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Recurrence structure of speleothem isotope records from Asia hints at simultaneous transitions in climate dynamics during the Holocene

Jonathan F. Donges (1,2), Norbert Marwan (1), and Sebastian Breitenbach (3)

(1) Potsdam Institute for Climate Impact Research, Research Domain IV Transdisciplinary Concepts & Methods, Potsdam, Germany (marwan@pik-potsdam.de), (2) Humboldt University, Department of Physics, Berlin, Germany (donges@pik-potsdam.de), (3) Climate Geology, ETH Zurich, Sonneggstr. 5, 8092 Zurich, Switzerland

Speleothems are important archives of past climate variability. We study isotope records of stalagmites from three caves at different locations in Asia: Oman, Northeastern India and China. The isotope records present proxies for the precipitation variability at these locations and cover a time span of 3-11 kyr before present. The large spatial separation of the considered caves results in a distinct influence of the Intertropical Convergence Zone and, therefore, mutually different summer and winter monsoon dynamics.

Recurrence analysis exploits a phenomenon frequently observed in nature – the tendency of a system's state to closely resemble an earlier state after some finite time of arbitrary evolution. Statistically analysing the stalagmite isotope time series' recurrence structure unveils synchronous transitions at all locations, although the records themselves do not linearly correlate. This finding suggests that at these times the entire Asian monsoon system underwent qualitative changes which are visible in the isotope time series despite the locally different climatic and environmental conditions.

A more detailed history of large scale monsoon dynamics in the recent geological past in context with other known climatic and environmental factors is essential for a deeper understanding of the underlying physical mechanisms. This in turn may prove useful for assessing the probability of the monsoon system undergoing a major qualitative transition (passing a tipping point) in the near future.