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A 1,600 year record of paleoseasonality from the neotropics of Central America and its implications for rainfall predictability in agricultural societies

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For millions of people living in the humid neotropics seasonally predictable rainfall is crucial for agricultural success and food security. Understanding long-term stability and volatility of seasonal rainfall distributions should be of concern to researchers and policy makers. However, reconstructions of paleorainfall seasonality in the neotropics have been constrained by a lack of precisely dated and sub-annually resolved records. We present a 1,600-year rainfall paleoseasonality reconstruction from speleothem sample Yok G, from Yok Balum Cave located in southern Belize, Central America. Yok G grew continuously from 400 C.E. to 2,006 C.E. and its age is constrained by 52 U-series dates with a mean error of ~7 years. The isotope record consists of 7,151 $\delta^{18}O$ and $\delta^{13}C$ measurements at ~0.22-year resolution allowing us to detect the presence and amplitude of annual wet-dry cycles. In Belize rainfall distribution and seasonality controls are currently dominated by the annual migration of the intertropical convergence zone (ITCZ) with marked meridional contrast. The Yok G record suggest distinct changes in seasonality at multi-centennial intervals. The earliest portion of the record (400-~850 C.E.) shows little intra-annual seasonal variation, the period from ~850-1400 C.E. has highly variable annual oscillations and periods of low seasonality, while the period from 1,400-2,006 C.E. shows well developed seasonal signals. Element ratios (Mg/Ca, Sr/Ca, and U/Ca) are used to assess Prior Carbonate Precipitation in the epikarst system. We review these changes and the isotopic record from Yok G and discuss tools for interpreting the stability and volatility in seasonal rainfall distributions and possible implications for past and modern agricultural societies.