Geoscientific

Model Development

Discussions

[GMDD]

Interactive

comment

Interactive comment on "The Polar Amplification Model Intercomparison Project (PAMIP) contribution to CMIP6: investigating the causes and consequences of polar amplification" *by* Doug M. Smith et al.

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Many thanks for your comments. Please see our replies below.

Anonymous Referee #1 Received and published: 26 June 2018 This manuscript outlines the rationale and protocol for the Polar Amplification MIP, one of the many CMIP6 contributed MIPs. Overall, the paper is clearly written and provides sound rationale for the proposed experiments. I only have a few technical comments.

1. Page 3, Line 30: Huang, Xia and Tan (JGR, 2017) argue that the pattern of CO_2

radiative forcing also contributes to polar amplification.

Thanks – we have now noted this in the manuscript.

2. Page 5, Line 19: England, Polvani and Sun (JCLIM 2018) have also shown an equatorward shift of the SH jet in response to Antarctic sea ice loss.

Reference now included – thanks.

3. Page 8, Line 31: The proposed AMIP-style experiments (in experiment set 1) aim to investigate the relative contributions of local SIC changes and remote SST changes to polar amplification, but there is no experiment that quantifies the total polar amplification. Is it safe to assume that the SIC and SST perturbation experiments are linearly additive?

The total impact of SIC and SST changes can be diagnosed by comparing experiments 1.1 and 1.2. This can be used to test the linearity of SIC and SST perturbations, at least for differences between pre-industrial and present day conditions. We have now noted this in the text.

4. Page 9, Line 11: Should be Blackport and Kushner

Corrected – thanks.

5. Page 12, Line 21: Based on Table 1, seems like most of these are tier 1.

We are not sure what you mean here. Assessing the role of SST in future polar amplification requires tier 2 experiment 1.4, and assessing recent decades requires the tier 3 atmosphere-only transient experiments (5.1 and 5.2). Note that the experiment set (1 to 6) is not the same as the tier, which is listed in column 5 of Table 1.

6. Page 13, Line 12: Observations are not a "control" experiment - how do we know that the climatological refractive index that one would compute from observations is not already perturbed by climate change?

We assume that the model simulations of the present day will include the effects of climate change on the refractive index and so may be compared with observations (to produce the x-axis in Fig. 9).

7. Table 1: Experiment set 2 - what does 'pa' stand for?

The prefix "pa" was suggested by the CMIP6 data panel to denote partially coupled experiments that are unique to PAMIP. We have clarified this in the table caption.

8. Table 2: I do not understand why 1.9-1.1 is a in the future column. Also, there is no reference to experiment 1.10 anywhere in this table.

This was a mistake and has now been corrected to read 1.10-1.9. Many thanks for drawing our attention to this.

9. Figure 1: How do we define polar amplification? as a mean of ratios or a ratio of means? Hind et al., Scientific Reports (2016).

How to quantify polar amplification in a multi-model ensemble is no doubt important for some applications but we do not think it is necessary to include it here. We prefer to keep our message simple and use this figure to show that polar amplification is robustly simulated in response to increases in CO_2.

10. Figure 2: 31 models are used in Figure 1 but only 25 in Figure 2. Why?

The figures were made by different groups using all of the available data at the time they were made.

11. Page 36, Lines 29-31: Maybe I am mixing things up, but, shouldn't this read this way: "For future, the lower (upper) quartile regression is used for SIC/SIT (SST), in order to give more weight to models with less sea ice and warmer SST. Conversely, for the pre-industrial period, the upper (lower) quartile is used ..."

We agree and have now corrected this – many thanks for spotting it.

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2018-82, 2018.