

POINT BY POINT RESPONSE TO REVIEWERS

REVIEW OF DAVRINCHE ET AL., 2025 – FUTURE CHANGES IN ANTARCTIC
NEAR-SURFACE WINDS: REGIONAL VARIABILITY AND KEY DRIVERS UNDER A
HIGH-EMISSION SCENARIO

We thank the reviewers for their time and their valuable and helpful comments on the manuscript. We have implemented the following changes in a revised version.

Black = reviewer comment / Blue = author's comment / *Italic* = revised text.

1. RESPONSE TO REVIEWER 1

1. L161: should Gill be underlined in Figure 1?

Yes that is correct. We had previously only underlined the stations on the right panel, but we have also added it on the left one in the revised version.

2. L370: unclear if this is causal or just coincident

We meant it in a more coincident way, since there is no clear consensus in the literature regarding the effect of sea-ice retreat on the mid-latitude jet position nor strength. Kidston et al., 2011 suggest that any future decrease in Antarctic sea ice are unlikely to have a profound effect on the Southern Hemisphere mid-latitude circulation while Bader et al., 2012 findsthat reduction of SH sea ice leads to an equatorward shift of the mid-latitude jet. Due to the complex interplay and feedback between temperature changes, sea-ice loss, oceanic heat transport and jet modifications, it is complex to say whether sea ice loss can have a direct impact on the changes in the jet position. In order to make it clearer for the reader that we are not implying any link of causality, we will rephrase the sentence as follows:

L320: *The pattern of increase in westerlies coincidentally appears to follow closely changes in the extent of sea ice, shown in thick black lines in Figure 4.*

3. L492: 21st

This has been modified in the revised version

4. L501: “the decrease in coastal easterlies in all models is stronger in the MAR downscaling, where changes in the surface forcing are likely better represented” – the paper focuses mostly on scalar wind speed (sfcWind), without an analysis of wind components. It could be worth rephrasing where you use ‘easterlies’ in this paper for clarity? An increase in sfcWind could mean weakening easterlies (replaced by westerlies) or strengthened easterlies and vice versa

Yes, we understand this comment as we have indeed not shown any map of the

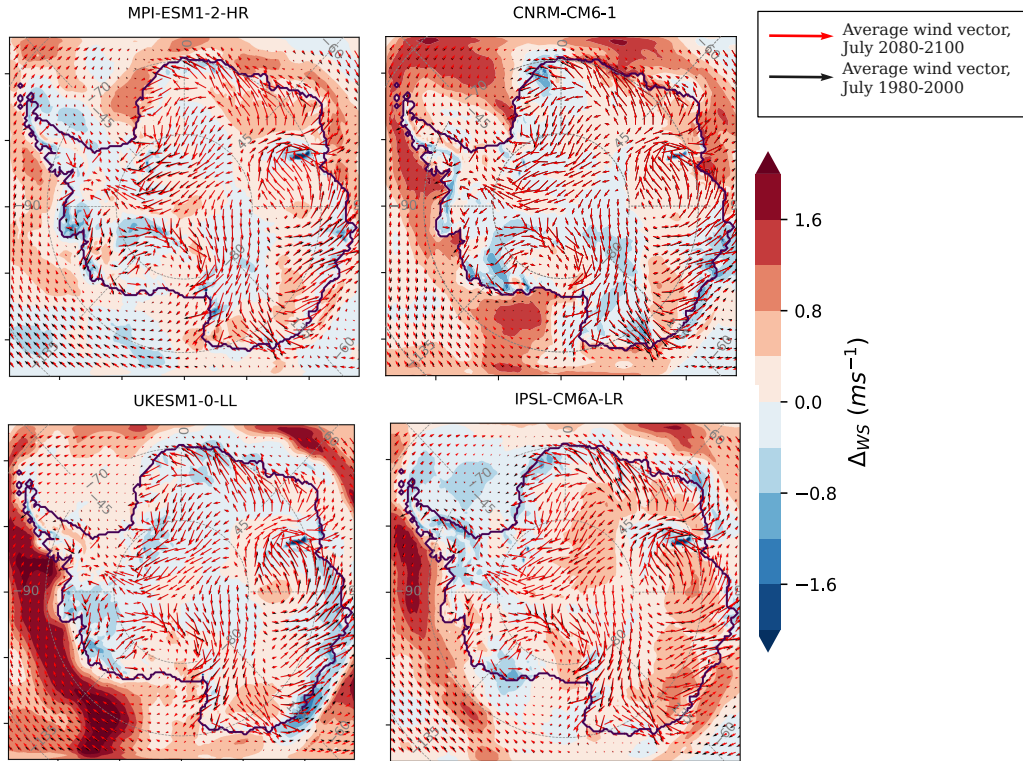


FIGURE 1. Projection of changes in 10-m wind speed between 2080-2100 and 1980-2000 for (a) MAR-MPI, (b) MAR-CNRM, (c) MAR-UKESM and (d) MAR-IPSL. Superimposed are the average wind vector for July 1980-2000 (black arrows) and July 2080-2100 (red arrows).

changes in wind direction. However, projected changes in mean wind direction or minor, as shown on Fig. 1. Therefore, we will change the following sentence, where we mention the weakening easterlies for the first time:

L329: *Everywhere else in Antarctica, MAR-IPSL and MAR-MPI project an overall increase in large-scale acceleration, while MAR-UKESM and MAR-CNRM exhibit some significant weakening of coastal easterlies (with minor changes in the mean wind direction) on Shackleton ice shelf and in Queen Maud Land.*

2. RESPONSE TO REVIEWER 2

1. The second paragraph of the Introduction is not a stand-alone paragraph – it's a single sentence, and consequently makes the Intro seem disjointed.

