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Identification of extreme rainfall events using high-resolution carbon isotope measurements across tree-rings

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Models suggest that global warming will cause an intensification of the hydrologic cycle, but they are poor at predicting changes in the frequency of short, intense precipitation events at the regional to local scale. High-resolution stable isotope measurements across tree-rings have shown potential for resolving precipitation at sub-annual resolution, but identification of single intense precipitation events across multiple tree rings has proven elusive. Here we report 218 high-resolution carbon isotope ($\delta^{13}C$) measurements made across eight growth rings of two *Pinus* trees cored in southern Louisiana. Tree-rings were targeted for the presence and absence of extreme rainfall associated with land-falling tropical cyclones within 100 km of the study site. Comparison of the $\delta^{13}C$ record to meteorological data yields a significant correlation ($r = -0.62$, $p = 0.0004$) between monthly precipitation and $\delta^{13}C$ value measured across the rings. We note significant, intra-ring declines of >1‰ associated with monthly precipitation > 200 mm that cannot be resolved by low-resolution sampling. We compare the effect of sample resolution on the $\delta^{13}C$ pattern and suggest a minimum sample resolution required for identifying precipitation events at sub-seasonal resolution. Recent technical and methodological advancements allow for more rapid preparation and analysis of intra-ring $\delta^{13}C$ data and provide opportunity for quantifying sub-seasonal environmental information within high-resolution tree-ring datasets. This work indicates potential for quantifying changes in magnitude and frequency of extreme precipitation events at individual sites from long-term intra-ring $\delta^{13}C$ records.