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A process-based modeling approach to the interpretation of high-elevation tree-ring records in the western US.

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The world's greatest concentration of millennial and multi-millennial, well-replicated tree-ring records is found in the high mountains of the western US. It is therefore of interest to attempt to disentangle the effects of temperature and moisture availability on them. In very broad terms, larger tree rings of a species like bristlecone pine are produced by wetter and cooler conditions near the lower elevation limit of the species, and by warmer and wetter conditions when growing near the upper limit. The temperature signal tends to be better expressed at decadal and longer time scales at the highest elevations, and the moisture signal there at interannual timescales (Hughes and Funkhouser, 2003). These features are apparent in comparisons with and statistical models using 4-km resolution monthly PRISM data for the period 1895 to 2006. We have also reproduced the properties of tree-ring records from the upper and lower limits of bristlecone pine using a process-based model of tree-ring growth driven by daily meteorological data from two high mountain stations, available from 1956 to 1979 (1977 at the lower elevation). Here we report the results of efforts to extend these simulations for a longer period, and apply them to a newly developed elevation transect of bristlecone pine chronologies. For this we use output for the years 1870-1999 from a realistically forced 20th-Century simulation of the coupled NCAR-CCSM-3 climate model. The implications of these results will be discussed in the context of recent tree-ring growth rates in bristlecone pine at the highest elevations that have been faster than in several millennia.

Reference

Hughes, M.K. and G. Funkhouser. Frequency-dependent climate signal in upper and lower forest border trees in the mountains of the Great Basin. *Climatic Change*59, 233-244 (2003)