RESPONSE TO ANONYMOUS REFEREE #2

REVIEW OF DAVRINCHE ET AL., 2023 – UNDERSTANDING THE DRIVERS OF NEAR-SURFACE WINDS IN ADÉLIE LAND, EAST ANTARCTICA

We thank the reviewer for their valuable and helpful comments on the manuscript. We propose to implement the following changes in a revised version.

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

1. Specific comments

L48: "Interdiurnal" is not very clear. Maybe "...the variability of these winds on daily to monthly time scales"?

Yes, we will rephrase in the next revised version: *on sub-daily to monthly timescales*

L65: Replace "…and fast easterlies on the shore" with "…and strong easterlies along the coast".

This will be replaced in the next revision

Figure 1: Is the spacing of the dots related to the model grid?

Yes, it will be stated clearly in the next revised version

L72-73: Do you know why the model correlates better with tower data?

The centre of the grid cell is 14 km from D10 and 13 km from D17. We also know that the model output is closer to D17, because this station is more continental and MAR does not properly represent the oceanic conditions at the coast. Furthermore, we realized that we had made a mistake in the preprocessing of the D10 AWS. It will be corrected in the next revised version (Fig. RR1(c)). For Concordia, the reason is different: the wind sensors on the American tower and the AWS are different. Genthon et al. [2010]. showed that the AWS temperature was biased because the instruments were not ventilated. As a result, people tend to trust the American tower's measurements more, even though it has not been demonstrated that the tower had a better performance for wind's measurements. We acknowledge that we cannot favour one site over another, and will add the AWS data (at least for DC) to Fig. 7c of the manuscript in the next revision.

