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Earth System Dynamics
Discussions

Interactive comment on "Systematic Correlation Matrix Evaluation (SCoMaE) – A bottom-up, natural science-based approach to identify Indicators" *by* Nadine Mengis et al.

Anonymous Referee #1

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General Comments:

This paper describes a method to identify indicators of environmental change that have statistical measurability, political and societal relevance, and scientific consistency. Indicator identification follows a novel 3-step process, based on the construction of a correlation matrix and significance of the r values. They use an Earth System Model of intermediate complexity run with 3 scenarios (historical, RCP 4.5 and 8.5) and 16 sensitivity perturbations in an example of their methodology.

While this paper was interesting and the concept was of indicators being used to describe natural and forced states is sound, there were some major issues that I feel

need to be addressed in the introduction and methods sections.

Specific Comments:

First, what is the common way to identify/construct indicators? Why would this methodology be new, novel, different, better, etc? Their argument is one-sided and more background into other methods is needed. It is implied that expert judgment is the only criteria for indicator selection.

This type of methodology was not compared across models, hence results are strongly model specific. Also, the methodology could only be applied if the ability to examine model sensitivity exists through perturbation runs. This would limit applying this method to specific models or would be far too computationally expensive to pursue.

The rationale for using 11-year averages for calculating delta was not given. I can assume that because these are global averages and the model has low internal variability (referenced from page 14 line 20) that 11 years is sufficient? 10-30 year periods are more common. Also, for the calculation of the historical period deltas, what years were used? The title on Figure 3 would suggest that some linear method was used to calculate delta? I could not find specific years used.

Additionally, 5% significance level is extremely low. What is the rationale for using such a low significance value? Why not use an absolute threshold for r instead? Or inflate the ensemble used for the correlation calculation by using more than 1 realization from each perturbation? Indicators from the historical period are interesting in that there are likely very few variables that have a clear signal or significant trend. Is this why the very low 5% significance level was used?

Cluster analysis: Why would this method be preferred over more standard methods of PCA/EOF analysis or step-wise regression to group variables? Can the results be compared? The emphasis seems to be on non-redundancy of variables, but what is the value of non-redundant groupings?

In the discussion section (Page 12, line 27-28), it is stated that “our results do suggest that a comprehensive assessment of future climatic states needs a re-evaluation of the ad-hoc chosen indicators, due to changes in prevailing climatic responses.” This is an interesting statement in that it implies that the historical indicators are often used to determine future states. Are there previous studies to compare this to? If there were more details in the introduction, this statement would make more sense and have a stronger impact.

Minor comments:

Page 2, line 23: The citation uses “respectively” but it is not needed.

Page 3, line 2. Is there a reference for this model? There are many references in the appendix section, but there should be one here as well.

The correlation matrix is constructed by taking correlation coefficient of 2 variable deltas under 16 perturbation experiments. I am assuming you are using Pearson correlation coefficient (r). This should be stated at least once in the methods.

The caption of Figure 1 could use more detail, and the figure itself could be generalized. If this paper is about the method (and not the model) it should be much cleaner and clearer. For example, if the 16 perturbation runs are not discussed in the methods section, why are they shown in the figure? This critique also applies to Figure 2.

The naming structure of the data was confusing. Prefixes A, O, F, and L were used. I am assuming that A was either atmosphere or absolute, F was flux, and O was ocean? There were also suffixes of O or L, which are ocean and land, and N or S (North and South?). While I understand that these variables were used to showcase the method and as such the naming conventions were not important, it was hard to interpret the results based on variable names.

In the abstract, there are 3 non-optional steps, but in the manuscript Step 3 is listed as “optional”.

Page 5 line 25, should there be forward slashes in the variable names?

Figure 5, the title of the x-y correlation ‘quilt’ has the word “periods”. Should this be changed to scenarios instead? It is not clear what is meant here. This isn’t a plot of the significance of the changes in periods, but more of the significance of the r values between variable deltas?

Page 15, line 16: what is meant by “natural science-based assessments”? “Natural” is used throughout the manuscript, but I am not sure it is needed.

The discussion in the Supplementary section is very interesting, but I would argue that it doesn’t belong in this paper. However, it could and should be used in a follow-up paper.

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