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An assessment of flood mitigation measures – “room for the river” vs. “retaining water in the landscape”

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In this paper we analyse the relative effect of different flood mitigation measures for the example of the Kamp catchment in Austria. The main idea is to decrease flood peaks through (a) retaining water in the landscape and (b) providing additional inundation areas along the main stream (room for the river). To increase the retention of excess rainfall in the landscape we introduced two different measures. One measure is the increase of water storage capacity in the study catchment through the change of land use from agriculture to forest. The second measure is the installation of many small sized retention basins without an outlet (micro ponds). The micro ponds are situated at the hill slopes to intercept surface runoff. In case of the room for the river scenario the additional retention volume is gained due to the installation of retention basins along the Kamp river and its tributary Zwettl. Three flood retention basins with culverts at each river are envisaged. The geometry of the bottom outlets is defined for design discharges in a way to gain the greatest flood peak reduction for large flood events (above a 100 yr flood).
The study catchment at the Kamp river with a size of 622 km^2 is located in north-eastern Austria. For the simulation of the different scenarios (retaining water in the landscape) a well calibrated continuous hydrologic model is available. The hydrological model consists of a spatially distributed soil moisture accounting scheme and a flood routing component. To analyse the effect of the room for the river scenario with retention basins along the river reaches a linked 1D/2D hydrodynamic model (TUFLOW) is used. In the river channels a one dimensional simulation is carried out. The flow conditions in the flood plains are represented by two dimensional model elements. The model domain incorporates 18 km of the Kamp and 12 km of the Zwettl river valley.
For the assessment of the land use change scenario the hydrologic model parameters for wooded areas are transferred to areas that are currently not forested. Through higher storage capacities in the wooded areas the scenario of afforestation helps to reduce flood peaks. The micro ponds are represented in the hydrological model by a bucket storage component. It is filled by a fraction of the simulated direct runoff and drains into the groundwater with a constant percolation rate. For the scenarios of flood mitigation with retention basins along the river reaches three locations at the Kamp and three locations at the Zwettl river have been chosen for hypothetical retention basins or polders with bottom outlets.
The main difference between the "room for the river" method and the "retaining water in the landscape" methods is the magnitude of the flood event for which the retention is maximised. For the case of retaining water in the landscape (either by land use change or microponds) the storage capacity obtained by these measures is filled at the beginning of the event. For small event magnitudes, the flood peak reduction is hence maximised. In the Kamp catchment, significant reductions in the flood peaks can be obtained when retention basins along the main stream are constructed and the flood plains are inundated. The main advantage of the room for the river methodology is that the polders/retention basins can be designed in a way that there is no retention for small flood discharges which leaves the full storage capacity for larger floods at the time of peak. In contrast, for the retaining water in the landscape measures, the storage is exhausted at an early stage of medium and large events, resulting in very small flood peak reductions.