Séminaire UMR Sysiphe :

Lundi 13 septembre, de 13h à 14 h :

Lieu : Université Paris VI, 4 place Jussieu, Paris 5°, métro Jussieu
Tour 56, 3° étage, couloir 56-46, salle "Darcy"

MODELING FLOW AND TRANSPORT THROUGH HIGHLY HETEROGENEOUS FORMATIONS: CONCEPTUAL ASPECTS

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The widely used analytical models of flow and transport through aquifers of spatially variable conductivity are based on a first-order approximation in σ^2_Y, the variance of the log-conductivity $Y = \ln K$. With Y modelled as random, a few flow (effective conductivity, head and velocity covariances) and transport (macrodispersivity) statistical moments depend on the mean and two-point covariance of Y only. Thus, the structure is essentially characterized by three parameters: K_G (the geometric mean), σ^2_Y and I_Y (integral scale, with two different values for horizontal and vertical directions for anisotropic aquifers).

Numerical modelling requires the knowledge of the entire statistical structure of Y and the traditional approach is to regard it as multi-Gaussian, i.e. the vector of Y values at different points is a multivariate normal vector. Comparison with first-order results showed that the latter are quite robust and apply to σ^2_Y as large as unity.

Recently, there is considerable interest in the behaviour of highly heterogeneous formations, of σ^2_Y values larger than unity. A few numerical studies were conducted primarily for 2D (two-dimensional) configurations. The multi-Gaussian model was questioned and alternative ones were considered. A brief review is presented, with emphasis on the multi-indicator model developed recently by the author in collaboration with A. Fiori and I. Janković.

The main aim of the presentation is to discuss a few conceptual problems arising in modelling of flow and transport in highly heterogeneous aquifers such as: the non-uniqueness of structure models in view of the scarcity of field data and criteria of selection of models; 2D versus 3D models; effective conductivity, stationarity and ergodicity requirements; macrodispersivity, its meaningfulness; robustness of first-order approximation and conditioning on data.