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Modelling river restoration and floodplain measures in Bavaria on different scales

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Many flood events of the last decades indicate the necessity of sustainable and integral flood protection strategies including nature-based retention measures. Therefore, it is essential to analyze the effects of river restoration and floodplain measures. Different modelling approaches as well as considering only a single or very few catchments per study impede the comparability of many research projects. For this reason, the effectiveness of these measures is often controversially discussed.
The aim of this study is to quantify the effects of a combined river and floodplain restoration in characteristic Bavarian catchments with various topographic properties and different spatial scales ($\sim$ 90 – 560 km2). The restoration and floodplain measures are implemented in the two-dimensional hydrodynamic model HYDRO_AS-2D which is based on a flexible mesh. This allows the consideration of detailed restoration scenarios. In total, three different scenarios per catchment are modelled and analyzed:
a) the current state: represents the current state of the investigation areas
b) the structure reduced current state: represents the current state of the investigation areas with adapted anthropogenic structures (e.g. transverse structures like crossing road and railway embankments) in order to reduce their impact on the development of the flood waves
c) the restoration scenario: holistic restoration of the investigation area including the modification of the river channel and the floodplain
Comparing e.g. the structure reduced current state with the restoration scenario allows to determine the effects of restoration and floodplain measures with focus on their dependency on natural catchment characteristics, as they are less affected by transverse structures. For the simulations five flood events with different underlying rainfall characteristics (spatial / temporal distribution, rainfall intensity) are considered. These flood waves are obtained by the physically based hydrological model WaSiM which is coupled with the hydrodynamic model by direct and diffuse inflow boundary conditions along the considered river section. First results of the ongoing study show a dependency of the obtained peak attenuation and the temporal translation of the flood wave on the predominant valley type and the size of the catchment. Furthermore, considerably higher inundation depths in restoration scenarios compared to current state scenarios are determined.
In summary, based on these simulations it is possible to quantify the effectiveness of the implemented restoration measures with respect to catchment specific areal and fluvial characteristics (e.g. the predominant shape of the surrounding valleys, the catchment size or the channel slope). In addition to the analysis of the resulting discharge curves at the model outlets, the discharge curves are evaluated along the whole investigated river sections to enable a catchment internal scale dependent analysis of the effectiveness of the considered measures.