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Flood forecasting in meso-scale catchments using a fuzzy rule-based expert system

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Within the last years, soft computing methods like Artificial Neural Networks or Fuzzy Logic have been successfully introduced into the field of hydrology. For short term flood forecasting in meso-scale catchments a fuzzy ruled-based expert system has been developed within the BMBF-founded project *HORIX – Development of an Operational Expert System for Flood Risk Management considering Prediction Uncertainty*. It replicates the model chain "forecast of rainfall events – rainfall-runoff-model – hydrodynamic model" and the included uncertainties in order to make the flood predictions within meso-scale river basins faster and more robust.

Within the rule-based expert system the two classical, in many areas successfully applied fuzzy methods are integrated: the Mamdani- and the Takagi-Sugeno-Method. The algorithms deal with fuzzy variables and describe data relations linguistically through IF – THEN rules. Further, they allow the implementation of both unsharp data and scientific expertise. Due to their structure they are transparent for the user showing the influence of all variables for any system state directly.

The developed ruled-based expert system consists of two cores with different time resolutions. Each core includes the corresponding fuzzy systems of the considered gauges. At normal flow conditions the discharge and water level forecasts are performed with the daily-based core. Thereby, the system checks if the predicted discharge or water level exceeds a specific threshold. The threshold values are based on the warning level defined by the responsible water administration. If one specific warn-

ing level is exceeded, the system will switch to the hourly resolution for a more precisely prediction of the peak height and entry. After flood events, the system switches back to the daily resolution.

The presentation discusses the set up of the developed expert system for the study area of the Upper Main catchment in Germany (A_E = 4244 km^2). The transferability of the expert system to other meso-scale catchments with different properties will also be discussed.