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Interactive comment on "Dominant patterns of interaction between the tropics and mid-latitudes in boreal summer: Causal relationships and the role of time-scales" *by* Giorgia Di Capua et al.

Anonymous Referee #1

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General comments: This manuscript purports to derive causal relationships between tropical convective activity and mid-latitude weather systems in the Northern Hemisphere. The approach is to apply maximum covariance analysis (MCA) between tropical convective activity (OLR) and mid-latitude geopotential height fields at 200hPa in order to identify the dominant modes of interaction – here the leading two MCA modes explaining roughly 30% of the variance. The potential causal interdependencies between the leading two MCA modes and other atmospheric fields, in this case 2m surface air temperature, are inferred via application of causal effect networks (CEN) at different time-scales and lags. The so-called causal maps reveal the unsurprising result that regions of enhanced tropical convection play a role in. modulating large-scale

synoptic variability within the midlatitude jets and notably in the regions associated with particular nodes of the circumglobal wave 5 pattern.

Specific comments: There is no literature review of other approaches to identifying causal relationships in climate data. One example is I. Horenko, S. Gerber, T.J. O'Kane, J.S. Risbey and D. Monselesan (2017) On inference and validation of causality relations in climate teleconnections, (In Nonlinear and Stochastic Climate Dynamics. Cambridge University Press, Eds. C. Franzke and T.J. O'Kane)

The initial application of MCA appears to perform a basic dimension reduction. The authors assert that "expert knowledge" is required in choosing the particular variables to calculate the cross covariances however there is no indication that any other combinations were examined. For example, OLR could be replaced with velocity potential – as in indices for the MJO – with similar results. The methodology applied here seems to be unable to answer if a sufficient set of covariates has been chosen apart. How, for example, do you test if the combination of actors is sufficient or even parsimonius? Can some form of information theoretic approach be applied for example Akaike or Bayesian?

Given the leading two modes of MCA appear to be in quadrature, how does MCA compare to EOF/PCA or even k-means? Apparently, many of the underlying assumptions are the same i.e stationarity etc It would help greatly if the authors could indicate if their approach is causal in the sense of Grainger given there appears to be no underlying stochastic model?

The analysis and attribution of the causal relationships is ultimately largely empirical, at times overly complicated and in some parts exceedingly verbose in description. The "causal maps" are very noisy and the reported relationships are very poorly represented from the patterns in the causal maps presented. It would greatly help the reader if the methodology was described in sufficient detail and better placed in context with other approaches, both in terms of dimension reduction and causal inference. This, in

combination with a more concise discussion of the physical properties of the modes would allow the reader to better judge the merits of the approach.

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