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The influence of soil hydraulic properties on bare soil evaporation dynamics

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Evaporation from bare soil is an important component of the global water cycle and the energy balance of the earth's surface. Forecasting bare soil evaporation requires knowledge of physical soil properties like thermal and hydraulic conductivity, heat and water capacity, and the water-content dependency of the albedo. The focus of this contribution is to analyze the sensitivity of soil evaporation dynamics with respect to physical soil properties. A coupled numerical model of water, vapor, and heat flow in soil considering the surface energy balance and temperature effects on the transport coefficients is used for the analysis. Particular attention is devoted to the influence of soil hydraulic properties on the duration of stage-one evaporation and evaporation rates during stage-two. We illustrate the importance of an adequate parameterization of soil hydraulic properties which should account for water sorption in dry soil, water flow in completely and incompletely-filled pores, and vapor diffusion. A comparison with data from evaporation experiments in the laboratory under different atmospheric forcings provides the link between models and reality. This confrontation unveils that the use of classic parametrizations of soil hydraulic properties leads to a bias in the description of experimental data and model predictions.