

# Climate Expressions in Cellulose Isotopologues Over the Southeast Asian Monsoon Domain

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Southeast Asia experiences a highly variant climate, strongly influenced by the Southeast Asian monsoon. Oxygen isotopes in the alpha cellulose of tree rings can be used as a proxy measure of climate, but it is not clear which parameters (precipitation, temperature, water vapor, etc) are most influential. Earlier forward tree ring models that use observed meteorological data have successfully simulated tree ring cellulose oxygen isotopes in the tropics. Simulations performed using the fully coupled atmosphere ocean Goddard Institute for Space Studies (GISS) ModelE General Circulation Model (GCM) provide resolution of global climate conditions. Water isotope tracers are included in the model and serve indicators of phase changes in the water cycle. By creating a cellulose oxygen isotope model that uses input data from GISS ModelE GCM runs, we are able to reduce model variability and integrate  $\delta^{18}\text{O}$  in tree ring cellulose over the entire monsoon domain for the past millennium. Observed paleoproxy data of  $\delta^{18}\text{O}$  in cellulose shows a consistent annual cycle, allowing confidence in the identification of interdecadal and interannual climate variability. By comparing paleoclimate data with GCM outputs and a forward tree cellulose  $\delta^{18}\text{O}$  model, this study explores how  $\delta^{18}\text{O}$  can be used as a proxy measure of the monsoon on both local and regional scales. Forced signals such as supervolcanos are visible in simulated and paleoproxy data. Simulated  $\delta^{18}\text{O}$  in soil water and  $\delta^{18}\text{O}$  in water vapor were found to explain the most variability in the paleoclimate data. Precipitation amount and temperature held little significance. Our results suggest that  $\delta^{18}\text{O}$  in tree cellulose is most influenced by local controls directly related to cellulose production. Lapse rates affecting fractionation in water vapor due to orographic lift are thought to impact  $\delta^{18}\text{O}$  cellulose further.