Flow and transport are the two main mechanisms in subsurface flow. Due to the very high resolution involved, direct numerical simulation of subsurface flow is usually not feasible. Therefore upscaling procedures are often applied to coarsen the highly detailed models to scales that are suitable for flow simulation.

In this talk, I will discuss a local-global two-phase upscaling method for flow and transport in heterogeneous reservoirs. The upscaling of two-phase flow parameters is challenging, due to their strong dependency on global flow effects. The local-global two-phase upscaling directly incorporates global coarse-scale two-phase solutions into local two-phase upscaling calculations. It effectively captures the impact of global flow, while avoiding global two-phase fine-scale simulations. The local boundary conditions are updated with time-dependent coarse-scale solutions. It therefore captures the global flow effects both spatially and temporally. The method is applied to permeability distributions with various correlation lengths and for different fluid-mobility ratios. Numerical results show that it consistently improves upon existing two-phase upscaling methods and provides accurate coarse-scale solutions for both flow and transport. (Received September 16, 2010)