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Determination of the hydraulic conductivity using direct-push methods

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Direct-Push (DP) technology is a promising investigation tool in evaluating the hydraulic conductivity (k) of shallow unconsolidated aquifers. DP is fast and cost effective method for the evaluation of the hydraulic conductivity with a high resolution in the vertical scale, however suffering from lack of information in the lateral direction. Various hydraulic methods (e.g. flowmeter, sieve analysis, permeameter and pumping tests) were performed at the Lauswiesen test site near Tübingen (South-West Germany). In addition to the existing large diameter wells, nine small diameter wells were installed using the DP technology, in where three different DP tests were performed: (1) DP electric conductivity (DPEC), (2) DP injection logging (DPIL), (3) DP slug test (DPST). The DPEC provided information on the vertical distribution of the electric conductivity (EC) in the unsaturated and saturated zone. DPIL profiles provided information on the relative hydraulic conductivity (kr) in the saturated zone indicating two aquifer zones, an upper homogeneous and a lower heterogeneous zone. Based on the results of the DPIL, eleven data points were chosen at which DP slug tests (DPST) were performed. The comparison between the DPIL and DPST resulted in a good correlation. Using the obtained correlation the relative hydraulic conductivity could be transferred to absolute k-values. Further, these values based on the DPIL method were correlated with k-values of conventional methods, i.e. pumping tests, at near by locations. A good correlation between the sieve analysis using Beyer (1964) and the DPIL could be obtained. The outcome of the various methods showed that the DPST results in the lowest k-values. The best estimate for the hydraulic conductivity using the DPIL was based on the correlation with the sieve analysis. In general, the DP injection logging (DPIL) proved to be a robust and fast investigation technique providing detailed vertical profiles on hydraulic conductivities.