

Hydrol. Earth Syst. Sci. Discuss., referee comment RC5
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Comment on hess-2021-445

Anonymous Referee #4

Referee comment on "Detecting hydrological connectivity using causal inference from time series: synthetic and real karstic case studies" by Damien Delforge et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-445-RC5>, 2021

I reviewed with great interest the manuscript entitled "Detecting hydrological connectivity using causal inference from time-series: synthetic and real karstic study cases". In their work, the authors explore four methods for detecting dependencies in two sets of time series, covering linear/nonlinear and bivariate/multivariate relationships among variables. Using a synthetic set of flows from two reservoirs, they measure statistics of dependency over a lag, finding critical differences among the methods. They capture further differences among the methods when applied to real data, finding that the CMI method is the most accurate for the synthetic case study but was unstable for the real data. The authors emphasized that the methods detect dependencies within the bounds of their parameterizations and highlight some exciting future avenues of research. Overall, this work was well presented and the analysis thorough such that I think it would benefit other researchers exploring these methods for application to their data. I have minor comments and suggestions to help improve the work, which I detail below. I recommend publication of this work after minor revision.

General comments:

I was confused about the difference between the original dataset and the differenced dataset when comparing the outcomes of the methods. I am not sure what was differenced to produce such different results within the method. Further clarification on this would be great.

When you find contemporaneous links, could this be due to shorter term processes that could be resolved with a shorter time step? So an instant link means that the data are

already synchronized and presumably there exists a measurable scale that could capture the actual lag of that information flow. Is that possible for the karstic data?

Discussion section: The discussion section could be improved by highlighting the results in terms of the connectivities described in the introduction, especially for the real case study. Also, greater connections between these results and previous studies on CIMs would add better context to the contributions of this study.

Specific comments:

L66: You state the abbreviation of the method before stating the actual name. Please correct.

L70: The phrase "obtained from" is repeated twice.

L99: Change "not" to "no"

Figure 1 caption: It is unclear what the red areas are showing in the figure based on the description. Is it the overlapping timespans for all data? Or just the portion that can be analyzed using a 5-day lag? Please clarify.

L210: What is QB'?

L218: Move the phrase "with R either A or B" earlier, when you first introduce HR.

L225, that paragraph: What is the length of the dataset? How did you set your length to ensure sufficient data for applying the CIMs?

L233: Formatting issue for variable HAB.

L238, that paragraph: It would help to reference specific parts of Figure 3 in the paragraph

L271: Are the patterns shown in the figure or just stated here? It is difficult to know which relationships you are showing. I am also confused by what you mean by the time dependencies flipping as you can't have a negative delay? Please clarify.

L297: Phrase "P2 is be removed" is awkward. Please revise.

L317: You state the instability of the CMI may be due to the interdependence of the ERT data. Could this be considered a strength? Since this means it can detect that these data were already inter-related and therefore do not function well as independent nodes in the network?

L329: Change "compare" to "compared"

Supporting information: There are some minor spelling mistakes in the document.

Figure SM2 caption: Are the descriptions for the symbols switched?