Title: Controls on Permo-Carboniferous tropical climate in Pangea: Insights from iCESM
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Tropical Pangea underwent profound long-term (10^6 yr) aridification during the Permo-Carboniferous. The presence of peat-forming forests, diverse paleoflora, paleosol composition and paleosol isotopic geochemistry indicate that the paleoequator was tropical with everwet conditions in the Carboniferous. However, throughout the late Carboniferous and early Permian these conditions shifted to seasonally dry climates associated with savannah-like flora, reduced soil moisture, and decreased low-latitude floral diversity. Few climate model studies have attempted to reproduce this tropical aridification, and proposed that high-latitude deglaciation and increased atmospheric pCO_2 primarily influenced drying and warming near the equator through different atmospheric processes. Still, these mechanisms have only been tested in a single model framework (GENESIS) so our understanding of tropical climate change during this time interval remains incomplete. Here we use iCESM, a contemporary water isotope-enabled Earth system model, to further constrain the climate feedbacks that influenced the long-term evolution of continental precipitation over tropical Pangea. The incorporation of water isotope fractionation processes enables a direct comparison with geochemical proxy data. Preliminary coupled atmosphere-land simulations suggest that an atmospheric pCO_2 increase from 1x to 8x present-atmospheric levels produces ~10°C higher annual surface temperatures and lower available soil moisture for precipitation near the equator. Our future work will focus on the relative contribution of alternative environmental factors, such as high-latitude glaciation, orography, and land-sea distribution, that have been shown by previous studies to influence low-latitude precipitation over Pangea. In addition, we will develop fully coupled isotope-enabled simulations based on these initial results to capture a combination of environmental factors that contributed to long-term tropical aridification. More broadly, climate change during the Permo-Carboniferous can be used as a case study for the response of tropical hydroclimate to high-latitude deglaciation.