

Summary

The manuscript, "Functional convergence of biosphere-atmosphere interactions in response to meteorological conditions," investigates the causal and correlational interactions between a number of variables measured across climate and ecosystem gradients at eddy covariance towers in the Fluxnet network. The primary unit of analysis in the manuscript is a multi-dimensional linked network of interaction strengths, as has been previously developed by the authors in an earlier study.

I was a previous reviewer for this manuscript and find the revisions to have significantly improved the presentation of methods, concepts, and analyses. I support publication of the manuscript at this time, either as is, or with minor clarifying revisions (see Specific Comments).

General Comments

I had a number of previous comments which I feel the authors have sufficiently addressed.

- 1) Clarification of the analytical framework:
The introduction of the new Figure 1 greatly improves readability in my mind, and provides the necessary framing of concepts for readers to follow along with the authors in their exploration of concepts.
- 2) Theoretical assumptions:
The revised manuscript contains explicit discussion of assumptions of PCMC1 and when those assumptions may not be met in section 2.3 as well as explicit limitations of the study design in the new section 3.6.
- 3) Motivation of the causal analysis framework:
The revised manuscript lays out a much clearer case for the causal framework used.
- 4) Further description of the distance correlations:
The inclusion of section 2.5 defining the distance correlations helps in explaining the network space.
- 5) Overlapping data analysis windows:
The previous manuscript emphasized the spatial coherence of the network points, which was problematic due to the fact that points shown in the 2d projected space all shared 2/3 of their data with other neighboring points. The revised manuscript de-emphasizes that discussion, removing the problem.

Even more generally, I feel like the addition of Figure 1 and the broader discussion of the archetypal networks greatly improves this manuscript. I think the study has a lot to offer readers, and that the insights included here are much more accessible following these revisions.

Specific Comments

- 1) I didn't fully follow the last part of the distance correlation definition in line 178. Is $\|X_k - X_l\|_p$ the p-dimensional Euclidian distance between two p-dimensional vectors?
- 2) I might have missed it, but do you state what the numbers are in the upper left corners of the panels in Fig 3? Might be worth putting in the caption.
- 3) Exclusion of downwelling shortwave feedbacks:

I think all of the reviewers were interested in what happens when Rg feedbacks are included in the analyses, as land-atmosphere feedbacks are at the core of the research questions asked by this manuscript. Their exclusion stands out in the methods, and I would have liked to see an analysis response somewhere in the response to reviewers, in supplementary discussion, or even in some summary statements in the methods or discussion (even if along the lines of, "Adding two-way linkages with Rg leads to a less interpretable 2d space – we believe this is because of violations of the stationary assumptions of the PCMCI method...").

The comment, "We acknowledge the possibility of Rg being influenced by other variables... we presume this effect to be rather small" does not seem to justify omitting a variable from a multivariate analysis – you would check the effect size and quantitatively assess whether this is true (the same as the notion of a direct effect of NEE on VPD, which has less direct physical linkage than LE-->Rg).

The new comment in line 126: "Besides these possibilities, setting Rg as driver can account for remaining non stationarities," gives some important motivation, and I can understand that if you want to load all of your non-stationarity somewhere, downwelling longwave seems like a good place to do it. At the same time, all of these data have been deseasoned, and so I wouldn't actually expect Rg to act any more exogenously than any of the other variables.

I'm not sure whether this point will significantly impact a reader's experience, but it does seem to jump out a little to me, both before and after the manuscript's revisions.