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Semi-automatic channel detection based on detailed LiDAR data for preliminary flood hazard assessment

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The flood hazard is affected by several natural factors, such as impermeable soil, depressions and unsuitable land cover. Human impact is also not negligible in the river basin. We can observe inappropriate tillage accelerating erosion or storage of various materials and waste in the immediate proximity and directly in watercourses. The size of the inundation area is affected by the capacity of the watercourse and its ability to transmit a flood wave.

Our medium-term goal is to enrich the preliminary flood hazard assessment with watercourse channel properties such as flow, depth and capacity. We want to determine these parameters quickly for large areas using detailed data. The sub-goal on which this paper is focused is the detection of the watercourse channel as an area. Hence we are focused on detecting the right and left bank of the channel. We test our methodology in a selected area of Slovakia with an area of 320 km^2. The input is LiDAR data with an average density of 32 points per m^2 and average height accuracy of 0.05 m. From the above data, we created a digital elevation model (DEM) with a cell size of 1 m and derived layers such as slope, topographic position index, topographic wetness index, and topographic openness. Subsequently, we used these layers in the machine learning random forest (RF) tool for the supervised classification of the spatial limits of the channels represented by the banks. We adjusted the classification output from other depressions or potential misclassification based on proximity analysis and a morphometric approach. For validation, we use a manually edited layer of channel lines based on detailed orthophoto from 2017 and DEM.

Keywords: LiDAR, channel detection, channel morphology, banks, random forest