

Review of “Atmospheric response to wintertime Tibetan Plateau cold bias in climate models” by Portal et al.

The authors present an interesting and sound analysis of the influence of cold biases in CMIP6 models/AGCM and its influence on the atmospheric state across east Asia and the North Pacific. The results presented by the authors is of interest and relevant to the journal, however I believe it could be improved by expanding on some results further and exploring model sensitivity. Furthermore, a greater explanation of the results from the SPEEDY model would be welcome. I list my several major points below as well as some more minor comments. Once these are addressed I see no reason why this manuscript should not be accepted for publication

Major Comments

1. It would be beneficial to show some of the model spread in the cold bias. Several things that would improve the analysis are: is it only the cold models that have the downstream response in heat fluxes, wind biases, eady growth rate, etc. A comparison of warm and cold models would be useful. Furthermore, all changes are expressed relative to the model mean, but are the models already biased relative to the observations/reanalysis? Do these cold models amplify an existing model mean bias or how much of the bias can be associated with the colder models? Do the coldest models have the largest biases in heat fluxes etc? I suggest plotting a scatter plot of temperature bias in the TP/MP region against average heat flux (or wind bias) downstream to test this.
2. What is the spread in response in the SPEEDY simulations? No stippling is shown in Fig. 5. I suggest something similar as above to investigate the variability in AGCM response.
3. You have performed a TP+MP and an MP cold experiments and come to the conclusion that most of the downstream response is a result of the TP forcing. Surely running experiments of just the TP cold bias would answer this question. I suggest the authors address this in some way.

Minor Comments

1. L37-38: I suggest adding a reference to Fig. 1b here.
2. L150: hyphen required in years.
3. L151 and Fig. 1a: how do you determine spread? Is this just the standard deviation of the temperature at each grid point?
4. L154: incorrect colour labelling and figure reference – please correct.
5. L167: ‘land’ not required.
6. L180-185: suggest adding more explanation here on the mechanism as to how the cold TP bias influences the flow downstream. This will just need to add some discussion from the introduction I believe.
7. L188-189: suggest adding some lat/lon co-ordinates to reference which part of the Chinese coast line you are referring to – it’s slightly confusing.
8. Is there anything particular about the models that have the largest cold bias? Are they of lowest horizontal or vertical resolution?

