



## **Evaluation of influence of historical changes in land use along the middle Vistula river reach on flood risk**

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There is a vast literature on the influence of land use changes on rainfall-runoff processes. The problem is difficult as it requires separation of climatic and water management related changes from land use influences. The present paper addresses the problem of the influence of land use changes on maximum flows at cross-sections along the middle River Vistula reach. We adopt a methodology tested at the catchment scale, which consists of an optimisation of a rainfall-runoff model using a moving time horizon and analysis of the variability of model parameters. In the present application, it consists of an analysis of changes of roughness coefficients of a distributed HEC-RAS model, optimised using a moving five-year window. The chosen river reach (between Annapol and Gusin) has a recorded history of land use changes over 50 years (from 1949 to 2001), which included 36% of the study area. The nature of the changes is complex and shows different trends for different plant communities and sections of the valley. Generally, there has been a several percent increase in the area occupied by forests and grassland communities and a slight increase in the proportion of scrub.

The first step of the procedure is to define the river reaches that have recorded information on land use changes. The second step is to perform a moving window optimisation of the HEC-RAS model for a chosen river reach. In order to assess the influence of land use changes on maximum flow values, the goodness-of-fit of the simulation of annual maximum water levels is used as an optimisation criterion. In this way the influence of land use changes on maximum inundation extent related to flood risk assessment can be estimated. The final step is to analyse the results and relate the model parameter changes to historical land use changes. We report here the results of the first two steps of the procedure.

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