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INVESTIGATING HIGH-RESOLUTION STABLE ISOTOPE SIGNALS OF ANNUAL TREE RINGS ACROSS A MOISTURE GRADIENT WITH THE MUSICA MODEL

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Abstract

Seasonal variations in annual precipitation have recently been shown to dominate the mean intra-annual variation in the carbon isotope composition of evergreen wood ($\delta^{13}C_{cellulose}$) across a range of biomes (Schubert & Jahren, 2011). When such strong relationships are preserved in plant cellulose it may also be possible to spatially reconstruct rainfall patterns in detail over large areas and back in time using empirical relationships (del Castillo *et al.*, 2013). Using a new high-resolution carbon and oxygen isotope dataset of cellulose, we investigated this relationship further. At five FLUXNET sites spanning a significant gradient of moisture (MAP range of 280 to 930mm) and temperature (MAT range of -1 to 18°C), we collected tree core samples and extracted cellulose at high resolution. For each site, we explored whether the inter-annual variability of seasonal precipitation over the past 15 years dominated the inter-annual variations in the amplitude of $\delta^{13}C_{cellulose}$. Using the process-based model MuSICA (Ogée et al., 2009), that links $\delta^{13}C_{cellulose}$ and $\delta^{18}O_{cellulose}$ signals in tree rings to environmental conditions, we explored the sensitivity of cellulose isotope signals to light, temperature and growing season length as these drivers may gain importance when trees grow without moisture limitations across large temperate regions.

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