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# *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 #2**

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General Comments:

This paper introduces a bottom-up approach (SCoMaE) to select a climate indicator for certain climate related question, and illustrates that to answer the same question, climate indicator under different climate scenarios may be different, and common correlation matrix could be used to assess multi-scenarios question. This topic is suitable for the journal, but clarification and improvement are needed.

The paper used one example to demonstrate SCoMaE. However, the example is not clearly described. What is the scientific question to answer? How are those variables selected? It might be better to include an experiment setting section instead of ap-

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pendix, since all Figures are based on the model experiments.

Please clarify the meaning of 'correlation', as shown in Figure 1, the correlation is not simply correlation between two variables, but correlation of two variable correlations under different input parameter scenarios. It is misleading through the whole text when discussing 'correlation of variable A and variable B'. Please modify the whole result and discussion.

Specific Comments:

Page 2, Line 14: a comprehensive assessment of what?

Page 2, last paragraph: Although there are more details on this topic on Page 3, line 12-21, it is not clear here whether the authors mean to use all variables from output of an Earth System Model or only certain selected variables? If variables are selected, how to select the variables regarding to certain scientific question? In addition, how about output of different time frequencies?

Page 3, Line 2: What are those selected indicators presenting in this paper? What is the question to answer here?

Page 3, Line 16-21: This method is bottom-up, but the selectin of variables is still expert judgment, as well as how to process the variable (e.g. monthly average or seasonal average?). And as the author mentioned "The selection. . .is very important for the outcome of the study". Please comment more on this.

Page 3, line 23-32: Please clarify the example question here, if it is "the correlation between global mean 'surface air temperature' (A_sat) and 'northern hemisphere sea ice area' (O_iceareaN)", then the correlation should be between time series of A_sat and O_iceareaN. If it is "the correlation between model output variables, given their reaction to varying model input parameters", then should compare correlations between time series of A_sat and O_iceareaN under different scenarios (different input parameters).

Page 3, Line 30: should mention Appendix A before Appendix B. Otherwise switch the order of A and B.

Page 4, Figure 1: please don't overlap the labels, as well as in other Figures.

Page 5, line 1: what does the 'negative correlation' indicate to? If it indicates to the locations of all crosses in the top right panel in Figure 1 (positive SAT change associated with negative sea ice change), it is correct. If it indicates '-0.955', the negative correlation of correlations in different input scenarios, it is wrong.

Page 5, Line 5: Figure 3 should show after Figure 2. Or change the order of figures.

Page 5, Line 21: precipitation over ocean areas is the first indicator of what?

Page 5, Line 20-30: Do Figure 2 and Figure 3 also use the same way to calculate correlation as in Figure 1 (r=-0.955)? If so, then those correlations are not correlations between variables, but the correlations of correlations under different input scenarios. If Figure 3 is showing the correlations between variables, I strongly doubt that A_sat (global surface temperature) and F_uplwr (surface upwelling longwave radiation) show no correlation. It is impossible, higher surface temperature results stronger surface upwelling longwave radiation according to black body radiation. If Figure 3 is showing correlations among different input scenarios, it makes sense, as in all input parameter scenarios, black body radiation should be the same. In that way, please change the way of description through the whole text: the color bar is not indicating the correlations of variables.

Page 5, Line 33: why surface albedo on land significantly correlated to ocean oxygen and sea surface salinity?

Figure 2: not clear how many model output variables are tested until Figure 3. Instead of "clustered variables", it might be better to list all variable names. How are those variables selected to answer the question of what is "the correlation between global mean 'surface air temperature' (A_sat) and 'northern hemisphere sea ice area"? Or

other questions? Please clarify.

Why Figure S5-S10 are after reference and tables?

Figure 3: need to explain all the variables.

Page 8, 2.3: please clarify the meaning of correlation first, if the correlation is based on different input parameter scenarios, then the text needs to be modified.

Page 13, Line 27: RCP4.5 and RCP8.5 has more CO2 emission than historical scenarios and higher sea temperature will contain less CO2 gas in the ocean. Therefore according to Henry's Law, larger CO2 gradient over the atmosphere and the ocean will enhance the air to sea carbon flux. In addition, under RCP4.5 and RCP8.5, soil respiration enhanced also due to higher temperature.

Page 14, 3.1.2: The method assumed that two time periods have the same climate sensitivity regarding to the input parameter change. But it is not true. For example, CO2 fertilization effect is different under different temperatures. In addition, how to select the variables for analysis will make a big difference in the result.

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