

A simplified model of precipitation enhancement over a heterogeneous surface

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Soil moisture heterogeneities influence the onset of convection and subsequent evolution of heavy-precipitating thunderstorms through the triggering of mesoscale circulations. However local evaporation also plays a role in determining precipitation amounts. Here we aim at disentangling the effect of advection and evaporation on precipitation over the course of a diurnal cycle by formulating a simple conceptual model. The derivation of the model is inspired from the results of simulations performed with a high-resolution (250 m) Large-Eddy Simulation model over a surface with varying degrees of heterogeneity. A key element of the model is the representation of precipitation as weighted sum of advection and evaporation, each weighted by its own efficiency. The model is then used to isolate the main parameters that control the variations of precipitation over spatially drier patches. It is found that these changes surprisingly do not depend on soil moisture itself but instead purely on parameters that describe the atmospheric initial state. The likelihood for enhanced precipitation over drier soils is discussed based on these parameters. Additional experiments are used to test the validity of the model.