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Probabilistic assessment of the least resistance path in heterogeneous porous media via graph theory

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High hydraulic conductivity (K) channels arising in heterogeneous aquifers strongly affect contaminant transport. Several studies have established correlation between connectivity properties of the K-field and the contaminant early time arrival. Therefore, a solid probabilistic assessment of the hydraulic connectivity is needed to estimate and predict the risk of early arrival times in environmentally sensitive locations. In this work, we utilize the concept of minimum hydraulic resistance and least resistance path to evaluate the connectivity of a K-field in a stochastic manner. We employ a fast graph-theory based algorithm to alleviate the computational burden associated with stochastic computations. The spatial probability distribution of the least resistance path is analyzed under different conditions and for different hydrogeological fields, providing indications on the stability of the method.