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Impact of land use changes on connectivity in a rural catchment with mild topography

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Concept of sediment connectivity and quantitative assessment of its spatial distribution became important tool for analysis of spatial connectivity of sediment transport processes in basins. Most of the first connectivity studies is focused on montane basins with high rates of erosion originating in steep slopes in headwater areas. However, less attention is paid to the mild landscapes in highland and lowland landscape, with often high connectivity. It applies to the rural areas where the sediment transport and erosion control are of key importance. Assessment of connectivity and its control in such environment thus can contribute to the efficient and sustainable landscape management.

In our study we have tested applicability of the concept of index of sediment connectivity (IC) in mid-latitude rural catchment with mild topography and extensive share of arable land. The aim of the study was (i) to test the GIS-based IC calculation in specific topographic conditions, (ii) to assess the effects of land use changes on the sediment connectivity and (iii) to identify the landscape features affecting connection between hillslopes and stream channels.

The study area - Loucka River Basin, Czech Republic with area of 386 sq km is located in highland landscape with 60% share of arable land. The basin study area has a reverse pattern of topography compared to the typical montane catchments - the extensive headwater areas, used for agriculture, are flat and are drained into steep valleys in downstream. The basin is equipped with long-term monitoring of suspended sediment transport.
We have used the high resolution 5 meter DEM derived from aerial LiDAR scanning as a base for analysis of topographic controls of sediment connectivity and for calculation of connectivity topographic index. The index of connectivity was calculated in a multitemporal scale of two decades since 1990 to analyze the the changes of sediment connectivity and its spatial distribution in response to the land use changes in the area. The calculated IC values were compared with spatial distribution of C-USLE factor and verified by field survey in situ.

Our study demonstrated (i) applicability of the sediment connectivity concept in rural landscapes, (ii) ability to reflect the impact of land use changes on sediment connectivity processes as well as (iii) the high sensitivity of the basin to the land use changes, which can be translated in decoupling of the processes in hillslopes and channels and result in exclusion of parts of the basin from the sediment transport.

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