

## ***Interactive comment on “Minimal impact of model biases on northern hemisphere ENSO teleconnections” by Nicholas L. Tyrrell and Alexey Yu. Karpechko***

### **Anonymous Referee #2**

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By using a two-step bias-correction technique, the influence of climatological bias in ECHAM6 spectral atmospheric model on its simulation of the ENSO-EU teleconnection is studied. The authors show that the AL intensity responds to the ENSO SST anomalies regardless of its long-term bias. While the polar vortex anomalies are weakened in TropBC and FullBC experiments, the NAO index is quite similar between the original biased and artificially-corrected simulations. Their research also found that the wave flux related to the stratosphere anomalies become less sensitive to the AL variability when the troposphere BC is improved, which leading to a weaker polar vortex signal in the upper stratosphere. In general, there is no significant difference in the ECHAM6 model's simulated ENSO-EU teleconnection (NAO intensity) before and af-

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ter the bias–correction technique is applied. The topic should be of interest to model developers and forecasters. However, some points worth careful consideration before publication are:

General comments:

My major concern is about the conclusion made by the authors “a stratospheric response is not necessary for the ENSO–North Atlantic teleconnection”. Some questions worth consideration are:

(1) Is there any downward propagation of stratospheric signals in the Ctrl experiment? If the answer is false, and in all these correction experiments there is also no such signal seen, then in all the simulations there is no influence from the stratosphere. However, the only conclusion we can reach here based on the modeling results is that the ECHAM6 can simulate the ENSO-EU teleconnection either with/without strong stratosphere anomalies. But it is not appropriate to conclude that the stratosphere is not important at all given the evidence found in OBS and many other studies.

(2) If all the experiments are accompanied with stratosphere-troposphere coupling, why the NAO signals are comparable between the experiments with strong and weak (FullBC and TropBC) stratosphere anomalies? Does that mean the BC in FullBC and TropBC are more favorable for downward coupling?

When the authors convey the opinion “The stratosphere BC bias is not the determinative factor for the upward wave flux”, a reminder pops out that some improvements are also embedded in the mid-latitude stratosphere of the FullBC and TropBC simulations. Moreover, I am not sure if the StratBC could have any influence on the downward process. To sum up, I recommend the authors to give some downward propagation analyses concerning the polar vortex anomalies in each modeling experiment.

I also have concerns about how representative UZ60 at 10hPa for the whole polar vortex strength?

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Specific comments:

Line 218-220: what's the evidence of this speculation? The Aleutian Low climatology bias reduction is just one feature in TropBC experiment. One can not rule out the possibility that the BC flow change in other areas / over upper levels plays a more important role.

Line 85-95: please explain why a regression method is used for extracting SST forcing fields not composite? Or how similar are the SST anomalies pattern in the sensitivity experiment and the one in observation? My point is that the regression patterns are exactly asymmetric between the EN and LN phases, but not in observation. Care should be taken when comparing the model results with OBS in Figure 3 then.

Figure1: why gives the 2D distribution of SLP but not at higher levels? The most obvious correction appears on the mid- to high- troposphere/stratosphere as shown by Figure1(e) and 1(f). Are the bias structure and corresponding improvement share a barotropic structure with the SLP field? If not, it's better to add more plots.

Line 110: It may be necessary to point out that in StratBC experiment, no significant improvement is seen below 20hPa (midlat) & 50hPa (polar), although the correction is applied from 100hPa.

Technical corrections:

Line 31-33: There is a paper by Mezzina et al (2020) titled "Multi-model assessment of the late-winter extra-tropical response to El Niño and La Niña" pointed out that the ENSO-forced SLP signal over the North Atlantic is kind of different from the NAO.

Line 195: "Hence, we find that climatological biases do not significantly affect the response of the Aleutian low to Rossby wave forcing, or the polar vortex to upward planetary wave forcing": upward planetary wave forcing does change because of TropBC correction, and the polar vortex intensity is highly corrected with that wave forcing. The authors might want to say "the StratBC climatological biases over the polar region is

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not important", but the description used is overly general and might be misunderstood. Please improve that.

Figure 3(b) : misused units marked as [m/s]

Figure 2(a) legend: Strat->StratBC, Full->FullBC, Trop->TropBC

Figure 3(a) legend: Strat\_BC->StratBC, Full\_BC->FullBC, Trop\_BC->TropBC

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