應用 VSAFT2 逆推含水層水力傳導係數之敏感度分析

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摘要

地下水污染與整治的課題在近幾十年來受到重視，而精確又有效率的整治政策需要仰賴對場址地下異質性之了解，透過水力剖面探測(Hydraulic tomography surveys)和其相關之逆推模式可以有效率地推估場址異質性之特徵。VSAFT2 模式可以藉由抽水試驗而得到水位變化，反推估二維含水層水力傳導係數(Hydraulic conductivity, K)。本研究使用 VSAFT2 模式，測試重要參數敏感性分析，如水力傳導係數之相關長度(Correlation length)、變異數(Variance)及隨機分布係數(Random seed)等參數，並計算水力傳導係數反推估結果的平均絕對誤差(Mean absolute error)和均方根誤差(Root-mean-square error, RMSE)。結果顯示(1)平均絕對誤差與均方根誤差具有相似趨勢；(2)當相關長度越大，推估誤差較小；(3)變異數較小時，隨機場 K 值分佈較集中於平均數，因此推估誤差也較小；(4)變異數較大時，對於較低 K 值區域具有較好反推估結果。未來預計要探討觀測井之密度、抽水事件多寡、在逆推過程中固定既有井之 K 值與否、利用既有井之K值重新計算逆推之平均K值、使用正規化均方根誤差計算(Normalized RMSE)等等以完善敏感度分析，這些資訊可以做為含水層參數推估以及整治工作場址設置之參考。

Sensitivity analysis of VSAFT2 apply on aquifer hydraulic conductivity inverse estimation

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Abstract

The issue of remediation of groundwater contamination is getting more and more crucial in recent decades. Accurate and efficient remediation strategies are highly rely on the understanding of hydrogeological conditions at sites. The hydraulic tomography surveys (HTS) and the associated inverse model have been recognized to be efficient techniques for high-resolution site characterization. VSAFT2 can estimate 2-D distribution of hydraulic conductivity by the variation of water level from pumping tests. In this study, the sensitivity analysis of parameter estimation is conducted by VSAFT2. We alter different parameters, such as correlation length, variance and random seed of hydraulic conductivity, calculate the mean absolute errors and root mean square errors (RMSE), to examine the sensitivity of different parameters. Results show that the mean absolute errors and the root mean square errors have the same trend; the larger the correlation length, the less the errors; the less the variance ln(K), the less the errors; the larger the variance ln(K), the better the estimate results in the low K zone. In the future, we intend to investigate different scenario of the cases, such as the density of observation well; the number of stress events; using hard data or not; changing the mean K value which calculated from hard data; changing the errors into the normalized root mean square errors (NRMSE) to strengthen the sensitivity analysis. This information is useful for improving estimation of aquifer hydraulic parameters and the efficiency of remediation designs.