Southeast Asian Monsoon variability during the Holocene based on speleothems from Laos

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Here we present the first high-resolution Holocene record of Southeast Asian Monsoon (SEAM) evolution compiled from four U-Th dated speleothems from Tham Mai Cave in northern Laos (20.75 N, 102.65 E), a key site at the interface between the Indian and East Asian monsoon systems. The speleothem oxygen isotope records are tied to robust chronologies constructed utilizing >40 U-Th ages, and indicate the records span from ~0.3 to 11.1 ka with sub-decadal resolution. The composite $\delta^{18}O$ record displays an abrupt decrease in values at 10.2 ka with depleted values persisting through ~8 ka, followed by increasing values through the mid-to-late Holocene.

To further investigate this, we present analyses of the MERRA nudged GISS ModelE2 simulations and the 20th century reanalysis nudged IsoGSM simulations of precipitation $\delta^{18}O$ from the grid point closest to our study site. Results show a significant correlation with Pacific SSTs over the Niño-3.4 region and in the western and northern Indian Ocean, suggesting that the $\delta^{18}O$ of annual rainfall may be influenced by climate modes such as ENSO and the IOD. Furthermore, correlations with OLR, SLP, and vertical zonal wind shear over the tropical Indo-Pacific all suggest a strong relationship with the Indian monsoon intensity and convection over the Indo-Pacific warm pool, which likely contribute to "pre-fractionation" of moisture advected to our study site. We therefore tentatively interpret the increasing $\delta^{18}O$ values through the Holocene as reflecting precession related decreases in SEAM monsoon strength and/or convective precipitation over the Indian Ocean and Bay of Bengal. Finally, through time-series analysis and comparison with other records, we assess the potential influence of coupled climate modes, such as ENSO, on our record.