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The impact of soil moisture inhomogeneities on modification of a mesoscale convective system: a budget-based model analysis

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In order to investigate the sensitivity of a mesoscale convective system (MCS) to soil moisture inhomogeneities in West Africa cloud-resolving simulations with the COSMO-Model initialized with European Centre for Medium-range Weather Forecasts analyses data were performed. Three scenarios were investigated: homogeneous soil type and soil moisture (HOM) and homogeneous soil type with a north-south oriented band of two degrees width with reduced soil moisture (BANDT) and with increased soil moisture (BANDM).
In all experiments an MCS developed east of the band in the late afternoon. Precipitation related to the MCS was continuously strong in HOM. When the MCS approached the band with reduced soil moisture in BANDT precipitation decreased because of higher convective inhibition (CIN) ahead of the band. Reaching the drier band precipitation increased again. The moist band in BANDM caused an increase of precipitation ahead of the band and a decrease in the area with higher soil moisture caused by very high CIN values. Soil moisture inhomogeneities induced thermal circulations which led to modified conditions in the lower troposphere and to changes in CIN and accounted for the modification of precipitation of an MCS. In BANDT, precipitating cells already developed in the western part of the dry band in the late afternoon, where convergence, generated by thermal circulations and supported by downward mixing of momentum from the African Easterly Jet, triggered convection.