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Improved simulation of groundwater - surface water interaction in catchment models

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Groundwater storage can have a significant contribution to stream flow, therefore a thorough understanding of the groundwater surface water interaction is of prime important when doing catchment modeling. The aim of this study is to improve the simulation of groundwater - surface water interaction in a catchment model of the upper Zenne River basin located in Belgium. To achieve this objective we used the "Groundwater-Surface water Flow" (GSFLOW) modeling software, which is an integration of the surface water modeling tool "Precipitation and Runoff Modeling system" (PRMS) and the groundwater modeling tool MODFLOW. For this case study, the PRMS model and MODFLOW model were built and calibrated independently. The PRMS upper Zenne River basin model is divided into 84 hydrological response units (HRUs) and is calibrated with flow data at the Tubize gauging station. The spatial discretization of the MODFLOW upper Zenne groundwater flow model consists of 100m grids. Natural groundwater divides and the Brussels-Charleroi canal are used as boundary conditions for the MODFLOW model. The model is calibrated using piezometric data.
The GSFLOW results were evaluated against a SWAT model application and field observations of groundwater-surface water interactions along a cross section of the Zenne River and riparian zone. The field observations confirm that there is no exchange of groundwater beyond the Brussel-Charleroi canal and that the interaction at the river bed is relatively low. The results show that there is a significant difference in the groundwater simulations when using GSFLOW versus SWAT. This indicates that the groundwater component representation in the SWAT model could be improved and that a more realistic implementation of the interactions between groundwater and surface water is advisable. This could be achieved by integrating SWAT and MODFLOW.