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Investigation of land-atmosphere coupling processes through long-term assimilation of radar precipitation data into the land surface scheme of a mesoscale model

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Land-atmosphere interaction processes comprise a major component of the energy and water cycles over land, the predictability of which can benefit from advances on associated processes, such as soil moisture-precipitation feedback, precipitation recycling, and boundary layer fluxes, to name a few. This study aims at investigating the sensitivity of these feedbacks on long-term assimilation of radar rainfall data into the land surface scheme of a mesoscale model. Warm-season simulations are conducted with the non-hydrostatic WRF-NMM model over central USA (state of Oklahoma). This area provides a rigorous benchmarking due to its abundance of in-situ and remotely-sensed rainfall and soil moisture observations, which are used to independently evaluate the numerical experiments. The prescribed technique compensates for the lack of high-spatiotemporal-resolution soil moisture retrievals that could be directly assimilated into the land surface model. Instead, theoretically more accurate precipitation information is provided to the land surface model, which subsequently improves the predicted soil moisture fields leading to improved representation of surface energy fluxes and other boundary layer properties. Simulations from the herein described data-modelling study are used to provide an accurate quantitative description of the variability of hydrologic parameters (e.g., rainfall, soil water content, river discharge, evapotranspiration, fluxes), the mechanisms underlying such variability, and the role of surface states at different spatial and temporal scales.