

Tools to Study Emergent Phenomena

Scientific Achievement

New mathematical techniques to couple pore networks using mortars were used to investigate behavior that occur at multiple lengths scales in subsurface applications. Approach applied to species transport in both advection & dispersion dominated domains.

Significance and Impact

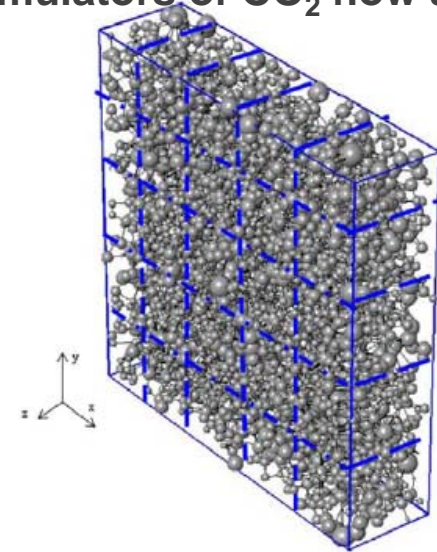
Models can quickly and accurately upscale transverse dispersion coefficients in porous media, which can be directly substituted into macroscopic simulators of CO₂ flow and transport and observe emergent phenomena.

Publications

- Balhoff, M., D. Sanchez-Rivera, A. Kwok, Y. Mehmani, and M. Prodanovic (2012), Numerical Algorithms for Network Modeling of Yield Stress and other Non-Newtonian Fluids in Porous Media, *Transport in Porous Media*, 93(3), 363-379.
- Mehmani, Y., T. Sun, M. T. Balhoff, P. Eichhubl, and S. Bryant (2012), Multiblock Pore-Scale Modeling and Upscaling of Reactive Transport: Application to Carbon Sequestration, *Transport in Porous Media*, 95(2), 305-326.
- Petersen, R. T., M. T. Balhoff, and S. Bryant (2011), Coupling Multiphase Pore-Scale Models to account for Boundary Conditions: Application to 2D Quasi-Static Pore Networks, *Journal of Multiscale Modeling*, 3(3), 109-131.
- Sun, T., Y. Mehmani, and M. T. Balhoff (2012), Hybrid Multiscale Modeling through Direct Substitution of Pore-Scale Models into Near-Well Reservoir Simulators, *Energy & Fuels*, 26(9), 5828-5836.
- Sun, T., Y. Mehmani, J. Bhagmane, and M. T. Balhoff (2012), Pore to continuum upscaling of permeability in heterogeneous porous media using mortars, *International Journal of Oil, Gas, and Coal Technology*, 5(2/3), 249 - 266.

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Schematic of a network model. The lines are imaginary boundaries where probability distribution constants change. Networks with $\sim 10^6$ pores have been used, but the network shown is smaller for illustration purposes.



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