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Biogeosciences Discussions

Interactive comment on "Spatio-Temporal Variations and Uncertainty in Land Surface Modelling for High Latitudes: Univariate Response Analysis" *by* Didier G. Leibovici et al.

Didier G. Leibovici et al.

d.leibovici@sheffield.ac.uk

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Thank you very much for these comments and questions. (see the document Received and published: 13 August 2019. related to Referee #1)

#1: ". . .lengthy description of SVD and then PTA-k . . ."

One of the goals of the paper is to describe a methodology that readers could reuse on their data. Therefore, it was necessary to explain enough the generalisation / extension from 2-way data table using the SVD to 3-way or k-way (k>3) data tables with the PTAk. This part of the paper covers in fact 2 pages (bottom of page 6 to bottom of page 8)

which is not that long (2 out of 27 without the Appendix and References). It includes the very minimum and necessary.

#1:" . . .inconsistent naming . . ."

The naming is not inconsistent but expressing how observed data are arranged into tables that mathematically can be interpreted as tensors. It is the same distinction between a data table with 2 dimensions and a matrix. We will make this more explicit in explaining that tensors are algebraic extension of matrices to more than 2 entries in the corresponding data table.

#1:"The term Principal tensor (PT) is also not introduced . . ."

Yes Principal Tensor (PT) should be defined at least at Line12 page 8. Thank you for pointing that out. Line 13 is in fact defining it without naming it; only rank-1 tensors with maximum possible fraction of variability in X is used. These rank-1 tensors are the Principal Tensors, in equation (3) The end of Line12 will be changed to ". . .or specifying the desired number of order k rank-1 tensors, or Principal Tensors (PT)."

#1:" . . .the manuscript would benefit from a greater focus on interpreting the PTs and how these explain "uncertainty" in LSMs. "

Here uncertainty is taken as variation from one LSM to another. Each PT describes at the same time the expected LSM variation spatio-temporally and also differences between the LSMs so the uncertainty in LSM simulations (as expressed by these 4 LSM). (see also your comment about LSM-weights)

#1: " The discussion about this (Pg13 L10) makes the point that . . ."

The discussion, page13 Line10, is representing a uncertainty from choosing one LSM or another and here choosing ORCHIDEE-HL instead of one of the other LSMs. Is it due to a bias in OR_HL or a lack of accurate modelling from the others? It is difficult to know or to identify exactly?

#1: “Similarly, if the first principal component explains around 90% of the. . .”

The first PT expressing a large amount of variability, 90%, allows a good approximation of each LSM and you are right the LSM weights are expressing the uncertainty from one LSM to another. For this PT this is up to 14% difference (lowest weight to highest weight) and this can be however relatively important.

We will add a sentence in section 2 on how to relate to spatio-temporal effect in interaction with the uncertainty in LSMs; when LSM-weights are not too different this shows a common feature otherwise it shows uncertainty due to LSM differences (potentially in interaction with an underlying feature existing in LSM)

#1: “Section 5 focuses on more on the differences between the LSMs by repeating the method on normalised NPP differences . . ..”

To be able to distinguish between bias and precision more data would be needed to analyse on one particular LSM.

#1: “Relatedly, it would be interesting to know how much more informative. . .”

The purpose of the method is to identify spatio-temporally where LSMs are different, i.e. a spatio-temporal representation. Computing coefficients of variations for the 4LSMs would help to understand if they are different but not where and when or for which specific spatio-temporal pattern. Table 2 and 3 provide some example of simpler comparisons.

#1: “Finally, a greater discussion of how the PTs and information could be used for quantifying uncertainty for CSI models . . .”

Uncertainty propagated to a CSI model is of course in the background as the initial motivation but the paper focuses more on how to describe independently the uncertainty in LSMs. Depending on the disease looked at, the spatial or the temporal may be more important to look at; scale will be also a major factor. This is another challenging issue. Knowing where and when models (and how much) LSMs disagree will be nonetheless

useful when running a CSI model.

#1: Pg.1 L.5 “ ...will have different impacts”. Impacts on what?

It is implicitly referring to the outcome of the applicative domain and impact in terms of decision-making error du to uncertainty in the LSM data. We will clarify by adding . . .” impacts in terms of uncertainty in decision-making.”

#1: Pg 6 L 2 multi-variate → multivariate

Thanks. This will be corrected.

#1: Pg.11 L.4 singulat → singular

Thanks. This will be corrected.

#1: Pg.26 L13 Although this analysis was only carried out for JULES, there is no reason to expect different findings for the other LSMs”. Why not?

Yes, this seems a bit of a leap of faith but the fact that the findings are related by a 1 single PT expressing 99%, so a strong effect which is very coherent with the 1st PT of the analysis with the 4LSM is inclining to make the statement. We will add these arguments in supporting the statement with a sentence like: “. . .here is no reason to expect different findings for the other LSMs (as the findings from a strong effect, 99% of variability are coherent with the first PT in the analysis with the 4 LSMs in Figure 3)”

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