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SOME VELOCITY DOWNSCALING SCHEMES FOR THE MULTISCALE ROBIN COUPLED METHOD

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Abstract. Multiscale domain decomposition methods for the simulation of multiphase flows in porous media, aiming at high performance and scalability, has been the focus of intensive research motivated by the practical needs of the energy and environmental sectors. The main idea is to decompose the computational domain into non-overlapping subdomains in which local small problems are solved. In order to recover a global solution, continuity of flux and pressure need to be fulfilled at the interface between subdomains. These compatibility conditions are usually relaxed and enforced weakly through low-dimensional spaces, reducing the number of unknowns to be solved turning it to a relatively inexpensive task. Examples of such methods are the Multiscale Mortar Mixed Finite Element Method (Arbogast et al, SIAM Multiscale Model., 2007) and the Multiscale Robin Coupled Method (Guiraldello et al, J. Comput. Phys., 2018). The drawback associated with such methods is a discrepancy in continuity (of pressure or normal fluxes, or both) at fine scales. As the flow solution is usually coupled to a transport problem, velocity postprocessing procedures are thus needed to recover local conservation at the fine grid level. We have proposed two velocity postprocessing procedures based on minimum overlapping regions. We investigate the applicability of these procedures when tested on contaminant transport problems using several multiscale methods and compare them in terms of accuracy to a standard technique. Results indicate that the proposed methods have the potential to produce more accurate results with similar or reduced computational cost.