EXECUTIVE SUMMARY

How the hydroclimate in Southwest North America will change in the future remains an open question. Although models generally predict an increase in climate extremes in this region with both more severe droughts and more intense precipitation events, large uncertainties remain. By studying the past, we can improve our understanding of the mechanisms driving current and future hydroclimate change in the area.

Records suggest that the hydroclimate of this region was drastically different during much of the last glacial cycle. However, the various mechanisms that produced these signals are difficult to deconvolve and continue to be debated. In this project, the research team employed a high-resolution, water isotope-enabled Earth system model for simulations of the last glacial maximum and preindustrial climates. The combination of water isotope tracers and high resolution allows for more direct comparison of the model outputs with the proxy records.

RESULTS & IMPACT

It is clear that further investigation is necessary to determine the most important mechanisms for driving the pattern of hydroclimatic change at the last glacial maximum. The combination of water isotope-enabled model experiments with speleothem records will allow the team to disentangle the influences of moisture source and transport, temperature, and precipitation amount on speleothem proxy records, an understanding that can be applied broadly to improve proxy interpretations across the region. From the results, the research group will be able to distinguish between several long-standing hypotheses of hydroclimate change in Southwest North America at the last glacial maximum, including: (1) a southward-displaced Pacific jet stream [8]; (2) a strengthening and meridional compression of the storm track [4]; (3) a thermodynamic control arising from a steepened humidity gradient [9]; and (4) an increase in moisture from a southwesterly, subtropical source [10] perhaps owing to increased contributions from atmospheric rivers [11]. These global simulations will also prove valuable for a wide range of paleoclimate questions. As the highest-resolution global simulations of the last glacial maximum ever performed, these outputs will be a valuable resource for the paleoclimate community and of particular interest to the paleoclimate model intercomparison project [12].