Combining abiotic and biotic models - Hydraulical modeling to fill the gap between catchment and hydro-dynamic models

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The European Water Framework Directive (WFD) requires a catchment-based approach, which is assessed in the IMPACT project by combining abiotic and biotic models. The core point of IMPACT is a model chain (catchment model -> 1-D-hydraulic model -> 3-D-hydro-morphodynamic model -> biotic habitat model) with the aim to estimate the occurrence of the target species of the WFD. Firstly, the model chain is developed for the current land use and climate conditions. Secondly, land use and climate change scenarios are developed at the catchment scale. The outputs of the catchment model for the scenarios are used as input for the next models within the model chain to estimate the effect of these changes on the target species.

The eco-hydrological catchment model SWAT is applied for the Treene catchment in Northern Germany and delivers discharge and water quality parameters as a spatial explicit output for each subbasin. There is no water level information given by SWAT. However, water level values are needed as lower boundary condition for the hydro-dynamic and habitat models which are applied for the 300 m candidate reference reach.

In order to fill the gap between the catchment and the hydro-morphodynamic model, the 1-D hydraulic model HEC-RAS is applied for a 3 km long reach transect from the next upstream hydrological station until the upper bound of the candidate study reach. The channel geometry for HEC-RAS was estimated based on 96 cross-sections which were measured in the IMPACT project. By using available discharge and water level measurements from the hydrological station and own flow velocity measurements, the channel resistence was estimated.

HEC-RAS was run with different statistical indices (mean annual drought, mean discharge, . . .) for steady flow conditions. The rating curve was then constructed for the target cross-section, i.e. the lower bound of the candidate study reach, to fulfill the combining with the hydro- and morphodynamic models. These statistical indices can also be calculated for the discharge series provided by land use and climate scenarios. In this way, the effect of land use and climate change on the catchment and the hydraulic processes can be assessed.