Application of regression trees and cluster analysis for identification of connections between modifications to streams and geomorphologic consequences of floods

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Modifications of watercourses at various spatial levels like stream route regulations, weirs and steps in the longitudinal profile, consolidation of the river banks and river bed or modifications to the riparian zone, may impact river flow during floods. Such modifications can affect the speed of the flood's progression, the likelihood of its efficient transformation, the concurrence timing of flood waves from various parts of the river basin as well as the geomorphologic consequences of flooding.

The cluster analysis and regression trees methods were applied to analyze the relationship between different forms of anthropogenic modifications to streams and the occurrence of geomorphologic consequences of floods. The analysis was based on the data resulting from field mapping of stream modifications and geomporphologic consequences of floods in the Volynka river basin, Czech Republic, which was at the center of the extreme regional flooding that impacted Central Europe in August 2002 and the intensive flash flood in July 2009.

The field mapping indicated that the geomorphologic consequences of flooding are unevenly distributed in the river basin. They are concentrated in the headwater and midway regions of the basin, while in lowland areas of the basin, the flood effects were reduced on account of several complex stream modifications.

Using cluster analysis and regression tree classification there were tested the connections between the modifications to streams and the observed flood effects. The cluster analysis was used to select indicators of stream modification and physiography of the basin, suitable for explanation of occurrence of the flood consequences. The regression tree analysis was employed to interpret the distribution of both erosion and accumulation in the context of physiogeographic features and river network modification.

The analyses identified various factors that impact the occurrence of erosion and accumulation after the floods in August 2002 and July 2009. The occurrence of bank erosion is related to the incidence of weirs and steps in the respective stream segment but is also connected with the nature of complex riverbed modifications. The occurrence of fluvial accumulations is then related to the sinuosity of the stream segment together with the stream slope.

The research indicated that in suitable conditions the river network modifications can have important effects on the nature and impacts of flooding. However, their effect is related to the physiogeographic features of the stream and river basin and should always be analyzed in the context of local geographic conditions. The applied combination of both cluster analysis and regression tree analysis proved to be efficient tool for such analysis.