Earth System
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Interactive comment on "Decomposing uncertainties in the future terrestrial carbon budget associated with emission scenario, climate projection, and ecosystem simulation using the ISI-MIP result" *by* K. Nishina et al.

Anonymous Referee #2

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The manuscript, "Decomposing uncertainties in the future terrestrial carbon budget associated with emission scenario, climate projection, and ecosystem simulation using the ISI-MIP result", makes a good attempt at partitioning the uncertainty in model projections through to 2100 of net primary production (NPP), vegetation carbon and soil carbon. The authors use ANOVA to partition the variance in model output related to the choice of vegetation model (GVM), climate model (GCM) and CO2 scenario (RCP) and classify the structure of the variance. Cluster analysis is used to group the models and scenarios.

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Interactive Discussion

Discussion Paper

I agree with the previous reviewer's general criticism that the paper is often vague and could do with more precise language and definition of concepts. This applies across the whole manuscript. Also, the methods are insufficient to understand and reproduce the work (for example but not limited to: how have the simulations have been implemented, presumably the clustering is applied to global annual data but this is not described, the authors say that 70 simulations have been made but by my count it's 72). I also agree that the manuscript lacks depth. For example, there has been very little examination of the causes of differences between the models and there is ample room to expand the discussion.

The ANOVA is unbalanced as two of the RCP factor levels (4.5 & 6.2) only have runs featuring the 6 GVMs with a single GCM factor level, not the full 5 GCM factor levels. Results of Type II sums of squares are sensitive to unbalanced data, biasing the results of the ANOVA. I suggest dropping these two RCP levels from the analysis to maintain a balanced design. Also I don't think that the variance partitioning equation presented in the methods holds using Type II sums of squares. Type II sums of squares for a main effect is calculated once variance for all other main effects has been calculated so variance shared between the main effects is not accounted for. Furthermore, there has been no discussion that for each factor (RCP, GVM, GCM) the factor levels are drawn from a 'population' of possible factor levels. For example, why were these 6 GVMs chosen? How representative are they of all GVMs? These types of questions have been extensively investigated in the literature with regards to parametric sensitivity analysis ().

While the clustering analysis is an interesting approach to analysing an ensemble of this nature, there has been no strong justification of why the particular method is necessary and why it is being used. I am unclear exactly what the clustering is doing. Exactly what similarity is the clustering based on? The analysis of Rouyer, cited by the authors for the wavelet clustering method, was used to analyse the temporal dynamics of fish populations at multiple frequencies. Are the authors of this paper really

interested in the temporal dynamics of NPP and carbon stocks at multiple frequencies? Which frequencies are this clustering technique picking out? Isn't the overall trend more important? The cluster analysis seems over-complicated with little sound justification and no real useful information pulled out and discussed by the authors.

I suggest much stronger definition of the research questions, collaborating with a statistician to help devise the appropriate statistical analyses to answer these questions, and base your methods more strongly in the literature.

p1199 ln15-17 I don't really understand what this means and I disagree with what I think you're trying to say. If GVM uncertainty dominates then we don't have sufficient understanding of terrestrial processes.

p1200 ln1 The climate system doesn't cycle C, the Earth System or the biosphere does. Also terrestrial ecosystems don't play a role in ecosystem services they provide them. This kind of imprecise language is used throughout the manuscript and the manuscript would really benefit from substantial editing for precision and clarity.

p1200 ln6 Potsdam, not Postsdom. Was this really the name of the Sitch 2008 intercomparison?

p1200 ln 26 What do you mean "phases"?

p1200 ln26&7 I really struggled with this sentence.

p1201 ln1 What experiences might be beneficial, be precise, spell them out. How are they relevant to this study?

p1201 ln9. Four of these GVMs were part of ESMs in CMIP5? Which ones, to my knowledge it's only JULES but I couldn't find out if VISIT was also used in a CMIP5 ESM.

p1201 ln21. I think you examined changes in these variables, again be more precise.

p1202 ln2. As far as I can tell there are not 5 GCMs x 4 RCPs. Looking at Fig 1, only

1 GCM was used in 2 of the RCP scenarios.

p1203 ln6. Please define the metric.

p1202 ln27. Should read 'warm temperate' in the Köppen-Geiger climate classifications.

p1208 ln27-29 This sentence is difficult to understand and could be improved.

p1209 ln1. Based on which data is the claim made that in RCP 6.2 NPP data were comparable but VEGC and SOC were not? Figure 1 shows absolute changes and this claim should be based on percentage changes or the coefficient of variation.

p1209 ln2-3. Suggest deleting "internal". Also you need to back this statement up with more reasoning and reference to the literature.

p1209 ln4. Could be more precise.

p1209 ln18 delete "which".

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