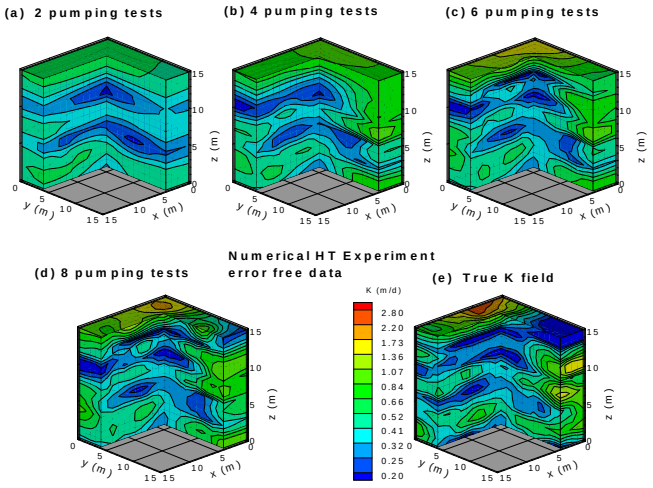
Efficient Software for Computing Correlated K-S_S Tomographs

Reliable prediction of how water resources and dissolved constituents move in subsurface requires accurate depiction of the spatial distribution of the hydraulic conductivity K and the specific storage S_s. However, subsurface is highly heterogeneous and uncertain. Recently, a technique was developed by Yeh and Liu (2000) to estimate the spatial distributions of K and S_s (tomographs/images) by applying hydraulic stresses at various locations sequentially and observing the hydraulic responses at other measurement locations. They developed a software to estimate the K and S_s values for each subsurface pixel of the tomographs, ignoring their possible correlation.



(from Prof. Yeh at University of Arizona)

Funded by the U.S. Department of Defense, a field experiment will be conducted at a pilot-scale site at the University of Waterloo and the data will be available in May 2013.

In this software lab project, the students will:

(1) develop a simple program to compute the hydraulic responses h to hydraulic stresses q by using linear finite elements to solve $\nabla \cdot (K \nabla h) + S_s \dot{h} = q$

(2) implement the adjoint sensitivity method to efficiently compute the first-derivatives of h with respect to K and S_s at each pixel;

(3) test the significance of incorporating K-S_s correlation in the parameter estimation.

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References

[1] Yeh, T.-C. J. and S. Liu (2000), Hydraulic tomography: Development of a new aquifer test method, Water Resources Research 38(8): 2095-2106