

Crossing the Scales and Coupling Multiple Physics for Subsurface Flow Simulation

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Understanding subsurface flow dynamics is essential for sustainable development of subsurface energy and environmental resources, such as hydrocarbon recovery, CO₂ sequestration and groundwater management. The multiscale heterogeneities of subsurface porous media continue to challenge the quantitative subsurface characterization, modeling and management toward optimizing development. In addition, the coupled multiple physical and chemical processes in fluid flow further exacerbate such as challenge.

In in this talk, I briefly showcase a number of ongoing research activities under the umbrella of crossing the scales and coupling multiple physics for subsurface flow simulation. Our solution strategies are centered on the idea of coupling multi-continuum model and multiscale approaches that could allow us to circumvent the limitations of typical idealized heterogeneity assumptions and will help us transition between scales. In particular, one can couple multi-continuum and multiscale modeling in a seamless way and take advantage of rigorous multiscale methods, having a potential to lead some breakthrough in subsurface flow simulation. I will also mention the extension of such approach for reactive transport in heterogeneous porous media.

Our research will have an impact in many disciplines related to studying subsurface flow dynamics, particularly for reservoir characterization, simulation and development optimization. We aim to discover approaches that allow performing accurate and affordable predictions for complex physical and chemical processes in subsurface by incorporating key information from small scales to larger scales and leveraging dynamic data.