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MHYDAS-DRAIN: Spatially distributed modelling of a small, artificially drained lowland catchment

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Although artificial drainage measures such as tile and ditch drainage, which shorten the residence time of water in the biologically active unsaturated zone, do not only enhance diffuse pollution of surface water bodies, but also substantially alter the hydrology of lowland catchments, they are rarely explicitly included into spatially distributed catchment models. This is even more the case with the frequently concurrentlyl ocurring flow anomalies causing a further, unexpected acceleration of water flux and solute transport. Here, we present the spatially distributed modelling concept MHYDAS-DRAIN to account for and to evaluate these phenomena. As a starting point for our model development, we chose the spatially distributed model MHYDAS which takes into account the discontinuities and the spatial variability of farmed catchments. The modelling domain consists of a system of interconnected 'hydrological units' which are derived by the overlay and intersection of geographical information such as land use, field limits, soil properties, tile drainage maps etc. and are linked to a ditch network. For the development of MHYDAS-DRAIN it was hypothesised that tile drain discharge is composed of two components accounting for preferential flow and matrix flow. The fast flow component is modelled by a transfer function approach while the slow drainage discharge is calculated by the Hooghoudt equation. In open ditches, an additional baseflow component contributes to the total discharge. All flow routing is realised by an analytical diffusive wave approximation. The model was then applied to a small experimental catchment in the pleistocene lowland area of north-eastern Germany. Modelled flow rates and groundwater levels agreed reasonably well with measured data, and upscaling from a tile drainage plot to a 180 ha catchment was eas-

ily possible. Snow events, however, as those having occurred in 2005, could not yet be simulated successfully. As frequently the case with conceptual models, parameters were found to be dependent on the calibration criteria as well as the spatial and temporal resolution of the modelling domain. Although the fast flow component contributed - according to the modelling results - only a few percent to the total tile drainage discharge, this may still be of importance for solute transport. The total tile drainage discharge, however, was predictably found to govern the hydrology of the investigated catchment.