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Subseasonal Effects of Large-Scale Soil Moisture Anomalies over Southeastern South America

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Soil moisture has been recognized as a source of predictability for subseasonal-to-seasonal forecasts. We perform a series of soil moisture (SM) sensitivity tests using the Community Earth System Model (CESM2) to understand the effect of antecedent land surface state on intra-seasonal hydroclimate variability over South America. Using extended empirical orthogonal function (EEOF) analysis with remotely-sensed and reanalyzed datasets, we establish a link between the dominant oscillatory mode of intraseasonal hydroclimate variability (EEOF-1) and antecedent SM anomalies. Large-scale dry SM anomalies are observed to persist over southeastern South America (SESA) prior to the intra-seasonal increase in precipitation. The modeled response of monthly mean conditions shows that SM exerts a strong influence on the surface energy budget and the evolution of the boundary layer in this region. A reduction of initial SM over the SESA region induces a thermal low and anomalous cyclonic circulation that would inhibit the moisture-rich northerly flow associated with the increase in intra-seasonal precipitation and decrease the variability associated with EEOF-1. Reduced availability of moisture at the surface also decreases the atmospheric moisture content through reduced recycling of local moisture. The overall impact of the surface anomaly through thermal and recycling pathways can support or compete with each other depending on the scale and the location of the initial perturbation. The goal of this study is to identify the mechanisms through which accurate initialization of SM in subseasonal forecasts can enhance predictability in this socio-economically vital region of South America.