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Retrieving hydrological connectivity from empirical causality in karst systems

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Because of their complexity, karst systems exhibit nonlinear dynamics. Moreover, if one attempts to model a karst, the hidden behavior complicates the choice of the most suitable model. Therefore, both intense investigation methods and nonlinear data analysis are needed to reveal the underlying hydrological connectivity as a prior for a consistent physically based modelling approach.

Convergent Cross Mapping (CCM), a recent method, promises to identify causal relationships between time series belonging to the same dynamical systems. The method is based on phase space reconstruction and is suitable for nonlinear dynamics. As an empirical causation detection method, it could be used to highlight the hidden complexity of a karst system by revealing its inner hydrological and dynamical connectivity. Hence, if one can link causal relationships to physical processes, the method should show great potential to support physically based model structure selection.

We present the results of numerical experiments using karst model blocks combined in different structures to generate time series from actual rainfall series. CCM is applied between the time series to investigate if the empirical causation detection is consistent with the hydrological connectivity suggested by the karst model.