Impact of land-atmosphere interactions on surface temperature distributions

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Land-atmosphere interactions, e.g., the feedback between anomalous soil moisture conditions and surface climate, are thought to modulate land region climate variability across multiple spatial and temporal scales. Here we explore the impact of soil moisture dynamics on the distribution of daily surface temperature as simulated by the Geophysical Fluid Dynamics Laboratory (GFDL) earth system model ESM2M, in a configuration with prescribed sea surface temperatures To carry out this study, two simulations—one with interactive soil moisture and the other with a prescribed soil moisture climatology—are investigated. For interactive compared to prescribed soil moisture conditions, summer season mean land region surface temperatures are generally warmer, and daily temperature variance is generally higher, especially in the well-known "hotspot" regions of land-atmosphere coupling identified by Koster et al (2004). Moreover, higher order moments such as skewness and kurtosis are also significantly impacted: skewness generally becomes more positive with interactive soil moisture, suggesting an asymmetric impact on hot and cold anomalies. In addition, soil moisture dynamics appear to impact temperature variability on distinct timescales over different regions in the model. We interpret the changes in surface temperature distributions by considering changes in the distributions of the surface radiative and turbulent fluxes.

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