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# Accurate 3D hydrological modelling for an improved assessment of groundwater resources: a case study in central Tunisia

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Central Tunisia is characterised by a semi-arid to arid climate where groundwater is taken as the main resource of water supply. Sidi Bouzid Plain is among the most available water resource in this region. To cope with, the artificial recharge of the groundwater has been favored in this aquifer by the development of gabion structures on the Wadi El Fekka designed for spreading of floodwaters. To ensure an efficient management of water supply regarding quantity, it requires a good knowledge of the dynamics of the aquifer. The relation between water table depth and evaporation rate as well as characterizing the exchanges that could exist with free surface flow in associated rivers are a crucial subject in such arid regions. The most efficient way to understand the behavior of the aquifer is to implement a 3D hydrological model that can represent all significant physical processes from the soil surface up to the saturated zone of the aquifer. To obtain an operational tool, a structured methodology for data integration is required. In this study, a 3D regional model of the Sidi Bouzid Plain is set up using the commercial finite element model FEFLOW. The most important hydrological processes such as precipitation, evapotranspiration, river-aquifer exchanges, and groundwater extraction are considered. The numerical study presents how the spatio-temporally variable water fluxes have been quantified in the transient flow model. Water uptake by evaporation was implemented in Feflow via an open user-defined interface. The developed conceptual model is based on a sink term that may be function of moisture distribution and water table depth. Note that such a physically limited water uptake by evaporation is essential to assess accurately the water balance outside the spreading perimeters where evaporation may exert a significant impact on the groundwater level. In addition to the sink term due to evaporation, measured flood hydrographs are used to derive the time-dependent hydraulic boundary condition of water level at the soil surface of the spreading perimeters along the Wadi El Fekka.
In a first step, one-dimensional flow simulations in the deep vadose zone were conducted at three spreading perimeters located near Wadi El Fekka. It was shown that successive flooding events contribute to a significant artificial recharge of the groundwater of Sidi Bouzid. Although the soil hydraulic parameters did not vary strongly in space, flow simulations showed significant differences in the overall water balance of approximately 9–16% for the various spreading perimeters. Hence, the ongoing work on the construction of a 3D unsaturated–saturated flow model will consider the variation in hydraulic parameters in both the vertical and horizontal directions. Furthermore, a field study is actually in progress to validate the input parameters of the numerical flow model such as the van Genuchten water retention parameters and the saturated hydraulic conductivity of the soils. The proposed modelling approach provides thus a useful tool for water managers in developing more efficient strategies to manage the spreading perimeters along Wadi El Fekka, evaluate the groundwater recharge and predict the effects of groundwater extraction.