Geophysical Research Abstracts
Vol. 14, EGU2012-5245, 2012
EGU General Assembly 2012

Contaminant Detection in Heterogeneous Aquifers: Sampling Frequency and Number of Monitoring Wells

E. Paleologos and K. Papapetridis
Technical Univ. of Crete, Environmental Engineering, Chania, Greece (evan.paleologos@enveng.tuc.gr)

A Monte Carlo stochastic model was developed to simulate contaminant transport from an instantaneous source into a heterogeneous, two-dimensional aquifer in order to evaluate the effectiveness of contaminant detection by a network of monitoring wells. Successful detection is influenced by many uncertainty factors, where the heterogeneity of the geologic environment and inherent contamination dispersion into the geologic medium are the most important. Additional uncertainty arises from the lack of information about the quantity and nature of the contaminants, the time of leakage, the number and location of the contamination sources and monitoring wells, as well as the frequency of sampling. The heterogeneity of the geologic environment was addressed through the hydraulic conductivity, which was simulated as a log-normal, stationary, second order, isotropic stochastic process. The second source of uncertainty arises from the way a pollutant is transported into the subsurface heterogeneous environment. The particle tracking method based on the 'random walk' approach was adopted to simulate a plume's advective and dispersive movement. In this study a conservative and fully water soluble contaminant was assumed, considering different cases of initially released quantities, single or dual random sources inside landfill's boundaries and different facility's dimensions. Several numerical experiments were conducted in order to determine the detection probabilities Pd achieved by monitoring networks, to evaluate the effectiveness of various sampling frequencies and to calculate the contaminated groundwater areas. It was shown that detection decreases as heterogeneity increases. Monitoring with 20 wells provides high detection, while 3 wells result in four out of five contamination cases to remain undetected. For fixed heterogeneity, for each well arrangement, Pd increases up to a certain value with increasing transverse dispersion coefficient and then it decreases. The frequency of sampling is critical in heterogeneous aquifers with bi-annual or monthly sampling improving Pd by 40%, and 70%, respectively, relative to that by annual sampling. It appears that at a minimum sampling should take place twice a year, with the once- in-a-month sampling appearing the optimum choice considering the effort involved and the improvements in detection. In heterogeneous aquifers a large number of monitoring wells sampled infrequently does not perform any better in terms of detection than a lower number of wells sampled regularly.