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Use of Modflow as an interpolation method

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Kriging is the most common method used for interpolations in groundwater applications. This geostatistical method is based on the assumption that the hydraulic conditions and properties of aquifers are random fields with known stochastic structure. This pure statistical approach, the ordinary Kriging method, has the disadvantage that it does not guarantee that the values of the interpolated hydraulic heads are consistent with the groundwater flow physics. This weakness is mitigated in the Universal Kriging (UK) method with the use of the so-called drifts. However the efficiency of the UK method still requires inspection in the vicinity of groundwater stresses (e.g. wells) or boundary conditions (no-flow boundary). In this study the use of MODFLOW for interpolation purposes is proposed as an alternative to the UK method. MODFLOW is simulating the aquifer without the requirement to represent accurately the aquifer water budget (the primary requirement in any normal operational application of MODFLOW). Instead, the MODFLOW parameters (conductivity, porosity) and stresses (recharge or release) are calibrated to minimize the residuals between the simulated and observed hydraulic heads. Consequently, the estimated parameters do not have a specific physical meaning but are rather considered as the parameters of the MODFLOW-driven interpolation. In the case study presented here, a hypothetical aquifer is used to produce synthetic observations. These observations are interpreted with the UK based model KT3D-H2O and with the proposed method. The results of the case study indicate that the proposed method is able to provide a better interpretation of the available data especially in the vicinity of areas where boundary conditions and stresses apply.