

Weather Clim. Dynam. Discuss., referee comment RC2  
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## Comment on wcd-2022-42

Anonymous Referee #2

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Referee comment on "Revisiting the wintertime emergent constraint of the southern hemispheric midlatitude jet response to global warming" by Philipp Breul et al., Weather Clim. Dynam. Discuss., <https://doi.org/10.5194/wcd-2022-42-RC2>, 2022

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### Summary of the review

This manuscript raises questions related to the physical interpretation of zonal mean jet in the wintertime Southern Hemisphere where the latitudes of jets in the Atlantic and Pacific differ from each other. The authors found from their CMIP6 multi-model analyses that the emergent constraint found for the zonal mean jet between its present-day and future shift does not hold for individual two halves of the hemisphere. Using a toy model, the authors demonstrate that a latitudinal shift of the zonal mean jet does not necessarily reflect a coherent jet shift in different longitudes, by showing that the strengthening/weakening of a zonally localized jet can also influence the zonal mean jet shift as a statistical artifact. Also, the toy model by the authors explains the similarity of the meridional structure of the future change of zonal mean zonal wind among CMIP6 models regardless of the present-day jet profile. I think this journal is appropriate for this article to be published after the following comments are addressed.

Major comments (Not necessarily in the order of importance)

a) Line 74.

The authors diagnose the physical existence of the jet using unfiltered daily data in Figures 2b-c. Instantaneous zonal wind in the southern hemisphere mid-latitudes is sensitive to the synoptic scale cyclones/anticyclones moving eastward due to the background jet stream (Figure 2a). Therefore, the physical meaning of zonal wind between Figure 2a and Figure 2b-c is different; the former is the basic state component,

and the latter is the mixture of basic state and eddy components. For the author's purpose, they should use daily data after applying a low-pass filter of e.g. 8 days to filter out the eddy component.

b) Figure 4c, Figure 5

These figures are based on the toy model where random variables are added to  $a_1$  and  $a_2$  respectively. Please explain why the values added to  $a_1$  and  $a_2$  are set independently of each other (i.e. no correlation) in comparison to the CMIP6 results.

c) Figure 5a

$\Phi_p$  of CMIP6 models is less clearly anchored, as the authors also discuss in line 135. There rather seems like two groups of CMIP6 models; one group is non-anchored models and the other is anchored models following the identity line in Figure 5a. The authors should explain what caused the second group. Given the fact that such a case never appeared in the toy model (Figure 5a), I wonder to what extent the toy model is applicable to interpret the anchoring found for CMIP6 models.

d) line 150

While Figures (3) and (A2) conceptually explain that the inter-model difference of the zonal mean jet axis is caused by the Pacific double jet structure, there is no figure showing it is the case in CMIP6. To justify the conceptual argument, please add a panel in Figure 3 which is like the current Figure 3 but for actual CMIP6 models.

Minor comments

a) Equation (1)

Please refine it in a form including subscripts (1,2) to represent the Pacific jet described in Table (1).