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Assessing Northern Hemisphere Land-Atmosphere Hotspots Using Dynamical Adjustment

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Understanding the influence of soil moisture on surface air temperature (SAT) is made more challenging by large-scale, internal atmospheric variability present in the midlatitude summer atmosphere. In this study, dynamical adjustment is used to characterize and remove summer SAT variability associated with large-scale circulation patterns in the Community Earth System Model large ensemble (CESM-LE). The adjustment is performed over North America and Europe with two different circulation indicators: sea level pressure (SLP) and 500mb height (Z500). The removal of dynamical “noise" leaves residual SAT variability in the central U.S. and Mediterranean regions identified as hotspots of land-atmosphere interaction (e.g. Koster et al. 2004, Seneviratne et al. 2006). The residual SAT variability “signal" is not clearly related to modes of sea surface temperature (SST) variability, but is related to local soil moisture, evaporative fraction, and radiation availability. These local relationships suggest that residual SAT variability is representative of the aggregate land surface signal. SLP dynamical adjustment removes $\sim$15% more variability in the central U.S. hotspot region than Z500 dynamical adjustment. Similar amounts of variability are removed by SLP and Z500 in the Mediterranean region. Differences in SLP and Z500 signal magnitude in the central U.S. are likely due to the modification of SLP by local land surface conditions, while the proximity of European hotspots to the Mediterranean sea mitigates the land surface influence. Variations in the Z500 field more closely resemble large-scale midlatitude circulation patterns and therefore Z500 may be a more suitable circulation indicator for summer dynamical adjustment. Changes in the residual SAT variability signal under increased greenhouse gas forcing will also be explored.