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# Comparison of object-based and object-oriented physically-based land-surface segmentation

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The land-surface of large mountain systems is formed by a pattern of relatively smaller features (particularly horsts, grabens, variously uplifted and dissected blocks, etc.) determined mainly by endogenous processes and differences in the geological structure. Based on this pattern, these features can be perceived as a mosaic of mountains and intramontane basins, which can vary in size, significance, and inner structure. Regardless of their properties, to perform a successful analysis of morphotectonic development of a given area, they need to be individually delineated as predominantly homogeneous features. Traditionally, it is done by manual mapping, resulting in individuals known as geomorphological regions.

As there is a demand for using automated processes, we developed a technique of land-surface segmentation using the object-based image analysis (OBIA) based on DEM and its derivatives. The goal of this study was not only to challenge the automatic replication of traditional manually-made geomorphological regions, but also to formulate and test hypotheses of morphotectonic development of the study areas. To emphasize the physical quantities of the land-surface development as geomorphic energy and work, three physically-based geomorphometric variables were defined: Endogenous geomorphic work, Exogenous geomorphic work and Relief brake force. Computation of these special geomorphometric variables required two sorts of input data. First, maximum, mean and range of elevation was computed using the SRTM V4 dataset, forming geomorphometric component of the variables. Second, the physical component of the variables was formed by rock density based on geological maps and gravity acceleration. Then, the process of land-surface segmentation was carried out in the eCognition Developer software based on the native multiresolution segmentation algorithm. Using physically-based variables not only in the subsequent interpretations, but already in the process of the segmentation, resulted in higher interpretation value.

Our approach was first tested at the territory of the Western Carpathians, where given by the contrasting composition of terrain, a complex hierarchical top-down object-oriented approach consisting of several segmentations and nested classifications was developed. To test versatility and robustness of the method, territory of the Alps was elaborated, too. Since the terrain is less contrasting there, even simple object-based segmentation proved to be sufficient.

Finally, a non-trivial morphotectonic interpretation of the delineated morphometrical-morphostructural individuals was done. Similarities and differences in the geological structure and geodynamic development of the both study areas were reflected by our novel Index of steady state, which compares the ratio of the endogenous and exogenous geomorphic work preserved in the recent terrain.

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