EGU24-10458, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-10458
EGU General Assembly 2024

South Atlantic Convergence Zone impacts on climate and vegetation changes over the last 16,000 years in Central Brazil based on a speleothem multi-proxy record

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The South American Monsoon System (SAMS) plays an important role in the hydroclimate variability and rainfall patterns across South America. Stemming from its convective core in the southwestern Amazon basin, the South Atlantic Convergence Zone (SACZ) is a southeastward convection band, being a critical component of SAMS responsible for large-scale moisture transport, particularly over Central Brazil. Previous paleoclimate studies suggest that SACZ has changed over time, usually associated with changes in the SAMS, and there are current debates regarding the nature of SACZ, shifts in position, size, and intensity, and their potential impacts on vegetation changes. Therefore, this study addresses these debates for the last 16,000 years based on a novel multi-proxy paleorecord of $\delta^{18}O$, $\delta^{13}C$, and Sr isotope ratios ($^{87}Sr/^{86}Sr$) from a stalagmite collected in São Mateus Cave at the northeast limits of SACZ in central Brazil. This site is therefore under the regime of SACZ, with a climate characterized as tropical semi-humid with a rainy summer season and a dry winter.

The inclusion of Sr isotope data enhances our interpretation of past local climate variability since changes in $^{87}Sr/^{86}Sr$ can provide valuable information about the water residence in the epikarst and changes in soil composition. Furthermore, as São Mateus Cave lies within the Cerrado biome, it offers a unique insight into the past climate and environmental changes in central Brazil due to its distinct floral compositions influenced by factors such as location, soil, rainfall distribution, and fire frequency. Comparisons with other paleoclimate data from SACZ-influenced sites are made to access climate and vegetation changes in different locations within this convective band, particularly over larger time scales, such as the transition from the Late-Pleistocene to the Holocene and longer trends. We demonstrate that even though there is a common change in the regional $\delta^{18}O$ signal connected with SACZ variations, differences in vegetation and local moisture between northern and southern SACZ limits are evident albeit being in the same biome. This multi-proxy approach, combining traditional stalagmite proxies with high-resolution LA-MC-ICP-MS Sr isotope analysis, offers a better understanding of SACZ changes and their implications for Central Brazil's climate and environment.