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North American Pan-Continental Droughts in Model Simulations of the Last Millennium

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Pan-continental droughts in North America, or droughts that simultaneously affect a large percentage of the geographically and climatically distinct regions of the continent, present significant on-the-ground management challenges and, as such, are an important target for scientific research. The methodology of paleoclimate-model data comparisons is used herein to provide a more comprehensive understanding of pan-continental drought dynamics. Models are found to simulate pan-continental drought with the frequency and spatial patterns exhibited by the paleoclimate record. They do not, however, agree on the modes of atmosphere-ocean variability that produce pan-continental droughts because simulated El Niño-Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO) and Atlantic Multidecadal Oscillation (AMO) dynamics, and their teleconnections to North America, are different between models and observations. Despite these dynamical differences, models are able to reproduce large-magnitude centennial-scale variability in the frequency of pan-continental drought occurrence—an important feature of the paleoclimate record. These changes do not appear to be tied to exogenous forcings, suggesting that simulated internal hydroclimate variability on these timescales is large in magnitude. Results both clarify understanding of the dynamics that produce real-world pan-continental droughts, while assessing the ability of models to accurately characterize future drought risks.