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Estimation of simulation parameters for steady and transient 3D flow modeling at watershed scale

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Unsaturated water flows at watershed scale or Darcy-scale are generally described by the Richardson-Richards equation. This equation is highly non-linear and simulation domains are limited by computational costs. The porousMultiphaseFoam toolbox is a Finite Volume tool capable of modeling multiphase flows in porous media, including the solving of the Richardson-Richards equation. As it has been developed using the OpenFOAM environment, the software is natively fully parallelized and can be used on super computers. By using experimental data from real site with geographical informations and piezometrics values, an iterative algorithm is set up to solve an inverse problem in order to evaluate an adequate permeability field. This procedure is initially implemented using simplified aquifer model with a 2D saturated modeling approach. A similar procedure using a full 3D model of the actual site is performed (handling both saturated and unsaturated area). The results are compared between the two approaches (2D and 3D) for steady simulations and new post-processing tools are also introduced to spatialize the error between the two models and define the areas for which the behaviour of the models is different. In a second part, an optimization of the Van Genuchten parameters is performed to reproduce transient experimental data. The 3D numerical results at the watershed scale are also compared to the reference simulations using a 1D unsaturated + 2D satured modeling approach.