Modeling of multiphase flow with a multiphysics framework on adaptive grids.

B. Faigle[1], R. Helmig[1], B. Flemisch[1] and I.Aavatsmark[2]

[1]*Dept. of Hydromechanics and Modelling of Hydrosystems, University of Stuttgart, Stuttgart, Germany*

[2]*Dept. of Mathematics / CIPR, University of Bergen, Bergen, Norway*

ABSTRACT:

Many environmental applications of multiphase flow in porous media, such as subsurface CO2 sequestration or remediation of hazardous spills in the groundwater, require a very large simulation domain and occur on large timescales. In most cases, however, complex flow regimes only occur on small sub-domains of the whole domain of interest. Inside these sub-domains, the quality of simulations benefit from highly resolved grids as well as from an in-depth description of the physics involved. Outside, in contrast, the grid could still remain coarse and the relevant processes can be captured with a simpler physical model.

The multi-physics concept presented here adapts the physical complexity of the numerical model locally according to the underlying physical processes. In addition, an adaptive and local h-refinement of the underlying grid is applied in areas of special interest. In the case of locally refined regular grids, the fluxes near evolving “hanging nodes” demand careful treatment. In this work, this task is met with a Multi-Point Flux-Approximation.