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Land-Atmosphere coupling and extremes in CORDEX-Africa: assessment of current and future climate projections

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The soil moisture-temperature coupling represents a determinant role in the evolution of weather and climate, as these interactions are of utmost importance for extreme phenomena. For this study, daily data taken from all CORDEX-Africa simulations are considered. Two periods were selected, a historical (1971-2000) and a future (2071-2100) period which features two Intergovernmental Panel for Climate Change Representative Concentration Pathways (IPCC-RCP) scenarios: the RCP 8.5 and the RCP 4.5. A throughout assessment of the ability of the models to express the coupling signal in current climate is performed. A multi-model ensemble mean is built. The ensemble mean outperforms individual models in almost all situations, representing the best estimate for both current and future climates. The soil moisture-temperature coupling strength is assessed with the evaporative fraction, correlations with 10 days of non-overlapping means between soil moisture and evaporative fraction and between latent and sensible heat fluxes. In general, individual models are consistent in representing the weak, no-coupling and strong coupling regions, corresponding to the humid, arid and semi-arid or Mediterranean environments, as identified by the evaporative fraction. However, some inter-model variability is found regarding the intensity of each regime. In desert areas such as Sahara and Namib deserts, where precipitation is overestimated, and over large areas of central Africa, characterized by an overall dry bias, both induce an overestimation of the coupling strength. For future conditions, the increase of the surface energy budget and changes in precipitation regimes, hints towards an expansion of the arid climates. On the other hand, the intensification of the coupling strength over humid and semi-humid areas, suggest a shift of the strong coupling regions. The increase of the available surface energy and changes in coupling regimes, projected for the end of the 21st century, reveal an overall increase of sensible heating and a consequently widespread warming of up to 7 oC, for the worst-case scenario.

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