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Evaporation from homogeneous and heterogeneous soil systems: Modeling approaches and experimental data

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Accurate estimates of water losses from the soil by evaporation are important for hydrological, agricultural, and climatic purposes. Different analytical and numerical approaches were developed to provide the capability to simulate and predict the dynamics of the evaporation process in terms of fluxes, and water and thermal distributions in the soil profile. Experimental investigation of the process under different boundary conditions is also possible by means of columns and weighing lysimeters. As part, these experimental setups allow addressing the impact of heterogeneity in the drying soil profile. Experimental data resulting from evaporation experiments under natural and laboratory conditions with homogeneous and heterogeneous soil profiles are presented and analyzed. These data are also compared to results from available analytical and numerical models. This comparison points out fundamental limitations of the approaches that assume hydraulic connectivity up to the surface, as well as those that suppose monotonic drying when unsteady conditions prevail. Differences between experimental data and model prediction emphasize challenging knowledge gaps that are part of ongoing research.