A fast and robust approach for simulating the pressure diffusion in three-dimensional discrete fracture networks applied to inversion problems

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This study is aimed at the characterization of discrete fracture networks (DFN) by a transdimensional inversion methodology. It has been demonstrated that the reversible-jump Markov chain Monte Carlo (rjMCMC) is suitable for the inversion of two-dimensional (2D) DFNs. Based on given statistical information and measured data, the algorithm identifies the main characteristics of a DFN correctly.

For this reason, the method will be extended to the inversion of three-dimensional (3D) DFNs which allows more realistic examples. Two main difficulties arise here. First, further constraints have to be defined to limit the number of unknowns due to the high dimensionality of the inversion problem. Second, the forward modelling is a restricting factor concerning the computational costs and the robustness of the iteration. The assumptions made to simplify the governing fluid equations are to be evaluated and the resulting limitations are presented, e.g. small Reynolds number, smooth fracture walls, impermeable rock matrix. Moreover, the errors caused by the numerical solution of the partial differential equation are estimated to verify the correctness of the implementation.