Geophysical Research Abstracts
Vol. 16, EGU2014-8893, 2014
EGU General Assembly 2014

Recurrence properties as signatures for abrupt climate change

Norbert Marwan (1), Sebastian Breitenbach (2), Birgit Plessen (3), Denis Scholz (4), and Jens Leonhardt (5)

(1) Research Domain Transdisciplinary Concepts and Methods, Potsdam Institute for Climate Impact Research, Potsdam, Germany (marwan@pik-potsdam.de), (2) Geological Institute, ETH Zurich, Zurich, Switzerland, (3) Climate Dynamics and Landscape Evolution, Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences, Potsdam, Germany, (4) Institut für Geowissenschaften, Johannes-Gutenberg-Universität, Mainz, Germany, (5) Thüringer Höhlenverein e. V., Erfurt, Germany

The study of recurrence properties of dynamical systems has been shown to be very successful in characterising typical dynamical behaviour, finding regime transitions, or detecting couplings and synchronisations, even for short, noisy, and nonstationary data, as typical in Earth Sciences. Recurrence plots and their quantifications are powerful techniques for the investigation of recurrence and increasingly attract attention in recent years.

We demonstrate the potential of the newly introduced extension of recurrence plot analysis by complex network measures for the detection of abrupt dynamical changes. This method is applied on a Holocene palaeoclimate data set from Central Europe derived from a stalagmite from Blessberg Cave, Thuringia, Germany. The stalagmite δ^{18}O proxy record covers the middle to late Holocene (6000–400 years BP). Dating uncertainties are considered by an ensemble approach derived from the COPRA framework. Characteristic changes in the recurrence properties reflecting regular dynamics coincide well with the occurrence of the Bond events 1, 2, and 3. During Bond events the Central European climate variability appears more regular. The analysis presented here examplifies the potency of quantitative recurrence methods in detecting climatic events, which otherwise remain hidden in the raw proxy time series.