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Causal analysis of time series from hydrological systems

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It is often difficult to infer cause and effect in hydrological systems for which time series of system inputs, outputs and state variables are observed. A recently published technique called Convergent Cross Mapping could be a promising tool to detect causality between time series. A response variable Y may be causally related to a forcing variable X, if the so called cross mapping of X using Y improves with the amount of data included. The idea is that a response variable contains information on the history of its driving variable whereas the reverse may not be true. We propose an alternative approach based on similar ideas using neural networks. Our approach is firstly compared to Convergent Cross Mapping using a synthetic time series of precipitation and streamflow generated by a rainfall runoff model. Secondly, measured concentrations of dissolved organic carbon and dissolved iron from a mountainous stream in Germany, that were previously hypothesised to be casually linked, are tested.