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Sediment connectivity assessment in a Romanian catchment affected by coal mining

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Over the recent decades, the interest in assessing the sediment and water connectivity by means of a (more) in-depth sediment dynamics analysis through the topographical metrics has predominantly targeted mountainous watersheds. Nonetheless, little reflection has been devoted to the role played by the anthropic landforms of the mining areas in increasing or inhibiting sediment connectivity.

In this research, we strove to understand sediment connectivity in a complex catchment, characterized by specific hydro-morphological disturbances and processes induced by the coal mining activities. The main objective is to comprehend the way in which sediment connectivity patterns affect the coupling and decoupling of mining areas to the rivers, so as to be able to explain the presence of coal traces in the alluviums.

The study focuses on Jiu River basin, the largest Danube tributary in south-western Romania (10,080 km^2), overlapping a large variety of landforms and geologic units: mountains (Carpathians) in the upper sector, Peri-Carpathian and piedmont hills in the middle sector, and plain in the lower part of the catchment. Distinguished by the presence of coal mining areas (hard coal in the mountains and lignite in the piedmont), traces of the two species, alone or mixed together, can be found in different proportions in the composition of the fine river sediments.

As methodology, in addition to the hydrological and geochemical analysis of the fine sediment yield and sources, the connectivity index proposed by Cavalli *et al.* (2013) has been applied to further evaluate the linkages between upslope and downslope geomorphic components in a number of sub-catchments within Jiu River Basin. To determine the connectivity between the mining areas and the main rivers, several Digital Elevation Models with spatial resolutions between 30 and 12.5 m were used. In order to analyze the connectivity between coal strata and sterile heaps exposed to erosion and landslides during intense rainfall-runoff events basins, some case studies of the lignite and hard coal-producing sub-catchments (Jilţ River's, and Western Jiu and Eastern Jiu Rivers' respectively) have been investigated.

By computing different weighting factors to test the topographical impedance to runoff and sediment mobilization, the research proved adequate for evaluating the performance of the connectivity index for medium resolution DTMs of the Jiu River Basin. By comparing the resulting connectivity maps of the mountainous sub-catchments, the mining areas appeared to be quite well connected to the hydrographical network, explaining the enrichment of fine sediments with coal, the largest amounts being reported during floods. On the contrary, for the piedmont sub-basins, with a seemingly disconnecting topography with respect to the receiving rivers, a lower degree of connectivity was found between the lignite open pit mines and the Jiu River. Finally, it is noteworthy that the lower sub-catchments do not present very high values of the connectivity index, as the preponderance of the topographic information in computing the weighting factor does not fully reflect the real sediment connectivity and the way in which the coal is mobilized during extreme hydro-climatic events.