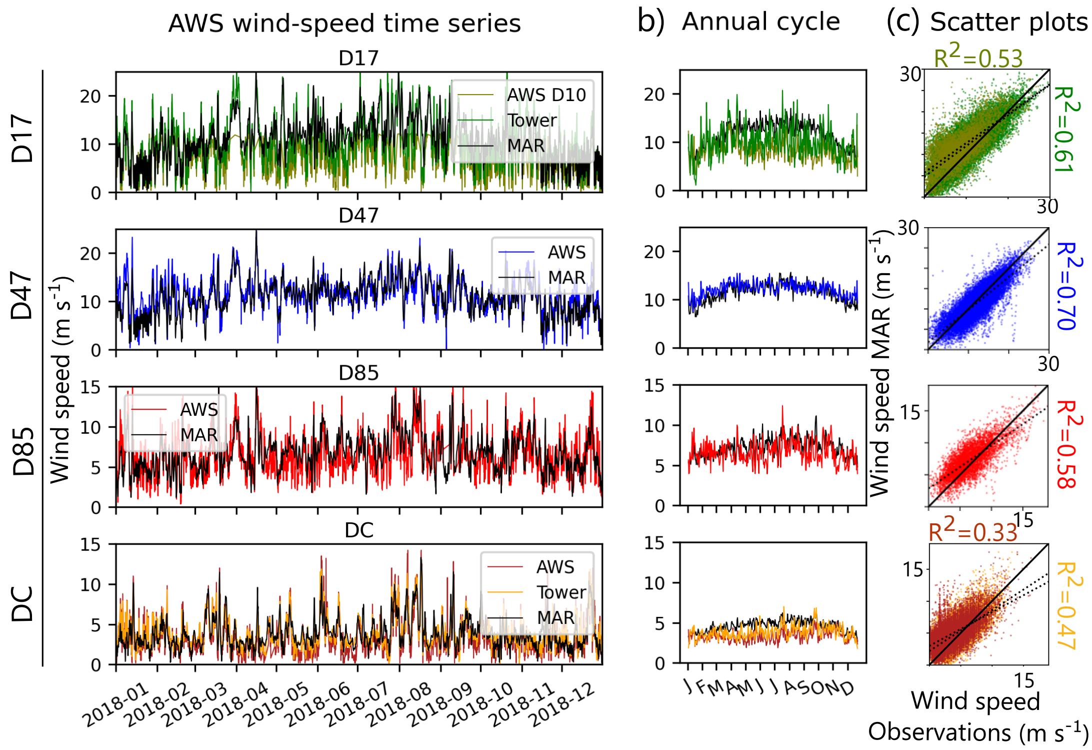

FIGURE R1. From top to bottom D17, D47, D85 and Dome C (a) Comparison of 3-Hourly MAR outputs (black lines) with meteorological tower measurements (when available, i.e. at DC and D17/D10) and AWS (coloured lines). (b) Seasonal cycle computed for the years available in each AWS, with MAR, AWS and the meteorological towers. (c) Scatter plots comparing observations and model outputs for each station. Black solid lines indicate the y=x line while the dotted ones are the linear fit associated with each evaluations. The determination coefficient R^2 is indicated next to each scatter plot.

L94: "...a horizontal resolution..."
This will be corrected in the next revision

L111: Capitalise "Near" at start of second sentence.
This will be replaced in the next revision

L129-130: Have you investigated how sensitive your results are to the various parameters used to decompose the potential temperature profile into its "background" and "near-surface" components? Demonstrating that your results are insensitive to the exact choice of, e.g. the height range for calculating θ_0 would add confidence to your findings.
Yes. We define the minimum value H_{min} for the interpolation of θ_0 as the height above which the first vertical derivative of θ becomes greater than a threshold

(i.e. N*$\gamma_{350-500}$), with N=5. The sensitivity of our interpolation to the value of N is shown in Fig. S1 and S2. Additionally, in the next revision, we will add a sensitivity test to the upper boundary of the height range (H_{max}). A comparison with a method based on the second derivative, instead of the first derivative (as suggester by reviewer #1) will also be added to the supplement of the next revised version of the paper.

Figure 3: Please include the station identifier in the legend for each panel in column (a) to help the reader
This will be done in the next revision

L198: "This includes a good representation of the seasonal cycle (Fig. 3b) ...". Actually, it looks as if MAR significantly overestimates the annual cycle at the D17 tower.
Yes, indeed. MAR overestimates the seasonal cycle compared to the D17 tower. The sentence "a good representation of the seasonal cycle" refers more to the spatial differences in the seasonal cycle. The authors wanted to highlight the fact that in both observations and MAR, the seasonal cycle is more pronounced in coastal and lower elevation areas than in the interior. However, it is true that MAR overestimates winter surface winds, leading to an overestimation of the seasonal cycle by almost 60 %. We will state that in the revised version of the manuscript.
You only show magnitudes of the accelerations here. Have you looked at the x- and y- components separately and, in particular, investigated whether (within expected uncertainty) they sum to zero, indicating closure of the momentum budget. Again, this would add confidence to your findings.
The turbulent acceleration term is in fact computed as a residual term separately in the x and y directions. Therefore, the x- and y- components sum to zero, by construction. However, we have confidence in our decomposition, because in both x- and y- direction, Our PGF native output correlates fairly well to our decomposition ($R^2 = 0.8$ in the cross-slope direction and $R^2 = 0.9$ in the downslope direction, see Fig. RR2).

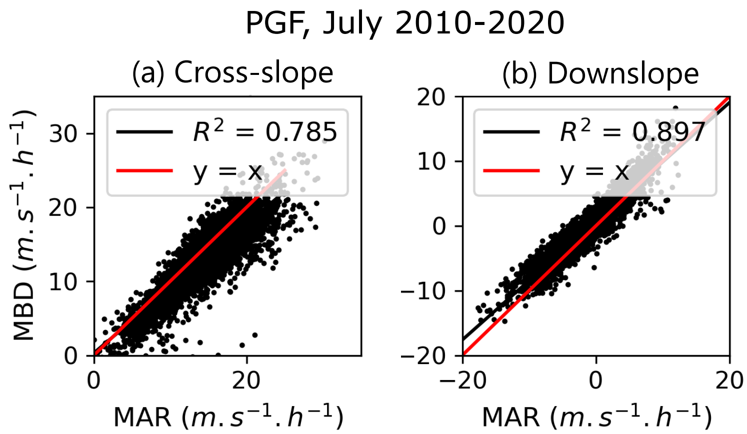

FIGURE R2. Pressure Gradient Force computed using our momentum budget decomposition (MBD) and natively computed by MAR in the (a) Cross-slope direction and (b) downslope direction

