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Geoscientific Model Development Discussions

Interactive comment on "System identification techniques for detection of teleconnections within climate models" *by* Bethany Sutherland et al.

Anonymous Referee #1

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The authors present a novel approach for identifying teleconnections in climate models on arbitrary time scales using the concept of transfer functions. They apply their methodology to climate model output where temperature is perturbed in the Nino3.4 region, and explore how this perturbation propagates to known ENSO-like features. In my opinion, the motivating scientific question is very interesting and extremely important, but I have several major concerns regarding the suitability of this manuscript for publication. My major concerns are listed first, with a variety of minor revisions suggested at the end of the review.

1. Relevance / applicability to the real world and gaining new knowledge for climate science

This quote from the discussion summarizes my reservations as to the usefulness of

the methods in this paper: "Applicability of this method to the real world is still to be determined." The methodology seems to require large ensembles and/or long runs of climate models, for both the control and perturbed scenarios. As mentioned in the discussion, there is no analog for this in the real world – so we are left to rely on imperfect models. I think the paper needs quite a bit more discussion about the relevance and usefulness of the methodology, given the reliance on climate models. I suppose there may be some value for analyzing mutli-model ensembles (to account for model uncertainty)?

More generally, I'm left wondering how one would apply this approach to generate new knowledge, even supposing we accept the use of climate models. In the example shown in the paper, the authors took region that is known to be associated with a teleconnection (the Nino3.4 region) and applied a perturbation that was expected to reveal the teleconnection patterns of interest. Thinking about how one would apply this more generally, it still feels like a fishing expedition, since one would have to choose a region of interest and an appropriate perturbation.

2. Focus of the manuscript

It seems to me that a more interesting focus for the manuscript would be on (a) uncertainty in teleconnection responses, and (b) differences in how teleconnections are calculated / quantified. Both of these ideas are touched on in Section 1. It seems to be that one could use the idea of transfer functions and the resulting uncertainty to assess the uncertain responses of things like temperature and precipitation to ENSO, as well as provide error bars on an ENSO time series.

3. Interpreting results

The main result of the analysis in this paper is (I think) shown in Figures 5 and 6. However, to my eye, these figures are still very difficult to interpret given the large and often spatially incoherent regions of significance (i.e., the "significant" areas are very noisy). I think that at least part of the reason for this noise is that fact that

you're assessing significance at each of a very large number of grid cells. In other words, there may be a large number of false positives in these maps due to the large number of "tests" being conducted. This is exactly the problem identified in this paper: {https://doi.org/10.1175/BAMS-D-15-00267.1}. I would highly recommend including some sort of testing adjustment, as well as possibly increasing your significance threshold (currently plus/minus one standard deviation if I'm reading this correctly) to make the maps of results somewhat more useful.

Additionally, I have a few minor comments:

- Missed literature: https://doi.org/10.1002/env.2523 and references therein

- Figs 3/4: somehow include the uncertainties here? Make this something like a Z-score map?

- Why are Figs 3/4 shown before Fig 2?

- Section 3.2: TCF = TFC?

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