Intraseasonal Hydroclimate Variability in the Yucatán Peninsula During the Maya Terminal Classic Period: A Proxy Record of Palaeo-MJO?

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Waves in the tropical atmosphere modulate rainfall and water vapor at the intraseasonal scale, including equatorial Rossby waves, Kelvin waves, and tropical disturbances organized by the planetary scale Madden-Julien Oscillation (MJO). The MJO's regions of enhanced and suppressed convection travel slowly eastward, resulting in a characteristic 30-60 day rainfall cycle at tropical sites. The MJO's pace and intensity vary over time and by location, influencing monsoons, El Niño-Southern Oscillation (ENSO) events, and tropical cyclone genesis/intensification. MJO-induced teleconnections influence extratropical weather anomalies, i.e. as atmospheric rivers. Despite forecast challenges, modeling studies indicate MJO sensitivity to anthropogenic climate forcing. Records of pre-instrumental MJO behavior would advance efforts to assess tropical palaeoclimate and hydroclimate sensitivity to climate forcing factors. Palaeoclimate records of MJO intraseasonal variability have not been captured due to the scale of MJO relative to proxy resolution. Promising weekly dripwater monitoring results from Rio Secreto cave, Quintana Roo, Mexico, however, show the influence of sub-seasonal weather events on speleothem stable isotope proxy records. We report a possible late Holocene palaeo-MJO signal in a ~weekly stalagmite oxygen isotope ($\delta^{18}O$ value) record from Cueva Tzabnah, Yucatán, Mexico.

We re-sampled a well-studied stalagmite, Chaac, across the Maya Terminal Classic Period (c. 800-950 C.E.) and instrumental era. With continuous micromilling at 6.5 μm spacing and stable isotope analysis (CM-2 micromill and small-vial Kiel IV+MAT253), we reached ~50 samples/year. The re-sampled Chaac record reveals expected interannual-decadal hydroclimate signals and better resolves short-term variability. A recurrent pattern of $\delta^{18}O$ value oscillations over about 4-12 samples (representing approx. 1-3 months). The amplitude of these intraseasonal-scale oscillations is around 0.3 - 0.5‰, smaller than annual/interannual variations. The intraseasonal pattern varies in amplitude, clarity, and frequency over time, similar to the modern MJO.

Intraseasonal stable isotopic oscillations in Chaac during the modern and Maya Terminal Classic Period most likely reflect local intraseasonal hydroclimate variability. Because this scale of rainfall variations is driven primarily by the MJO, we are investigating this pattern as a possible palaeo-
MJO record. We will present the new Chaac record and results of wavelet analysis, and discuss prospects for intraseasonal tropical paleoclimate dynamics.