Nonlinear Processes in Geophysics Discussions

Nonlin. Processes Geophys. Discuss., referee comment RC1
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Comment on npg-2021-10

Anonymous Referee #1

Referee comment on "Identification of linear response functions from arbitrary perturbation experiments in the presence of noise – Part 2: Application to the land carbon cycle in the MPI Earth System Model" by Guilherme L. Torres Mendonça et al., Nonlin. Processes Geophys. Discuss., https://doi.org/10.5194/npg-2021-10-RC1, 2021

The authors present a data driven mean of determining linear response functions from exisiting CMIP experiments. The manuscript is well written, and the method is sufficiently described considering it is presented in detail in part 1 of this study.

I would recommend this manuscript for publications. I suggest only minor modifications are required that perhaps clarify my specific comments below. Note, these comments pertain mainly to reaffirming my own understanding, and also my curiosities on how widely applicable this method might be.

Line 193 - Is it too strong a statement to say that the prediction error comes solely from the deterioration of the recovery of the response function and not from nonlinearities? The optimal (or even appropriate) form and coefficients in subgrid parameterisations of any one of the many unresolved processes within Earth system models would in general be dependent on the level of forcing. Could this type of nonlinearity influence the deterioration in the recovery of the response functions? Note, in general parameterisations developed in GCMs are designed / tuned to reproduce the historically observed climate, and not necessarily future ones with different forcing.

To what extent are the responses sensitive to the historical trajectory of the emissions? For example could the sensitivities determine in the the 1% runs be used to determine the responses in a more temporally complex trajectory as specified in the ScenarioMIP project?

To what extent are the responses sensitive to the spatial distribution of the emissions? Clearly there are many spatial distributions that could produce the same global average (or even tropical / extra-tropical averages). Presumably not all of these distributions would produce the same response.

Following this line of thinking, could one consider the response functions between the global average quantities as the first scale in a spatial spectrum? Could one calculate response functions per say the principal components (PCs) of land carbon and PCs of surface temperature, or some other modal decomposition of these fields?