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A DOMAIN DECOMPOSITION MULTISCALE MIXED METHOD FOR FLOW IN POROUS MEDIA BASED ON ROBIN BOUNDARY CONDITIONS

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Abstract. In this work we propose a domain decomposition method based on Robin type boundary conditions that is suitable to solve the porous media equations on very large reservoirs. In order to reduce the algebraic systems to be solved to affordable sizes, a multiscale formulation is considered in which the coupling variables between subdomains, namely, pressures and normal fluxes, are seek in low dimensional spaces on the skeleton of the decomposition, while considering the permeability heterogeneities in the original fine grid for the local problems. In the new formulation, a non-dimensional parameter in the Robin condition is introduced such that we may transit smoothly from two well known formulations, namely, the Multiscale Mortar Mixed and the Multiscale Hybrid Mixed finite element methods. In the proposed formulation the interface spaces for pressure and fluxes can be selected independently. This has the potential to produce more accurate results by better accommodating local features of the exact solution near subdomain boundaries. Several numerical examples which exhibit highly heterogeneous permeability fields and channelized regions are solved with the new formulation and results compared to the aforementioned multiscale methods.