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An object-based approach to hierarchical classification of the Earth's topography from SRTM data

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Digital classification of the Earth's surface has significantly benefited from the availability of global DEMs and recent advances in image processing techniques. Such an innovative approach is object-based analysis, which integrates multi-scale segmentation and rule-based classification. Since the classification is based on spatially configured objects and no longer on solely thematically defined cells, the resulting landforms or landform types are represented in a more realistic way. However, up to now, the object-based approach has not been adopted for broad-scale topographic modelling. Existing global to almost-global terrain classification systems have been implemented on per cell schemes, accepting disadvantages such as the speckled character of outputs and the non-consideration of space.

We introduce the first object-based method to automatically classify the Earth's surface as represented by the SRTM into a three-level hierarchy of topographic regions. The new method relies on the concept of decomposing land-surface complexity into ever more homogeneous domains. The SRTM elevation layer is automatically segmented and classified at three levels that represent domains of complexity by using self-adaptive, data-driven techniques. For each domain, scales in the data are detected with the help of local variance and segmentation is performed at these recognised scales. Objects resulting from segmentation are partitioned into sub-domains based on thresholds given by the mean values of elevation and standard deviation of elevation respectively. Results resemble patterns of existing global and regional classifications, displaying a level of detail close to manually drawn maps. Statistical evaluation indicates that most of the classes satisfy the regionalisation requirements of maximising internal homogeneity while minimising external homogeneity. Most objects have boundaries matching natural discontinuities at the regional level. The method is simple and fully automated. The input data consist of only one layer, which does not need any pre-processing. Both segmentation and classification rely on only two parameters: elevation and standard deviation of elevation. The methodology is implemented as an eCognition® customised process, available as free online download. The results are embedded in a web application, where users can visualise and download the data of interest in GIS ready vector format.

The method has originally been developed on the SRTM, but may be applied to any other DEM and regional area of interest. The tool allows for modifications in order to meet the requirements of individual research tasks. Both segmentation and class thresholds are relative to the extent and characteristics of the input DEM. Therefore, when applying the tool to regional or national scales, the results should be interpreted within the adequate context.