Hydrologische Modellierung im Einzugsgebiet des Brunnenfeldes in Neufahrn bei Freising (Deutschland) mittels FREEWAT

Hydrological modelling in the recharge area of the well field in Neufahrn bei Freising

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Abstract

The primary goal of this thesis was to generate a hydrological model that is able to reproduce the groundwater dynamics in the recharge area of the drinking water protection zone in Neufahrn bei Freising (Germany). The examined area is integrated as a pilot area in the Interreg Project PROLINE-CE. The generated groundwater model needs to be capable of an adequate performance in order to provide a reliable tool for the management of the water resources in area of Neufahrn bei Freising. To implement the model, I first conducted a fundamental literature review regarding the climatological and hydrogeological characteristics of the recharge area. Based on the processes of the hydrological cycle, I synthesized a conceptual model to analyse and make sense of the fundamental understanding of the hydrological processes. Combining the qualitative nature of the conceptual model with quantitative information on the recharge area, I further generated the desired groundwater numerical model. The software FREEWAT was used to implement the numerical model. FREEWAT is a plug-in integrated in the QGIS desktop that applies MODFLOW codes to simulate the water quality and quantity in surface water and groundwater. MODFLOW is a three-dimensional finite difference groundwater model developed by the U.S.Geological Survey (USGS). The model was generated for the time between October 1979 and November 1990 and was divided in two sub-periods, the calibration period (October 1979 - September 1985) and the validation period (October 1985 until November 1990). It consisted of one convertible layer. The MODFLOW Packages used in the model were the Discretization (DIS) Package, the Basic (BAS) Package, the Layer-Property-Flow (LPF) Package, the Time-Variant Specified-Head (CHD) Package, the Well (WEL) Package, the River (RIV) Package and the Unsaturated- Zone Flow (UZF) Package. The calibrated parameters were the hydraulic conductivity and thespecific yield. A horizontally homogeneous and isotropic hydraulic conductivity (Kx = Ky) was assumed. The results showed that the optimal values are Kx = Ky = 0,009 m/s and Kz = 0,0009 m/s for the hydraulic conductivity and Sy = 0,20 for the specific yield. The calibration yielded very good model performance (NSE = 0,963, MAE = 0,216m, RMSE = 0,315m and RSR = 0,133). The uncertainty analysis and the validation verified the model quality. The model revealed a contradictory behaviour at piezometer 16600, which is important to be investigated in future research. Future work should also consider adjusting the defined material property parameters to be

heterogeneous. It is also important to perform a more detailed uncertainty analysis, to reduce the surface leakage in the water budget by adding the Stream Flow Routing (SFR) Package and to adjust the water elevation in the River (RIV) Package, concerning the impact of the Isar River bifurcation upstream of the study area. FREEWAT was in general a powerful tool to generate and further develop the model.

The thesis is written in English language.

The thesis can be consulted upon request.

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