

Subsurface flow with uncertainty : applications and numerical analysis issues

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In this talk we first quickly present a classical and simple model used to describe flow in porous media (based on Darcy's Law). The high heterogeneity of the media and the lack of data are taken into account by the use of random permeability fields. We then present some mathematical particularities of the random fields frequently used for such applications and the corresponding theoretical and numerical issues. After giving a short overview of various applications of this basic model, we study in more detail the problem of the contamination of an aquifer by migration of pollutants. We present a numerical method to compute the mean spreading of a diffusive set of particles representing a tracer plume in an advecting flow field. We deal with the uncertainty thanks to a Monte Carlo method and use a stochastic particle method to approximate the solution of the transport-diffusion equation. Error estimates will be established and numerical results (obtained by A.Beaudoin et al. using PARADIS Software) will be presented. In particular the influence of the molecular diffusion and the heterogeneity on the asymptotic longitudinal macrodispersion will be investigated thanks to numerical experiments. Studying qualitatively and quantitatively the influence of molecular diffusion, correlation length and standard deviation is an important question in hydrogeology.