



Methods for estimating the minimum hydraulic resistance and first arrival time in heterogeneous porous media: a comparative analysis using Multi-Indicator Models (MIM)

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Transport properties of a solute plume are affected by the physical characteristics of the heterogeneous porous media in which the plume is flowing. We analyze the relation between first arrival time of a solute plume, and the minimum hydraulic resistance and least resistance path (Rizzo & de Barros, WRR, 2018), which are both static measures (i.e. based only on the hydraulic conductivity field). A Multi-Indicator Model (MIM) is used to depict the hydraulic conductivity field (Cvetkovic, Fiori, Dagan, WRR, 2014), allowing a semi-analytical treatment for the minimum hydraulic resistance and first arrival time PDFs. We use two methods to compute the minimum hydraulic resistance PDF in a MIM framework: a "greedy" approach, leading to a fully analytical solution, and an "exhaustive" approach, leading to a more complex semi-analytical solution suited for highly heterogeneous fields. The analysis carried out in this work allow us to establish a link between the first time arrival (dynamic quantity) and the minimum hydraulic resistance (static quantity).