Geophysical Research Abstracts
Vol. 20, EGU2018-8708, 2018
EGU General Assembly 2018

Prioritizing Uncertainty Sources in Modelling Surface Water – Groundwater Interactions of Gravel-bed Rivers

Thomas Wöhling (1,2) and Moritz Gosses (1)

(1) Technische Universität Dresden, Institute of Hydrology and Meteorology, Chair of Hydrology, Dresden, Germany (thomas.woehling@tu-dresden.de), (2) Lincoln Agritech Ltd, Hamilton, New Zealand

Gravel-bed rivers form aquifers with complex structures, regions of varying transmissivity and sometimes subsurface flow networks of highly conductive flow paths. They are often perched above the regional water-table in their upstream regions where river water is percolating vertically through the riverbed to become groundwater. Further downstream, upwelling groundwater re-emerges as low-land springs in the coastal regions and flows back into the river. In general, the exchange flow between river and aquifer can change direction along the course of the river and is highly variable in space and time. Therefore, predicting river-groundwater exchange flow with mathematical flow models is very challenging.

In this study we analyze and rank different uncertainty sources for predicting river-groundwater exchange flows for a section of the Wairau Aquifer, New Zealand using a detailed regional flow model (Modflow) of the area. The uncertainty sources considered are the parameterization of the hydraulic properties of the aquifer, the parameterization of river bed and drain conductivities, the parameterization of the soil-water balance and groundwater abstraction model, meteorological input uncertainty, and uncertainty associated to the parameterization of the river channel geometry.

Hydraulic conductivity and specific storage fields for three of the four different hydrogeological units considered in the model are parameterized with a pilot point scheme and calibrated using regularization constraints. The uncertainty of these fields is evaluated using Null-Space Monte-Carlo techniques. Input and parametric uncertainty of the soil-water balance model are evaluated by stochastic simulation.

Results indicate that the dominant uncertainty sources are related to hydraulic properties of the aquifer and to properties of the river channel while uncertainty of the soil-water balance model and of the meteorological inputs play a lesser role. This can be explained by the fact that about 95% of the water in the Wairau aquifer originates from the Wairau River and land-surface recharge accounts only for a comparably low proportion of the water balance. However, the relative contribution of the water balance components is not static in time. The critical time from the water management point of view occurs in summer when river recharge and aquifer storage are at a low. Then, land-surface recharge is negligible too and the relative contribution from the uncertainty of irrigation abstraction is larger.

In our study, we analyzed and ranked critical information for the simulation of surface water – groundwater exchange flows in the Wairau Plain aquifer system. The results can be used as guidance for the experimental design and the analysis of other gravel-bed rivers.