

“Porous Media and Free-Flow Coupling - From REV to Pore Scale and Back”

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Abstract:

Flow and transport at the interfaces between porous media and free-flow regions, are central to many industrial, biomedical, and environmental systems—from fuel cells and vascular flow to soil evaporation and groundwater contamination. A key challenge is that system-scale behavior is governed by interface processes occurring at pore scales, which are often unresolved in conventional models. This lecture introduces new conceptual frameworks that bridge pore-scale and representative elementary volume (REV) models, evaluates their advantages and limitations relative to classical approaches, and demonstrates their application to soil evaporation, salinization, and related environmental and industrial processes.

Short bio:

Professor Rainer Helmig is the head of the Department of Hydromechanics and Modeling of Hydrosystems at the University of Stuttgart, Germany. Rainer is widely recognized as a pioneer and visionary in developing numerical modeling concepts in the fields of groundwater hydrology, subsurface energy storage, and coupled processes at the interface between porous media and free-flow compartments. His research has shaped both the theory and practice of multiphase flow and transport across scales, with broad applications in environmental, industrial, and energy systems.

Rainer has received numerous prestigious honors including Darcy Distinguished Lecturer, AGU Fellow, InterPore Lifetime Achievement Medal, Society for Industrial and Applied Mathematics (SIAM) Geosciences Career Prize, and elected member of the German Academy of Science and Engineering.

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