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Is the land surface – atmosphere feedback as important for predictability of convective systems in the Sahel region as the dynamical forcing?

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To address the question of different influences on the predictability of mesoscale convective systems (MCSs) in the Sahel region in West Africa, convection-permitting ensemble simulations were conducted with the NWP model COSMO. Several studies highlight the importance of the land surface – atmosphere feedback in West Africa and indicate that MCSs are often initiated in regions with strong land surface heterogeneity and mainly above the driest soils. At the same time, the representation of the land surface that controls the partitioning of the available energy into the turbulent fluxes of sensible and latent heat is very uncertain in NWP models. Therefore, we developed land surface perturbations for the generation of our ensemble simulations. They had to be both sufficiently large and as realistic as possible. We combined them with atmospheric perturbations that consist of different global analyses chosen for initialization and as boundary conditions for the limited-area model COSMO. After assessing the forecast skill and finding a sufficiently realistic representation of the simulated MCSs, ensemble members with the same land surface perturbations on the one hand were compared to members with the same atmospheric perturbations on the other. By this we can show that the land surface perturbations generate as much ensemble variability of the precipitation forecast as the atmospheric ones. Yet, it is the dynamical forcing that determines on which days MCSs are to be expected.The analysis showed that an interplay of the dynamical features of African Easterly Waves, the heat low and the monsoon flow controlling the large-scale moisture supply determines the MCS development. Within this given atmospheric state, the land surface can influence the strength of MCSs by significantly modifying humidity and temperature distributions in the boundary layer. Furthermore, land surface heterogeneities also have an impact on the location of initiation in the ensemble simulations. By this, we can conclude that in the Sahel region, the land surface – atmosphere feedback actually is as important for predictability of convective systems as the dynamical forcing.