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Automated location optimization of detention basins as a contribution to an efficient flood mitigation strategy

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A considerable share of the losses by extreme flooding are in upstream areas, where centralized flood mitigation measures have no effect. Consequently, modern flood mitigation strategies address this problem by a distributed combination of measures, including nature-based solutions and decentralized flood detention basins. These small basins can be realized by minor changes in the landscape and can influence the runoff behavior at the site and downstream. However, the economic viability of the sites and the local and regional effectiveness depend on the location optimization, which is influenced by the local topography as well as by complex superposition effects.

We address this complexity with a combination of two innovative and automated optimization tools: LOCASIN (LOCation detection of retention and detention bASINs) is a flexible tool to automatically detect, characterize and evaluate detention basin locations. It is based on topographical data and provides information on the basin geometry as well as on the required curves for basin retention calculations. TOBAS (Tool for the Optimization of BASin efficiencies) calculates the effectiveness of a basin combination, taking into account the mutual influence when optimizing the throttle size. The input data includes the relation of water level and retention volume from LOCASIN and hydrographs generated by a hydrological model (e.g. WaSiM). Furthermore, TOBAS can be applied to select and dimension an optimized basin combination from the locations determined with LOCASIN. The optimization is based on the respective objective, e.g. effectiveness or economic efficiency. Hence, the joint application of both tools can contribute to improve efficient flood mitigation strategies and enhance flood resilience. The applicability of the tools and the benefits for the assessment of flood mitigation concepts were tested and confirmed by means of different Bavarian catchments.