Geophysical Research Abstracts, Vol. 9, 05490, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05490

Geostatistical characterization of a fluvial unconfined aquifer based on pumping test data from four wells

M. Riva (1), S. P. Neuman (2), A. Guadagnini (1), T. Ptak (3)

(1) Politecnico di Milano, Dipartimento di Ingegneria Idraulica Ambientale e del Rilevamento, Milano, Italy, (2) University of Arizona, Department of Hydrology and Water Resources, Tucson, Arizona, USA, (3) University of Göttingen, Geosciences Center, Göttingen, Germany (monica.riva@polimi.it, tel.: +39-02-2399-6214, Fax: +39-02-2399-6298).

The interpretation of pumping tests has traditionally been based on analytical solutions of groundwater flow equations in relatively simple domains, consisting of one or at most a few units having uniform hydraulic properties. A more recent development has been the use of geostatistical inversion to assess the spatial variability of medium properties on the basis of multiple cross-hole pressure interference tests. The approach yields detailed "tomographic" estimates of how these properties vary in three-dimensional space, as well as measures of corresponding estimation uncertainty [e.g. *Vesselinov et al.*, 2001]. However, tomography is experimentally demanding and computationally intensive. *Neuman et al.* [2004] proposed a simple graphical method to estimate the mean, integral scale and variance of (natural) log transmissivity on the basis of quasisteady state head data when a randomly heterogeneous confined aquifer is pumped at a constant rate from a fully penetrating well. They conjectured that a quasisteady state, during which heads vary in space-time while gradients vary only in space, develops in a statistically homogeneous and horizontally isotropic aquifer as it does in a uniform aquifer. Their conjecture has been confirmed numerically by *Blattstein et al.* [2007] who show that whereas random time-drawdowns are difficult to interpret graphically, quasisteady state distance-drawdown data are amenable to such interpretation by the type-curve method of *Neuman et al.* [2004]. We describe a component of the same study in which we use the latter method to characterize geostatistically an unconfined fluvial aquifer at the Lauswiesen site in the Neckar River valley near Tübingen, Germany. The aquifer consists of sandy gravel overlain by stiff silty clay and underlain by hard silty clay. We analyze simultaneously late transient (quasisteady state) drawdown data from five consecutive tests performed by pumping each well at a constant rate while treating the other four as observation wells. Upon comparing our results with 312 flow meter measurements of hydraulic conductivity in these and several additional wells across the site we find that (a) four wells are sufficient to provide reasonable estimates of lead log transmissivity statistics for the Tübingen site by the graphical method of *Neuman et al.* [2004]; (b) the time-drawdown method of *Cooper and Jacob* [1946] underestimates the geometric mean transmissivity at the site by 30 – 40 %; (c) the graphical method yields an estimate of the integral scale of natural log transmissivity approximately equal to one tenth the maximum distance between the test wells, consistent with an observation [*Gelhar*, 1993; *Neuman*, 1994] that the apparent spatial correlation scales of natural log hydraulic conductivities and transmissivities tend to be 1/10 of the characteristic length of their sampling window as the latter ranges between 1 m and 450 km; and (d) the method yields an estimate of 1.5 for the variance of natural log transmissivity, very close to that (1.4) estimated on the basis of flowmeter tests.