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Fully tensorial 3D upscaling of hydraulic conductivities

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No matter how powerful computer codes become, there will always be a discrepancy between the scale at which we can characterize the medium and the scale at which we will run our numerical models. This discrepancy calls for an upscaling technique that is capable of accounting for the fully tensorial nature of the upscaled conductivity. We propose a 3D upscaling algorithm that is coupled with a 3D finite-difference numerical model that accurately reproduces average hydraulic heads and average flows within the upscaled flows. The key factor is to focus in upscaling the block values at the interfaces of the blocks in the upscaled models.

The algorithm is demonstrated in three synthetic experiments, they differ in the patterns of heterogeneity, the first one is isotropic, the second one is anisotropic, and the third one is layered. In all cases the proposed algorithm works well.