Hydrology and Earth System Sciences
An Interactive Open Access Journal of the European Geosciences Union

Hydrol. Earth Syst. Sci., 13, 69-77, 2009
www.hydrol-earth-syst-sci.net/13/69/2009/

Influence of aquifer and streambed heterogeneity on the distribution of groundwater discharge

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Abstract. The spatial distribution of groundwater fluxes through a streambed can be highly variable, most often resulting from a heterogeneous distribution of aquifer and streambed permeabilities along the flow pathways. Using a groundwater flow and heat transport model, we defined four scenarios of aquifer and streambed permeability distributions to simulate and assess the impact of subsurface heterogeneity on the distribution of groundwater fluxes through the streambed: (a) a homogeneous low-*K* streambed within a heterogeneous aquifer; (b) a heterogeneous streambed within a homogeneous aquifer; (c) a well connected heterogeneous low-*K* streambed within a heterogeneous aquifer; and (d) a poorly connected heterogeneous low-*K* streambed within a heterogeneous aquifer. The simulation results were compared with a base case scenario, in which the streambed had the same properties as the aquifer, and with observed data. The results indicated that the aquifer has a stronger influence on the distribution of groundwater fluxes through the streambed than the streambed itself. However, a homogeneous low-*K* streambed, a case often implemented in regional-scale groundwater flow models, resulted in a strong homogenization of fluxes, which may have important implications for the estimation of peak mass flows. The flux distributions simulated with heterogeneous low-*K* streambeds were similar to the flux distributions of the base case scenario, despite the lower permeability. The representation of heterogeneous distributions of aquifer and streambed properties in the model has been proven to be beneficial for the accuracy of flow simulations.

Final Revised Paper (PDF, 1284 KB) Discussion Paper (HESSD)

Citation: Kalbus, E., Schmidt, C., Molson, J. W., Reinstorf, F., and Schirmer, M.: Influence of aquifer and streambed heterogeneity on the distribution of groundwater discharge, Hydrol. Earth Syst. Sci., 13, 69-77, 2009. Bibtex EndNote Reference Manager