Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., community comment CC1
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Comment on gmd-2021-196

Daniel Fiifi Hagan

Community comment on "Quantifying Causal Contributions in Earth Systems by Normalized Information Flow" by Chin-Hsien Cheng and Simon A. T. Redfern, Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-196-CC1, 2021

A very interesting paper with a really good application which the community needs. Kudos! I have two concerns that I really hope the authors can address:

1. It seems to me that *the authors have missed the recent papers of Liang's group* which have addressed almost all the issues raised in this paper. I realized that in Cheng and Redfern's paper, the references to Liang's works are only up to 2018. I am convinced that these recent works will give more insight on how this study is framed. Please see below for these papers:

Entropy | Free Full-Text | Normalized Multivariate Time Series Causality Analysis and Causal Graph Reconstruction (mdpi.com)

Entropy | Free Full-Text | A Note on Causation versus Correlation in an Extreme Situation (mdpi.com)

(11) (PDF) El Niño Modoki thus far can be mostly predicted more than 10 years ahead of time (researchgate.net)

(11) (PDF) Measuring the importance of individual units in producing the collective behavior of a complex network (researchgate.net)

Panel Data Causal Inference Using a Rigorous Information Flow Analysis for Homogeneous, Independent and Identically Distributed Datasets | IEEE Journals & Magazine | IEEE Xplore

2. The authors suggest using pearson correlation sign to correct IF causality, however, I think this suggestion seems to ignore the differences between the meaning of the signs of IF and the meanings of the sign of pearson correlation (PC). They are not the same. As the authors rightly noted, Liang provided some semantics to the intepretation of the signs of IF when positive or negative, and I believe they should not lose sight of that when considering the signs of the PC. PC signs merely suggest the direction of change between two consecutive time points of two time series. This is not the case for IF signs. Liang's own interpretation (which have over the years evolved) imply that the IF signs characterize entropy in the system being analyzed. So *I disagree here that we can simply*

integrate these two. I am conviced that when the changes in the time series are very small(so that correlations are mostly insignificant), this suggested formalism would break down. Thus, one may have to begin looking at the standard deviations or another quality to complement it. Moreover, Liang's notes on causation vs causality (which he has noted very often in previous studies) shed more light on this. PC signs are qualitative while IF signs are quantitative. Recently though, Liang has advocated more for the use of the absolute IF, even though I personally believe there is more merit in paying attention to the signs (and I believe the authors agree with me on this point).

I could also comment on the contribution of noise and the different delays and their impacts which the authors have noted, but these are all well captured in Liang's paper (please see first link in the papers above), so I wish the authors would have a look at these studies and include the outcomes in this paper.

Again, I believe the applications in this paper is very necessary to the community, so I hope it gets out there to make others more aware of the potential of this formalism.

Cheers