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Coupling strategies for free flow with porous media -from single to two phase flow-

Thursday, 3 June 2021 10:00 (15 minutes)

Exchange processes across a porous-medium free-flow interface occur in a wide range of environmental, technical and bio-mechanical systems. In the course of these processes, flow dynamics in the porous domain and in the free-flow domain exhibit strong coupling, often controlled by mechanisms at the common interfaces. Therefore, understanding the underlying processes is decisive. An example of such an environmental problem is soil-water evaporation. The challenge is how we can include scale-dependent, interface-driven processes into mathematical and numerical models for systems of coupled free flow and porous-medium flow.

Based on the excellent work of Andro Mikelic and his co-workers we will discuss the influence of different interfaces for modelling of the coupled systems. In this study, the existing coupling concept is first extended to turbulent free-flow conditions. This includes the interface conditions between a Reynolds-averaged Navier–Stokes free flow using k-omega SST model and a Darcy porous-medium flow. A sensitivity analysis of the evaporation rate and porous-medium quantities on different model setups, boundary conditions, Beavers–Joseph coefficients will be performed. Results demonstrate how turbulence affects the evaporation rate.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

M. Schneider, K. Weishaupt, D. Gläser, W. M. Boon, and R. Helmig. Coupling staggered-grid andmpfa finite volume methods for free flow/porous-medium flow problems.J. Comput. Phys., 401, 2019.
E. Coltman, M. Lipp, A. Vescovini, and R. Helmig. Obstacles, interfacial forms, and turbulence: Anumerical analysis of soil–water evaporation across different interfaces.Transport in Porous Media,134(2):275–301, 2020.

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Primary authors: HELMIG, Rainer (University of Stuttgart); Mr COLTMAN, Edward (Ned) (University of Stuttgart); SCHNEIDER, Martin (University of Stuttgart); LIPP, Melanie

Presenter: HELMIG, Rainer (University of Stuttgart)

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Track Classification: (MS24 - Invitation Only) Mathematical and computational challenges related to porous media - Special session in memory of Andro Mikelic