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Identification of a multilinear flood routing model for flood forecasting systems in data-poor situations

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Availability of sufficient and up-to-date data describing the morphologic and hydraulic channel characteristics is rather rare. In many circumstances detailed field investigations, which would supply these, are prohibited by time schedules and project costs. It is not likely that this situation will change substantially especially for smaller catchments and local flood forecasting system. The lack of appropriate channel geometry and roughness data hinders the application of hydraulic models for flood routing in engineering design and flood forecasting. Moreover the application of complete distributed hydraulic flow routing models in data-poor situations is neither justifiable nor advantageous. Therefore, the application of hydrologic flood routing methods, in which the river is described as a lumped system, still remains a rational alternative under certain hydraulic conditions, when the use of hydraulic models, due to their complexity and data intensity, may not be a feasible and economic solution.

In the contribution a nonlinear hydrologic routing model is proposed and tested. It is based on a state-space formulation of the linear reservoir cascade model, which belongs to the class of lumped hydrologic flow routing models based on the storage-discharge relationship, and an empirical wave-speed discharge relationship, which accounts for nonlinearity of the flood routing process. The resulting model belongs to the family of multilinear models.

The discrete state space representation of the Kalinin-Miljukov model was used as the basis for a multilinear discrete cascade flood routing model. The time distribution scheme of model inputs was employed in the setup of the multilinear model and the travel-time parameter of the model was allowed to vary with discharge. A piecewise linear model of that relation has been suggested with constraints, which were consis-

tent with the physical interpretation of the factors determining the relation. The shape and parameters of that model were fitted by constrained optimisation of the multilinear model performance on one large flood wave with the help of a genetic algorithm.

The relationship between travel-time of flood peaks and peak discharge was also studied on a river reach based on data from several floods. The optimised piecewise linear relationship fitted well the empirical data on travel-times of flood peaks and was also consistent with the findings in the literature.

The modelling results showed that the proposed inclusion of empirical information on the variability of the travel-time with discharge from one flood and with two physically justified constraints enabled satisfactory accuracy of the prediction of flood propagation. The method can thus be used for calibrating the conceptual multilinear flood routing model in data-poor situations.