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Uncertainties in flood modelling

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Due to increasing flood events and attributed losses, the demands on the accuracy of flood forecast systems are high. In many countries these systems are used for emergency and evacuation plans. Therefore spatially and timely distributed water levels with its uncertainties have to be forecasted, which is usually carried out by numerical models.

The main goal of this contribution is to quantify the uncertainties in flood modelling. The uncertainties are divided in parameter and model uncertainties. The investigation area is a 27 km long river section of the Upper Main (Bavaria, Germany). As an appropriate hydraulic model Sobek-Rural 1D/2D (WL|Delft Hydraulics) is used, which calculates for each grid point a corresponding water level.

Monte Carlo Simulations are performed to analyze the influence of various parameters on the water level like roughness and elevation in channel and floodplains. Thereby all parameters are assumed to be uniformly distributed.

The results show that due to different parameter combinations the fluctuation of the water level is spatially distributed. It depends on the relationship between foreland to channel discharge and on the combination between structures and embankments. The sensitivity of the water level on each parameter differs according to the river section and is analysed by the General Sensitivity Analysis (Wade et al., 2001) for each calculation point. It is shown, that the friction and the foreland height are the parameters with the largest influence on the water level in flood modelling. The maximum range of al calculated water levels is about 0.35 m – 0.55 m (mean water level 1.0 m – 1.4 m). The 10% to 90% quantile range varies between 0.14 m and 0.3 m. These values

are nearly constant for discharges between HQ5 and HQ100. The inundation depths for steady and unsteady discharges with equal recurrence intervals are also compared.

Generally the flood modelling takes place with different complex models. Thus the model complexity is also analysed by comparative analyses with the models HYDRO_AS-2D and MIKE FLOOD. It is shown, that different momentum exchange between the discharges in the bank section, the foreland and the channel causes water level differences up to 0.25 m between the models. Moreover the approximation of the topography by a raster or a mesh has also local influences. Depending on the grid size of a raster, structures like small road embankments cannot be respected so that water level differences up to 0.20 m are possible.

Literature:

Wade, A.J., Hornberger, G.M., Whitehead, P.G., Jarvie, H.P. & Flynn, N. (2001): On modeling the mechanisms that control in-stream phosphorus, mycrophyte, and epiphyte dynamics: An assessment of a new model using general sensitivity analysis. Water Resources Research, Vol. 37, No. 11, Pages 2777-2792.