Speleothem reconstruction of last 1,500 years of Brazilian climate

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The South American Monsoon system (SAMS) is a significant source of rainfall to the South American tropics. Characterizing the decadal to centennial variability of the SAMS is pertinent to understanding its response to future warming. We present the past 1,500 years of climate reconstructed from an aragonite speleothem collected near Brasilia, Brazil. Speleothem growth rate ranged from 0.1 to 1.2 mm/yr, with fastest growth rates occuring during the Little Ice Age (LIA, 300-500 years ago) and the slowest growth occurring near present. Fast growth rates during the LIA indicate wet conditions at that time, as the first order control on speleothem growth rate is moisture availiability. This result is coeval with the most recent expansion of forest over savannas in this region as preserved in soil organic matter. Furthermore, wet LIA conditions over central Brazil are consistent with previously reconstructed LIA dry conditions over northeast Brazil, as previous work documents anti-phasing of Holocene moisture conditions between northeast Brazil and the rest of South America. Furthermore, this correspondance suggests that, in addition to the millineal scale, such anti-phasing persists at the centenial scale.

Paired laminae are visible in plain light, ranging in thickness from 0.1 to 2.5 mm, and are consistent with the range of annual growth rates, indicating that seasonal processes may be preserved. Preliminary analysis of isotopic values document a range from -7.0 to -4.2‰ for $\delta^{18}O$ and -11.4 to -8.5‰ for $\delta^{13}C$. Stable isotopes values vary centennially, but not millenially. Lowest $\delta^{13}C$ values correspond with the interval of fastest growth, and highest $\delta^{13}C$ values correspond with the slowest growth interval further confirming increased effective moisture in the region during periods of higher growth rate. Variations in $\delta^{18}O$ values, however, are decoupled from growth rate. The decoupling is unexpected as previous variations in Brazilian speleothem $\delta^{18}O$ were interpreted to reflect SAMS intensity, and, therefore, would be expected to co-vary with growth rate. The growth rate-$\delta^{18}O$ decoupling suggests that $\delta^{18}O$ values from this speleothem reflect climate processes other than SAMS activity.