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Estimation of Aquifer Lower Layer Hydraulic Conductivity Values Through Baseflow Hydrograph Rising Limb Analysis

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The estimation of catchment-averaged aquifer hydraulic conductivity values is usually performed through a base flow recession analysis. Relationships between the first time derivatives of the base flow and the base flow values themselves, derived for small and large values of time, are used for this purpose. However, in the derivation of the short time equations, an initially fully saturated aquifer without recharge with sudden drawdown is assumed, which occurs very rarely in reality. It is demonstrated that this approach leads to a non-negligible error in the parameter estimates. A new relationship is derived, valid for the rising limb of a base flow hydrograph, succeeding a long rainless period. Application of this equation leads to accurate estimates of the aquifer lower layer saturated hydraulic conductivity. Further, it has been shown analytically that, if base flow is modeled using the linearized Boussinesq equation, the base flow depends on the effective aquifer depth and the ratio of the saturated hydraulic conductivity to the drainable porosity, not on these three parameters separately. The results of the new short-time expression are consistent with this finding, as opposed to the use of a traditional base flow recession analysis. When base flow is modeled using the nonlinear Boussinesq equation, the new expression can be used, without a second equation for large values of time, to estimate the aquifer lower layer hydraulic conductivity. Overall, the results in this paper suggest that the new methodology outperforms a traditional recession analysis for the estimation of catchment-averaged aquifer hydraulic conductivities.