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Framework for the comparison of the performance of restoration of floodplain retention vs. technical retention basins for the reduction of flood risk

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The attenuation of flood waves on alluvial reaches of rivers was often influenced by river training works carried out mostly during the last century. The effectiveness of restoration of floodplain retention vs. technical retention basins is often discussed when proposing measures to reduce risk of flooding. This study presents a framework that can be used to statistically assess the performance of these measures. When data on historical floods are available it can be used:
- for the estimation of changes in design floods in consequence of river training in the past,
- for the quantitative comparison of the effectiveness of floodplain restoration and technical retention basins in the reduction of flood risk.
The applicability of the methodology was demonstrated on a case study on the Morava River in Slovakia. The attenuation of flood waves on lower Morava River between Moravský Svätý Ján and Záhorská Ves was influenced by extensive river training during the last century. In the case study the transformation of flood waves for historical and present river bed conditions was studied together with the effect of three planned flood detention reservoirs.

First empirical data on the travel time of the flood peaks were collected from a set of historical flood waves from periods before the river engineering works had been completed and also from the recent past. The flood-peak travel-time vs. peak-discharge relationships for both periods were analysed and approximated by empirical piecewise linear models, which clearly show the acceleration of flood movement as a consequence of flood plain loss. Second, a multilinear conceptual flow routing model was set up. The discrete state space representation of the Kalinin-Miljukov model was used with the time distribution scheme of the model inputs. The time parameter of the state space model was allowed to vary with input discharge according to the travel-time peak-discharge relationships for historical and present river bed conditions. The applicability of this model parametrisation was verified on floods not used for the travel-time vs. peak-discharge analysis. Further a simple conceptual model of the flood detention reservoirs planned to be constructed on the Morava River was also proposed. The model assumes, that the forecast lead time during floods is sufficient to control the operation of these.

Since the changes detected in the travel-time of floods peaks were included in the parameterisation of the multilinear model, the changes in design floods could have been assessed by frequency analysis of flood peaks gained by the simulation of the attenuation of a series of flood waves. Eighty flood waves of annual maximum floods from the period 1923-2002 were routed for pre-river training conditions, which represent a total restoration of lost flood plains, present river bed conditions and through the planned reservoirs. The past, present and expected flood regime of the lower Morava River was statistically analyzed, design floods were compared and the effectiveness of the proposed measures discussed.