Reconstructing Coupled Time Series in Climate Systems using Three Kinds of Machine Learning Methods

Anonymous Reviewer 2:

I would like to appreciate the effort of the authors for including my specific suggestions and answering my queries. The result and discussion section looks good to me. However, I have some issue with the presentation of the manuscript. There are English language errors in the manuscript, which dilute the impact of the manuscript in some areas and can cause confusion to the reader. Please find my major comments below.

1. In response to my specific comment No. 22, the explanation associates the presence of non-stationarity in time series, a time varying local mean, to the performance of LSTM. However, the same has not been added in the main manuscript, instead it has been associated to the “simple architecture of LSTM”. That feel vague. Although, I agree with the authors’ point that it would require further analysis to establish non-stationarity as the sole reason for the performance of LSTM. But, it should also be mentioned in the manuscript, as that will pave the way for future research on this topic.

2. In response to my specific comment No 23, 24, and 25, the authors only provided half of the explanation in the section 4.2.3. Through the comments, I wanted to see the performance of LSTM, RC, BP, and LSTM* with a changing coupling strength (θ). As in the previous manuscript this section did not mention LSTM but claimed that LSTM along with RC to be better than BP and LSTM* in reconstructing the lorenz96 system. Currently, the section talks about BP and LSTM*. And a line is added in the Figure caption that, RC overlaps LSTM, i.e., RC and LSTM have the same

performance. However, it seems the earlier explanation about the insensitivity of RC with respect to correlation and its sensitivity to CCM has been removed (430 - 439; from the last reviewed manuscript).

"*However, the RC is not so much restrained by the Pearson correlation. When θ is equal to 0.7 or 0.3, the values of CCM index are both higher than 0.9, that is to say, the nonlinear coupling strength is not changed by θ. Then, it can be found that the quality of reconstructed X_1 by RC is always good. As Fig. 7b shows, the green dots (RC output) in Fig. 7b always overlap with the black line (original target series). Actually, the reconstruction quality of the RC is determined more by the nonlinear coupling strength. The values of CCM index are calculated between X_1 and X_2, X_3 …, X_{18}; meanwhile, X_1 is reconstructed from X_2, X_3 …, X_{18}, respectively. Then, a significant correspondence exists between the nRMSE and CCM index (Fig. 8), especially for the results of RC. This indicates that the reconstruction quality is dependent on the coupling strength between the reconstructed variable and different explanatory variables.*". I would suggest keep this explanation and add LSTM along with RC here too as both seems to be sensitive to CCM and not Pearson's correlation.

3. I would urge the authors to check the English language thoroughly in the manuscript.

Specific Suggestions

1. Lines 43-44: rewrite.
2. Lines 50 - 54: There seem to be a disconnect between these lines and the preceding line (Line 49). have a look at it.
3. Overall, give another look to the presentation of the matter and its English language.

4. Shorten all the Figure captions. Captions should only include the information of the Figure, not its description. Its description should be added in the main body of the manuscript.

5. Line 212: write “governing” instead of “govern”.

6. Lines 229 - 231 can be rewritten as: “*The Root Mean Square Error (RMSE) of residuals is used here to evaluate the quality of reconstruction by machine learning. The residual represents the difference between the real series (b(t')) and the reconstructed series (*$\hat{b}(t')$*).*”

7. Lines 267 - 268 can be rewritten as: “*Sugihara et al. and Tsonis et al. defined the causal inference according to* $\rho_{a\to b}$ *and* $\rho_{b\to a}$ *as: …*” follow proper reference format (Sugihara et al and Tsonis et al. Are missing its years).

8. Line 440: Instead of “two-directional”, use “bi-directional”.

9. Lines 472 - 474: It can be rewritten as: “*In this case, performance of the reconstruction through BP and LSTM* are not good and it is analyzed in section 4.2.3.*”

10. Lines 510 - 512: The sentence is confusing, please rewrite.

11. Line 538: no need to mention: “*… mentioned in the introduction*”.