

## **Causal Relationships Among Time Series of the Lange Bramke Catchment (Harz Mountains, Germany)**

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Convergent Cross Mapping (CCM) has recently been introduced by Sugihara et al. for the identification and quantification of causal relationships among ecosystem variables. In particular, the method allows to decide on the direction of causality; in some cases, the causality might be bidirectional, indicating a network structure. We extend this approach by introducing a method of surrogate data to obtain confidence intervals for CCM results.

We then apply this method to time series from stream water chemistry. Specifically, we analyze a set of eight dissolved major ions from three different catchments belonging to the hydrological monitoring system at the Bramke valley in the Harz Mountains, Germany. Our results demonstrate the potentials and limits of CCM as a monitoring instrument in forestry and hydrology or as a tool to identify processes in ecosystem research. While some networks of causally linked ions can be associated with simple physical and chemical processes, other results illustrate peculiarities of the three studied catchments, which are explained in the context of their special history.