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# Estimating Parameters of Aquifer Heterogeneity from Transient Pumping Test

Alraune Zech (1), Sebastian Müller (1), Sabine Attinger (1,2)

(1) Helmholtz Centre for Environmental Research - UFZ, CHS, Leipzig, Germany (alraune.zech@ufz.de), (2) Institute for Geoscience, Friedrich Schiller University, Jena, Germany

We present a new method for interpreting drawdowns of transient pumping tests in heterogeneous porous media. The vast majority of natural aquifers are characterized by heterogeneity, which can be statistically represented by parameters such as geometric mean $\bar{K}$, variance $\sigma^2$, and correlation length $\ell$ of hydraulic conductivity. Our method can be understood as extension of the effective well flow method [Zech et al., 2012] from steady state to transient pumping tests. It allows a direct parameter estimation of $\bar{K}$, $\sigma^2$, $\ell$ from head measurements under well flow conditions.

The method is based on a representative description of hydraulic conductivity for radial flow regimes $K_{\mathrm{CG}}$. It was derived previously using the upscaling procedure *Radial Coarse Graining* in combination with log-normal hydraulic conductivity. A semi-analytical solution for the mean drawdown of transient pumping tests was derived by combining the upscaled solution for the radially adapted hydraulic conductivity $K_{\mathrm{CG}}$ and the groundwater flow equation under well flow conditions. The dependency of the drawdown solution on the statistical quantities of the porous medium allows us to inversely estimate $\bar{K}$, $\sigma^2$, $\ell$ from pumping test data.

We used an ensemble of transient pumping test simulations to verify the drawdown solution. We generated pumping tests in heterogeneous media for various values of the statistical parameters $\bar{K}$, $\sigma^2$, $\ell$ and evaluated their impact on the drawdown behavior as well as on the temporal evolution. We further examined the impact of several aspects like the location of an observation well or the local conductivity at the pumping well on the drawdown behavior.

Zech, A., C. L. Schneider, and S. Attinger, 2012, The Extended Thiem's solution: Including the impact of heterogeneity, Water Resour. Res., 48, W10535, doi:10.1029/2012WR011852.