Comments on npg-2024-24

This study focuses on explaining the origins of high forecasting skills of recently emerging deep learning models for ENSO predictions. More specifically, the authors firstly build a skillful Reservoir Computers (RC) model for simulating Zebiak-Cane numerical model, and then investigate and compare the sensitivities on initial perturbations of RC and ZC models (also including an LC model). The authors find RC models are less susceptible to initial perturbations no matter for short and long lead months, which is also the possible reason of weakening the impact of spring predictability barrier (SPB) and extending the effective lead time. In general, this study crafts some novel experiments, and I have the following major questions for the author to answer:

1. W^{in} in Equation (4a) and W_{in} in the following illustration is not consistent.
2. What is the value of N_x in your study, which is quite an important configuration for forecasting skill of RC model.
3. Around line 169, the authors mention that "the initial reservoir state for each prediction was determined using 5-year of data prior to the time t". Can you explain this expression more to those unfamiliar with RC models?
4. Around line 224, the authors mention that "This result aligns with expectations, as non-linearities play a more important role in the supercritical regime". I am wondering is it true that the supercritical regime exhibits more nonlinear than subcritical regime, which favors the performance of the RC model? What's the relationship between nonlinearity of regime and RC model performance?
5. Around line 248, do the authors use values of the CNOP objective function to assess whether the model is susceptible?
6. For figure 5, why the CNOP results for ZC model is quite symmetrical while the CNOP results for RC models are usually biased?
7. Around line 297, the authors mention that the inclusion or exclusion of wind speed anomalies has a large effect on the different variables of CNOP in the RC models for the subcritical regime. I am wondering why this is not obvious in the RC models for the supercritical regime?

8. I have noticed there is another similar study that revealing the initial perturbations of SST for ENSO predictions in AI model (https://doi.org/10.1002/qj.4882). Maybe this is a more comprehensive way to detecting the detailed patterns and physical variables of initial perturbations related to SPB from index models (such as RC models used in this study) to spatial models.
9. The AI model appears to be less sensitive to the initial perturbations, or the initial perturbations do not grow as fast as those in numerical models, which is the reason for the higher skill of the AI model. Similar conclusions are also obtained in another similar study (https://doi.org/10.1029/2023GL105747). Can the authors discuss the pros and cons of this characteristics? I think this will be significantly valuable for the future modelling, as well as further understanding, of earth system.