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Darcy multi-domain approach for coupling surface-subsurface flows: application to heterogeneous configurations

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A fully integrated coupling between surface and subsurface flows has been implemented during these last years (Weill et al., J. Hydrol. 2009). This model unifies the Richards and the diffusive wave equations into a single generalized Richards equation defined in a single domain composed of surface and subsurface subdomains. The unified equation is solved with a Picard iterative scheme in the Cast3M numerical framework (www-cast3m.cea.fr). This model has been applied successfully to 2D configurations (Abdul and Gilham, Water Resour. Res. 1984; Ogden and Watts, Water Resour. Res. 2000). It also allowed us to simulate several theoretical benchmark test cases involving the runoff production by excess saturation or by excess infiltration, and the runon-runoff processes on a heterogeneous soil (Kollet and Maxwell, Adv. Water Resour. 2006; Sulis et al., Adv. Water Resour. 2010). However, the model must still be improved to simulate 3D configurations (Govindaraju and Kavvas, Water Resour. Res. 1991; Panday and Huyakorn, Adv. Water Resour. 2004). We will show the developments performed to simulate such configurations.