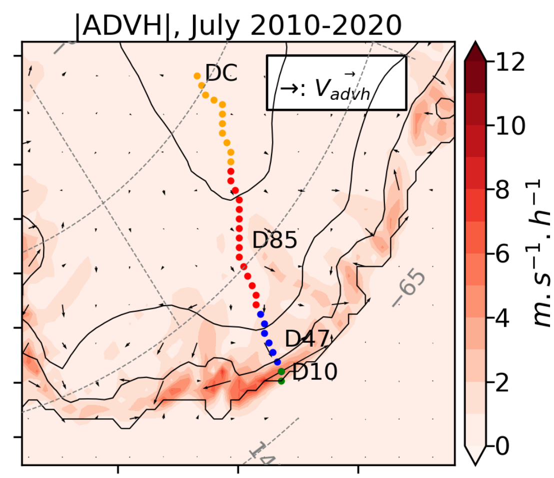

FIGURE R3. Map of mean 3-hourly July 2010-2020 horizontal advection (ADVH) and associated wind-vectors

L271-272: Why have you excluded ADVH from the list of terms studied? From Table 3, it looks as if it is locally and seasonally as important as some other terms. ADVH can indeed be important, especially in the slope break. In the next revision, we will add a map of ADVH (Fig. RR3)in Fig.7, plot its annual cycle in Fig. 8 and compute the correlation coefficients of ADVH and WS in Fig.9.

L276: "...spatial standard deviation...". Is this the standard deviation of all transect gridpoints for the mean July profile? Is this a useful metric - I would have thought that the range tells you everything that you want to convey
The authors thank the reviewer for this comment. It is the standard deviation of all transect grid points for the mean July profile. It doesn't convey any additional information. Thus, in the next revision, this metrics will be removed.

L277: Maybe "...the product of the surface slope and the potential temperature deficit..."
This will be corrected in the next revision

L284: Maybe "...inland of the coast", rather than "...from the coast" to avoid ambiguity
This will be corrected in the next revision

L288: Figs. 7a and 7b referred to in wrong order
This will be corrected in the next revision

L292-293: Maybe replace "This weaker mean intensity is due to the changing location of synoptic perturbations." with "However, the magnitude of the large-scale acceleration term varies greatly with a changing synoptic situation."
In the next revision, we will add the suggested sentence and move the original one to the end of the paragraph: '*The magnitude of the large-scale acceleration term varies greatly with a changing synoptic situation.* In winter, at D47, for instance, the large-scale acceleration displays a mean value of 5.4 m s^{-1} h^{-1}, but a value of the 99^{th} percentile (computed with 3-hourly outputs) of about 12.6 m s^{-1} h^{-1}, which is comparable to the mean value of the katabatic acceleration for that period. *The weaker mean intensity is due to the changing location of synoptic perturbations.*'

L323: "... EITHER the seasonal variability of the total wind speed, OR...
This will be corrected in the next revision

L416: Maybe "might not..." rather than "would not..."
This will be corrected in the next revision

References

Christophe Genthon, Michael S. Town, Delphine Six, Vincent Favier, Stefania Argentini, and Andrea Pellegrini. Meteorological atmospheric boundary layer measurements and ECMWF analyses during summer at Dome C, Antarctica. *Journal of Geophysical Research: Atmospheres*, 115(D5):2009JD012741, March 2010. ISSN 0148-0227. doi: 10.1029/2009JD012741. URL `https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2009JD012741`.