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Pattern simulation approach for elucidation of glacial relief misclassification

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One of the goals of geomorphometry is an automatic classification of terrain. Automatic classification is much faster than manual mapping and the results are based on clearly defined rules. On the other hand automatic algorithm does not possess human "knowledge" about numerous hidden relations between entities in the data which leads to classification errors. In terrain classification errors appear for three reasons: (a) selection of inappropriate classifier, (b) lack of clear distinction between classes, and (c) gap between the information available in the data and the knowledge needed to make a correct classification. The third reason is rarely considered when performing automatic terrain classification.

We present the results of a numerical experiment aiming at explaining reasons for classification errors when using an automatic pattern-based terrain classifications algorithm proposed by Jasiewicz et. al. [2014]. Performance of this method gained 70% against the manual classification of landscapes in Poland.

Our goal here is to investigate the reasons for misclassifications at the level of data description. Using a complex texture-composition signature we want to check what information affects the misclassification: general long-range (of the order of kilometres) composition of the whole area or short-range (order of tens of meters) textural properties. To solve the problem we run conditional simulations where as the source of information about the long-range composition we used misclassified areas and as a source of short-term texture we used examples of areas which were classified correctly. Simulation will change the texture of the area but will keep its general composition. The similarity between new simulated "landscape" and landscape types used as a source for composition component and texture component will answer which of those two elements plays more important role during classification process.

The source data was 30 m DEM of post-glacial developed areas across the North Poland. To simulate landscape patterns we used FILTERSIM algorithm implemented in the SGeMS software. To address our problem we selected 3 areas which were used as training examples in both for young and old moraine plateaus. We defined them as True Positive (TP) and True Negative (TN) respectively. Also we choose 8 areas which undoubtedly are located on young and old areas but were classified inversely. We defined them as False Positive (FP) and False Negative (FN) respectively. In our experiments we sampled composition from FN and FP, and used the patterns from surfaces of TP and TN previously used to train classifier.

We found that classification errors come from convergence of landscape properties: after replacing texture in misclassified areas with texture as indicated by an example area a new synthetic area shows higher degree of similarity to the landscape class from which it inherits texture. It allow to draw conclusion that short-range textural properties is that feature which at that moment best describes diversity of landscapes for automatic classifications.

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Jasiewicz, J., Netzel, P., Stepinski, T.F., 2014: Landscape similarity, retrieval, and machine mapping of physiographic units. Geomorphology 221: 104-112.