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Modeling evaporation from porous media influenced by atmospheric processes

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Modeling evaporation processes from partially saturated soils into the ambient air is a challenging task. It involves usually a variety of interacting processes and depends on the multitude of properties of the fluids and of the porous medium. Often, the ambient free-flow and the porous-medium compartments are modeled separately with a specification of the evaporation rate as boundary condition.

We have developed a coupling concept, which allows the combined modeling of a free-flow and a porous-medium system under non-isothermal conditions with the evaporative fluxes across the soil-atmosphere interface as model output. It is based on flux continuity and local thermodynamic equilibrium at the interface.

Darcy's law for multiple phases is used in the porous medium, whereas the ambient air flow is modeled as a compositional single-phase Stokes system. The concept has been implemented in the numerical simulator DuMux. A comparison of simulated and measured data from wind tunnel experiments performed in the group of D. Or (ETH Zürich) will be shown. Furthermore, the impact of several parameters, such as a varying wind velocity, temperature or different soil properties on the evaporation process has been analyzed in a numerical parameter study. The results will be presented and discussed.