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Spatial analysis of fluvial terraces in GRASS GIS accessing R functionality

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Terrace research along the Danube is a major topic of Hungarian traditional geomorphology because of the socio-economic role of terrace surfaces and their importance in paleo-environmental reconstructions. Semi-automated mapping of fluvial landforms from a coherent digital elevation dataset allow objective analysis of hydrogeomorphic characteristics with low time and cost requirements. New results obtained with unified GIS-based algorithms can be integrated with previous findings regarding landscape evolution.
The complementary functionality of GRASS GIS and R provides the possibility to develop a flexible terrain analysing tool for the delineation and quantifiable analysis of terrace remnants. Using R as an intermediate analytical environment and visualisation tool gives great added value to the algorithm, while GRASS GIS is capable of handling the large digital elevation datasets and perform the demanding computations to prepare necessary raster derivatives (Bivand, R.S. et al. 2008).
The proposed terrace mapping algorithm is based on the work of Demoulin, A. et al. (2007), but it is further improved in the form of GRASS GIS script tool accessing R functionality. In the first step the hydrogeomorphic signatures of the given study site are explored and the area is divided along clearly recognizable structural-morphological boundaries.The algorithm then cuts up the subregions into parallel sections in the flow direction and determines cells potentially belonging to terrace surfaces based on local slope characteristics and a minimum area size threshold. As a result an output report is created that contains a histogram of altitudes, a swath-profile of the landscape, scatter plots to represent the relation of the relative elevations and slope values in the analysed sections and a final plot showing the longitudinal profile of the river with the determined height ranges of terrace levels. The algorithm also produces a raster map of extracted terrace remnants. From this dataset it is possible to interpolate a new digital elevation model approximating the former terraced valley surface using the Ordinary Kriging method (Troiani, F. and Della Seta, M. 2011).
The applicability of the algorithm was tested on the northern foreland of Gerecse Mountains, an antecedent valley section of the Danube, with terrace remnants expected in 6 to 8 altitude ranges. Methodological issues arising from determining the optimal threshold values were explored using an artificial hillslope model, while the terrace profiles and terrace-top surfaces raster generated from the digital elevation model were validated with the previous findings of traditional geomorphological surveys.
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