



Synchronous climate transitions during the Holocene in Asia derived from speleothems

Norbert Marwan (1), Jonathan F. Donges (1,2), 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 offer rich archives of past climate variability. We analyse isotope records of stalagmites from three caves at different locations in Asia: Oman, Northeastern India and China. These records are proxies for the rainfall variability at these locations and cover a time range of approx. 3-11 kyr. Due to the large spatial separation of the considered caves, the influence of the Intertropical Convergence Zone and, hence, the summer and winter monsoon is quite distinct at each location.

Recurrence is a fundamental property of dynamical systems. The recurrence behaviour of processes is captured by the binary recurrence matrix. Interpreting the recurrence matrix either as a recurrence plot or a recurrence network yields powerful methods of nonlinear data analysis based on recurrence quantification analysis and complex network theory, respectively. The statistical analysis of recurrence plots and recurrence networks can uncover hidden transitions in data series, which cannot be found by linear methods of time series analysis.

Analysis of the recurrence structure of the stalagmite isotope records unveils synchronous transitions at all locations, even though the data series themselves do not correlate. This result suggests that at these times the entire monsoon system underwent changes which are visible in the isotope records despite the locally different dependence of rainfall on the summer and winter monsoon dynamics.