Intercomparison of 3D Pore-Scale Modeling Methods

Objective

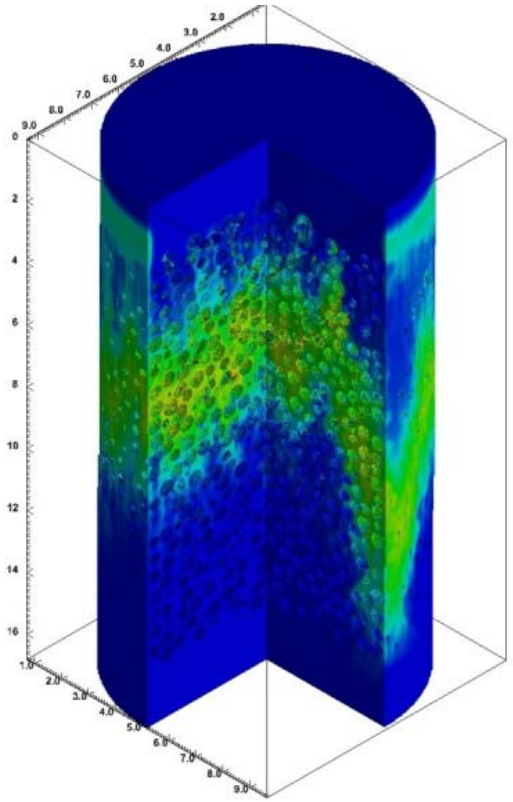
- Compare performance of four major types of pore-scale single-phase flow and solute transport models using a benchmark problem previously validated against experimental observations.

Approach/Results

- Yang et al. (2013) previously validated a Computational Fluid Dynamics (CFD) simulation of pore-scale flow in a 3D bead pack against Magnetic Resonance Velocimetry measurements.
- We compared the validated CFD results against new results from three other major pore-scale modeling methods (Lattice Boltzmann, Smoothed Particle Hydrodynamics, and Pore Network Model).
- Results from all four models compared favorably overall although some specific differences were observed.

Significance and Impact

- Simulation of flow and transport at the pore scale is mechanistically-based and provides high-fidelity information not available from conventional continuum-scale models.
- Increased confidence in pore-scale models, and better understanding of the characteristics of different methods, provides a solid foundation for their broader application.
- The results provide objective input to the model selection process.
- This paper will be part of a special issue on “Pore-Scale Modeling and Experiments”.



Visualization of simulated tracer transport in the 3D bead pack. Yellow and green colors indicate high tracer concentrations.

Yang, X., Y. Mehmani, W. A. Perkins, A. Pasquali, M. Schoenherr, K. Kim, M. Perego, M. L. Parks, N. Trask, M. T. Balhoff, M. C. Richmond, M. Geier, M. Krafczyk, L.-S. Luo, A. M. Tartakovsky, and T. D. Scheibe (2015) Intercomparison of 3D pore-scale flow and solute transport simulation methods *Advances in Water Resources*, accepted, DOI: 10.1016/j.advwatres.2015.09.015.