The paragraph break has been removed.

2. The paragraphs from lines #229 to #233 are also not suitable as stand-alone paragraphs.

Both paragraph breaks has been removed.

3. I don't think that a paragraph break is necessary in Line #295.

The paragraph break has been removed.

4. The remark in the final paragraph of the Introduction of the causes of katabatic winds should be mentioned much earlier, when katabatic winds are first introduced.

This remark has been moved to line 36/37

5. The use of 'Bedmachine' DEM requires a reference

We have added a reference to Morlighem et al., 2020.

6. line #160 gives short names for the GCMs and says there are referred to these hereafter, but the long names are then used in Table 2 and Line #169

Yes, it is true. Therefore we have introduced the short names line 169, at the end of the section instead.

7. Sentences such as 'They are regridded using a bilinear interpolation on MAR's grid.' are rather careless, as its not clear what is being regridded from this sentence (Output from these models are regridded ...).

We have modified the sentence as suggested:

L160: *Output of these models are regridded to MAR's 35km polar stereographic grid using a bilinear interpolation.*

8. line #174, which starts by mentioning storylines, then jumps to climate sensitivity, and then back to explaining the storylines. The justification for mentioning the different future changes in sea ice extent or stratospheric polar vortex is not very clear.

We understand this comment. Therefore we have:

- Moved the following sentence "*Note that all of these models are Earth System Models, except for CNRM-CM6-1 which does not include interactive ocean biogeochemistry nor atmospheric chemistry (Voldoire et al., 2019)*" right before the first mention of storylines, so that it does not interrupt the sentences about the storylines.
- We understand that the explanation for mentioning the ECS, SIE and SPV was not very clear and rephrased it such as follows:

The choice of these four models for our study is supported by another study by Williams et al., 2024 where these models were classified among

the best performing in winter when comparing their sea ice extent (SIE), surface air temperature, zonal wind at 850 and 50 hPa to ERA5. Furthermore, these models are representative of the large variability of plausible patterns of responses to climate change among CMIP6 models and can be expected to exhibit different patterns in wind-speed changes by the end of the 21st century. For example, Williams et al., 2024 noted that they correspond to different storylines for Antarctica, using winter SIE and Stratospheric Polar Vortex (SPV, linked to the strength and position of the surface westerlies, Table 2) as predictors. Additionally, they have different Earth's Equilibrium Climate Sensitivity (ECS, corresponding to the change in temperature at equilibrium that would result from a doubling of CO₂), which is a proxy for the intensity with which the model warms the Earth's surface temperature. While UKESM has one of the strongest ECS of all CMIP6 models, MPI exhibits one of the lowest.

9. Line #429: XXIst century? Is this the 21st century? I have never seen this written like this before.

Yes, it is 21st century in roman numerals. It has been changed in the manuscript.

10. I simply don't see much of a Discussion of the results here. Such as putting them into context with the current scientific understanding. Properly explaining them. Referencing other similar work / results / studies. Etc. This section actually only mentions three papers, one of which the authors led. And there is again poor paragraph structure (line #462). This entire section rather comes across as a series of statements about the results, so much more Conclusion than Discussion. This section needs to be strengthened considerably, with a lot more thought put into it.

We have reorganised and rewritten the entire discussion. Major changes are the following ones

- We have separated the section into 1. Discussion and 2. Conclusions*
- The conclusion section incorporates the majority of the sentences from the initial conclusion but has been reorganised and care has been given to the structure of the paragraphs*
- The discussion section is completely new and incorporates more comparison with results from 7 previous studies*

3. REFERENCES

- Bader, J., Flügge, M., Kvamstø, N. G., Mesquita, M. D., & Voigt, A. (2013). Atmospheric winter response to a projected future Antarctic sea-ice reduction: A dynamical analysis. *Climate Dynamics*, 40(11), 2707-2718.
- Kidston, J., Taschetto, A. S., Thompson, D. W. J., & England, M. H. (2011). The influence of Southern Hemisphere sea-ice extent on the latitude of the mid-latitude jet stream. *Geophysical Research Letters*, 38(15).

Morlighem, M., Rignot, E., Binder, T., Blankenship, D., Drews, R., Eagles, G., ... & Young, D. A. (2020). Deep glacial troughs and stabilizing ridges unveiled beneath the margins of the Antarctic ice sheet. *Nature geoscience*, 13(2), 132-137.