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Evaluating the role of soil physical properties on simulated land-atmosphere interactions over South Africa using coupled atmosphere-hydrological modeling

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Land degradation with its direct impact on vegetation, surface soil layers and land surface albedo, has great relevance with the climate system. Assessing the climatic and ecological effects induced by land degradation requires a precise understanding of the interaction between the land surface and atmosphere. In coupled land-atmosphere modeling, the low boundary conditions impact the thermal and hydraulic exchanges at the land surface, therefore regulates the overlying atmosphere by land-atmosphere feedback processes. However, those land-atmosphere interactions are not convincingly represented in coupled land-atmosphere modeling applications. It is partly due to an approximate representation of hydrological processes in land surface modeling. Another source of uncertainties relates to the generalization of soil physical properties in the modeling system. This study focuses on the role of the prescribed physical properties of soil in high-resolution land surface-atmosphere simulations over South Africa. The model used here is the hydrologically-enhanced Weather Research and Forecasting (WRF-Hydro) model. Four commonly used global soil datasets obtained from UN Food and Agriculture Organization (FAO) soil database, Harmonized World Soil Database (HWSD), Global Soil Dataset for Earth System Model (GSDE), and SoilGrids dataset, are incorporated within the WRF-Hydro experiments for investigating the impact of soil information on land-atmosphere interactions. The simulation results of near-surface temperature, skin temperature, and surface energy fluxes are presented and compared to observational-based reference dataset. It is found that simulated soil moisture is largely influenced by soil texture features, which affects its feedback to the atmosphere.