land Surface Parameters (LSPs) were calculated which are supposed to best discriminate the cirques components, i.e. altitude, elevation percentile, mean curvature, negative and positive openness, plan and profile curvature, and slope angle. For each subsequent cirque feature, a specific combination of segmentation and classification parameters was used. Classifications of the three main cirque components were then validated by comparing manually mapped cirque features to the results of the object-based classifications. The preliminary results indicate the overall cirque accuracy is between 72% and 88%. Individual cirque component accuracies lie between 58% and 73% (water divide), 52% and 85% (cirque floor) and 48% and 74% (cirque headwall). The lower accuracy values relate to low-lying cirques, while the highest accuracies relate to the higher positioned cirques. We conclude that the main cirque components can be extracted with acceptable accuracies, and that rule sets can be successfully transferred to other area. For the cirques moraines, cirque lakes and cirque thresholds however, localised rules are required. We suggest to fine-tune these local classification rules to better respond to local variations in post-glacial landscape development and lithology. Furthermore, it is proposed that differences in the accuracy of classifications resulting from the same rule sets, could indicate differences in regional landscape development.