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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influence of ENSO on entry stratospheric water vapor in coupled chemistry-ocean CCMI and CMIP6 models" *by* Chaim Israel Garfinkel et al.

Anonymous Referee #2

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This study compares 12 models from the CCMI and CMIP6 projects with reanalysis observations to evaluate these models' skills in simulating ENSO's impacts on stratospheric water vapor variability at 90hPa in the tropics. One key metrics (asymmetry of the ENSO-water vapor relationship) is used in this work to assess each model's performance. It appears much effort has been put into this work and I don't see any serious problems in their analyses. In my view, the authors use right tools (resampling, composite) and their analyses are basically sound. However, considering that the authors seek to publish this study in a scientific journal, I expect to read more discussions to understand why some models are better than others and what possible causes of these failures and successes displayed in this paper could be. The authors only briefly dis-

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Discussion paper

cuss this issue in section 5 (the final paragraph). They attribute the limitations of some "bad" models to weak interannual variability of water vapor around the troposphere and a lack of some key processes determining variability of cold point temperatures. I feel this very limited discussion is not sufficient and more in-depth thoughts are needed to improve the presentation and reasoning in the paper. So I consider that some minor revisions are required before accepting this article for publication.

To me, the main finding of the paper is that all models can well capture LN's impacts on water vapor variability in winter. I feel that the paper could benefit more from some more discussions on why all models perform better on this aspect, rather than just making a list of models with better performance.

In Fig4, there is a 2-month lag between T and water vapor and two models show very different patterns from others. I am wondering whether these differences are sensitive to the selection of the time lag. With different time lags, could we observe an improved performance in these two models.

The climatological mean state of vertical temperature profile in the tropics in models may play a key role to determine model's performance in replicating the ENSO-water vapor linkage. Here the authors mainly examine anomalies away from the mean state. I suggest that the authors should pay some attention on the mean state of cold point temperatures to examine whether some biases in the mean state could be translated to models' failures to reflect the ENSO-water vapor connection.

In my view, the selection of 15S to 15N in Fig. 3 needs to be justified. In addition, it is better to show the latitude -vertical transects of zonal mean temperature anomalies (or an average across some longitudes in the pacific) to provide a 3-D picture of LN and EN' related tropical temperature responses I the 6 models.

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