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The potential of tree-ring chronologies to global-change studies in the tropics: a quantitative review

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Tropical forests and woodlands are key components of global carbon and water cycles and due to their importance we need to better understand present and future tropical tree growth responses to climatic variation. Tree-ring analyses provide long-term datasets from which such responses can be derived. A substantial number of tropical tree-ring chronologies exist with hundreds of topical tree species showing potential for tree-ring analyses. Despite this large potential, a quantitative analysis of the distribution and characteristics of tropical tree-ring chronologies is missing. We compiled a network of >490 tropical ring-width chronologies to assess their geographic and climatic distribution, and the gaps therein. To evaluate the potential for climate reconstructions we assessed the timespan covered by these chronologies, the strength of their common growth signal (rbar), where the strongest climate-growth correlations are found, and how these chronology attributes correlate with mean climatic conditions per site. Finally, we used species-distribution modelling to identify regions with high potential for building long chronologies. We answer these questions at pantropical level and address important differences between continents and between angiosperms and gymnosperms. Tropical chronologies have been built in all continents and tropical climate types but chronology building is biased towards high-elevation locations and gymnosperms, with clear gaps in warmer and wetter climates, on the African continent and for angiosperm species. Chronology length correlated negatively with mean annual temperature (MAT), while the common growth signal decreases with increasing mean annual precipitation (MAP) and MAT. Drier sites have the most responsive chronologies: the strength of the precipitation-growth correlations decreases with increasing MAP, but showed no

correlation with MAT. Tropical dendrochronological studies already cover a substantial part of the tropics and most areas are expected to have 5 to 15 species with potential to generate centennial chronologies. This study wil provide an important basis to select species and areas to expand dendrochronological studies to underrepresented areas and improve our understanding of the climatic drivers of tropical forest tree growth.

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