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A mechanistic understanding of precipitation isotopic changes in the Western United States since the LGM

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Proxy records have established that hydroclimate of the Western US was drastically different during much of the last glacial cycle. For example, at the Last Glacial Maximum (LGM), large lakes covered many now arid regions. High temporal resolution δ18O records from speleothems indicate regional temperature and hydroclimate evolution during the last deglaciation. However, the various mechanisms that produced these δ18O signals are difficult to deconvolve. Theories for the hydroclimate differences in the Western US at the LGM include displacement of the jet stream and storm track, thermodynamic enhancement of the moisture gradient, and greater moisture transport from the subtropics. Here, we use a version of the Community Earth System Model (iCESM) with water isotope tracking capability to explore the mechanisms responsible for precipitation δ18O variability in the Western US since the LGM. Using a fully coupled model configuration with regional isotope tracking techniques and high frequency outputs, we simulate several distinct time intervals of the last deglaciation. These model results allow us to separate the contributions of precipitation amount, moisture source, and temperature to the variability found in the δ18O of speleothems in the Western US. Through this model-proxy comparison, we help settle the debate surrounding multi-millennial scale hydroclimate change in the Western US since the LGM.