Response to reviewer 1

2nd review of "Dynamical drivers of Greenland blocking in climate models" by Clio Michel et al.

Thank you to the authors for carefully addressing my comments from the first round of revisions. I have only one new issue on the significance testing for composites which I think is slightly flawed as presented. Otherwise and as written before I think the manuscript should be published in Weather and Climate Dynamics as it fits well into the scope of the journal and presents very timely work.

Thank you for your second careful review of the manuscript.

Minor comments:

section 2.6.2: Given that blocked/unblocked days are highly auto-correlated, the bootstrapping should account for this by not drawing X random days buy picking random periods corresponding to the blocked/unblocked periods in the original time series. See e.g., methods of Brunner, L., Hegerl, G. C., & Steiner, A. K. (2017). Connecting atmospheric blocking to European temperature extremes in spring. Journal of Climate, 30(2), 585–594. https://doi.org/10.1175/JCLI-D-16-0518.1

We thank the reviewer for the thoughtful suggestion. We have calculated again the significance following Brunner et al. (2017) as seen with the dots in Figs. 5, 6, and 7. The new calculation highlighted a small mistake in the calculation of the events duration, which lead us to change Fig. S10 of the supplement as well. However, the results do not change much and the conclusions are the same. The method as been updated in Section 2.6.2 (see lines 170-173).

section 2.3/Figure 2: I think the usage of blocking frequency is still ambiguous. The convention to define the fraction of blocked days in the Greenland region as 'Greenland blocking frequency' seems somewhat counter-intuitive. Without careful reading of the methods the readers interpretation of figure 2 might easily be that it shows the average blocking frequency over Greenland (so, e.g., the average of blocking in the black box in figure 1f for ERA-I – which is NOT what is shown). My suggestion would be to clearly distinguish between the two, e.g., by using 'frequency of blocked days' instead of 'blocking frequency' as xlabels in figure 2.

We agree and have changed the x-axis labels on Fig. 2. We have also changed the captions of Fig. 2 and Table 1 accordingly.

Response to reviewer 3

Review of manuscript wcd-2021-26 (version 2):

Dynamical drivers of Greenland blocking in climate models

by

Clio Michel et al.

I reviewed the original submission and have now read the second version of the manuscript as well as the author responses. I would like to thank the authors for additional analyses and discussion, some of which in response to my earlier comments about compositing, significance testing, and the evaluation of model biases. Although some questions must remain open, one very interesting aspect of this study is to have a specific example of two models that show very similar Greenland blocking (GB) frequency, but a very different representation of dynamical fields thought to be closely associated with GB – cyclonic Rossby wave breaking in this case. This example will surely be an interesting reference for future research. I recommend this study for publication in WCD with (nearly) no further comments:

The authors thank the reviewer for his second review of our manuscript. Our response to the only comment is in blue here below.

Figure 6:
The caption says "... (g,h,i) Same as (c,d) but for anticyclonic wave breaking frequency. ..." Is this correct?

It is not correct. It has been changed to *"(g,h,i) Same as (d,e,f) but for anticyclonic wave breaking frequency."*. Thank you for spotting the mistake.