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IWAN - a tool for modelling water balance and nutrient dynamics of floodplains

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The assessment of ecohydrological functions of wetlands and floodplains requires an advanced knowledge about the specific hydrological characteristics, the water balance and about the interactions between floodplain processes and the river dynamics. For successful modelling of the water balance processes and nutrient dynamics of wetlands an adequate reflection of floodplain hydrological characteristics within the model concept is necessary. Therefore the runoff generation and the vertical soil water processes of the unsaturated zone as well as lateral groundwater flow processes of the saturated soil zone and the variable interaction with the surface water dynamics have to be implemented within the model concept. Although most of the mesoscale hydrological models implement runoff generation processes as well as the processes within the unsaturated soil zone rather well and numerical groundwater models enable for efficient simulation of groundwater dynamics and lateral flows, the number of applications of integrated approaches which couple the processes of the unsaturated soil zone and groundwater flow processes is limited. To ensure an adequate reflection of hydrological processes within lowland wetlands and floodplains the IWAN model was developed which enables to integrated process based modelling of water balance and nutrient dynamics. It is based on the successful coupling of the deterministic distributed hydrological model WASIM-ETH and the numerical groundwater model MODFLOW. Within the IWAN model concept WASIM-ETH is used for approximation of the runoff generation and vertical soil water processes within the unsaturated zone, MODFLOW realises the simulation of lateral groundwater flows as well as the interaction with the adjacent river. Both models are coupled by the way of transferring simulated groundwater recharges and groundwater uptakes or decreases between both models. Interactions between groundwater and surface waters are realised by calculating the spatially and temporarily variable leakage based on pressure gradients

between groundwater and surface water. The solute transport model MT3D, which is coupled with the groundwater model MODFLOW, is used for modelling the nitrogen metabolism within the groundwater passage, considering advection, dispersion, sorption and autotrophy denitrification. The model was successfully applied within different sized catchments of the Lower Havel River in the Northeast German lowlands. It was used for the simulation of water balance and nitrogen dynamics within the groundwater for several mesoscale catchments. It was applied for an analysis of the actual water balances as well as for the analysis of scenario assumptions considering changes in landuse or river geometry. An analysis of the uncertainties, proofs the applicability of this approach and the correctness of the assumptions for the Lower Havel River. Furthermore it shows the limitation of the transferability for application within further floodplain catchments.