

## ***Interactive comment on “The role of the winter residual circulation in the summer mesopause regions in WACCM” by Maartje Sanne Kuilman and Bodil Karlsson***

### **Anonymous Referee #1**

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Review of manuscript acp-2017-647: “The role of the winter residual circulation in the summer mesopause regions in WACCM”, by Maartje S. Kuilman and Bodil Karlsson.

This manuscript revisits the mesospheric Interhemispheric Coupling (IHC) contribution to control temperature in the summer mesopause, using the comprehensive climate model CESM/WACCM. The main result is that this model is able to reproduce the mechanism as shown by Karlsson and Becker (2016 J Clim, KB16) with the KMCM model. The manuscript is well written and structured, but the new scientific insights it offers are not clear. Regarding this, I have one general concern, and some specific comments, that the authors could address before meriting publication:

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1) What is the motivation for trying to reproduce KB16 results with WACCM? Are there processes included in WACCM and not in KMCM that justify the study? It is relevant that Figs. 1 to 6 are basically the same figures as those in KB16, but with WACCM instead of KMCM. The authors could offer a detailed comparison between the two models, because those figures present some differences that are not highlighted in the text. For example, it would seem that the correlation is very weak in the NH summer polar mesopause in WACCM (Fig. 4 top left), but quite significant in KMCM (Fig. 8A in KB16).

Specific comments:

2) It would be interesting to include a discussion on the effects of turning off the GWD on the Brewer-Dobson circulation (BDC) itself. In the experiments where the GWD in the winter hemisphere is turned off, does the amplitude of the planetary waves change? In other words, say the GWD represents 80% of the total wave forcing in the winter mesosphere; is  $w^*$  80% weaker in the experiments versus control? (i.e. does the EP flux divergence increase in the experiments, trying to compensate the missing GWD?)

3) Lines 302 and elsewhere. For the correlation, why is the SH temperature averaged over 40-60S, and not over polar latitudes (as the authors do in the NH)?

4) Figure 4 (and 6). If the point of these figures is to highlight the importance of the equatorial mesospheric temperatures on controlling the summer mesopause T, why not correlating the equatorial T (instead of extratropical T) with T elsewhere?

5) Lines 327-328. What is the NLC region? Is it the region bounded by the contour? If so, it is hard to see any response in temperature there.

6) Lines 358. It seems not quite conventional to use T in the extratropics as a proxy for the strength of the BDC, when the model provides with all the variables needed to calculate it. Please comment on this choice.

7) I wonder how necessary are Figures 7, 8, 10 and 11; they seem to provide the same

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piece of information as Figures 4 and 6. I believe similar conclusions can be reached with the latter. Also, in lines 350-356 the authors decide to focus the discussion on the NH summer in July because of the stronger influence of the SH winter on the NH summer than vice versa. However, several paragraphs are devoted to this weaker connection between the NH winter on the SH summer. I recommend suppressing 412-450 (and the corresponding figures) for the sake of concision.

8) Section 3.1. I have some trouble trying to understand the objective of this section. Why is it interesting to discuss the role of the summer stratosphere on the summer mesospheric T in situations that are far from being realistic? Perhaps more interesting would be to perform an additional experiment in which the summer GWD is turned off. This way you can compare the importance of the summer BDC versus the IHC on the mesospheric T, and would definitely add new information from that given in KB16.

Technical comments:

- Figures: It is hard to see the dots that signal the statistical significance, and it is also quite difficult to assign a color to a value (in the colored figures). Perhaps adding black contours helps.

- Line 283: At the same "time"?

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