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Numerical simulation of micro-scale flow and colloid transport near air-water interface in unsaturated porous media[1] GRACE SHI, VOLHA LAZOUSKAYA, YAN JIN, LIAN-PING WANG, U. Delaware — This work is motivated by the need to understand colloid-facilitated transport of contaminants in unsaturated soil porous media. Unsaturated soil is characterized by the presence of moving air-water interface within micro-scale flow passage of soil porous media. Previous experimental observations using confocal microscopy reveal the importance of air-water interface and contact line on the retention of colloids. Here we develop a computational approach to model the transport and retention of colloids near the interfacial region. First, we simulate the microscale flow field near the interfacial region by simultaneously employing a mesoscopic lattice Boltzmann equation approach and a macroscopic volume-of-fluid approach. We will examine how the flow field changes with capillary number, Reynolds number, density ratio, and viscosity ratio. Numerical issues such as stability and spurious currents for interfacial flow simulation will be discussed. We then track the motion of colloids by solving colloids equation of motion including hydrodynamic forces and physicochemical forces, to study the trajectories of colloids and the likely retention sites. Numerical results will be compared with parallel visualization experiments.

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