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A 2D numerical study on the effects of conceptualization and parametrization of dual permeability modelling of fractured clays.

Juan Pablo Aguilar-López, Thom Bogaard, and Mark Bakker

Water Resources - Dept. Hydrology, Delft University of Technology, Delft, Netherlands (j.p.aguilarlopez@tudelft.nl)

Dual permeability models are often used for simulating preferential flows on structured soils. Their conceptualization is based on the assumption that the whole porous media system may be represented by two different but connected subsystems; the matric and the preferential flow system. While, the latter subsystem is often used to represent 'hollow' heterogeneities such as root holes, cracks and earthworms rather they are still parametrized as porous mediums. Furthermore, soil water retention functions are used to characterize 'hollow' flow paths where capillary effects may even be negligible. Hence, the present study aims to better understand the implications of parametrizing the 'hollow' preferential flow domain as a porous material in a dual permeability model. Soil systems like fractured clays are a clear example for which matric and preferential flow domains may be clearly distinguished. Therefore, two finite element models of a fractured clay block were built: one solved as a single permeability solution including fractures as explicit domains and a second finite element model representing the same system but solved as a dual permeability solution in which fractures are not explicitly schematized in the numerical mesh but rather as percentage of the overall system. A transient Dirichlet boundary condition was applied to both models until full saturation was achieved. The infiltration rates, pore water pressure and water content distribution and exchange fluxes of both models were compared for different parametrization approaches. The results show that, a physically feasible parametrization choice of the system may result in unrealistic estimations of the pore water pressure distribution, crack saturation and mass exchange fluxes.