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A non-calibrated, runoff process-based rainfall-runoff model for prediction of floods in ungauged basins

Andreas Steinbrich (1) and Markus Weiler (2)

(1) Institute of Hydrology, University Freiburg, Germany (Andreas.Steinbrich@hydrology.uni-freiburg.de), (2) Institute of Hydrology, University Freiburg, Germany (Andreas.Steinbrich@hydrology.uni-freiburg.de)

Predicting peak flow and floods in ungauged headwaters and meso-scale watersheds is still challenging. The potential of different regionalization approaches has already been explored in many studies, but the potential of spatially explicit predicting runoff generation processes to predict areas with different runoff generation intensity and finally flood hydrographs has not yet fully explored. We have developed a new rainfall-runoff model that combines high resolution GIS data (1m grid size of DEM and land-use), geological and pedological data as well as information about the effect of macropores and preferential flow pathways on the generation of infiltration excess, saturation excess and subsurface flow. The model is expected to predict the influence of different types of precipitation (high intensity and short duration / low intensity and long duration) as well as different antecedent moisture conditions for the different regions situated in the federal state of Baden- Württemberg. The choice of catchments in different regions is of particular interest to test the hydrological model since the variability of geological, pedological and climatological watershed characteristics amongst the regions is high. All parameter sets, needed to run the model, are derived from GIS-Data, available for the whole area of Baden- Württemberg. There is no calibration of any parameters used in the model. We believe that this new model is different from many other model approaches not only in respect to spatial resolution, but in particular by incorporating a detailed understanding of hydrological processes, obtained from many experimental studies carried out world wide with respect to runoff generation at the plot and hillslope scale. To test the capability of the model, flood events in 18 meso-scale watersheds with different physiographic properties and induced by different types of precipitation are modelled and compared to the observed hydrographs.
First results are satisfying and very promising. If the model meets the expectations it will be applied to the whole area of Baden- Württemberg for different model storms and given moisture conditions to generate a dataset that can be used to predict peak flows at watershed scales ranging from several hectares to hundreds of square kilometres.