We thank the reviewer for their helpful and constructive comments. The reviewers comments are shown in black, our response in blue italics, and amendments to the text are in red.

Response to reviewer 1:

So far as I know (and I am not an expert) this is the first documentation of microplastics in Antarctic snow. As such it is a valuable paper that documents the ever growing reach of this pollutant.

Analysis of air borne microplastics is a relatively new field and one where protocols are still being developed. I am pleased to see that considerable thought has gone into the minimising of contamination in this study. The sampling and analysis protocols are thoroughly described and rigorous, providing confidence that the results of microplastic concentrations are accurate. The discussion of the potential sources is thoughtful and realistic. I have some specific comments below that might be considered before final publication about the analysis and the sources.

The analysis method (section 2.3) involves visual identification of the microplastics followed by FTIR characterisation. This visual approach must necessarily preclude some very small microplastic fragments, but there is no discussion of a lower size limit. The useful effort to check recovery focusses on particles of 500µm. In Figure 5 the lowest size range is 0-200 µm. Around line 240 there is discussion of the possible bias against detecting small particles in this work, but I would suggest that this be discussed in the methods section.

To address this, two sentences have been added to line 80 and 88, respectively:

"It is recognised that due to human error, inability to transfer some particles due to the small size and brittleness, and the translucent and transparent nature of some microplastics that there are limitations to this method which are unavoidable. This may lead to the underestimation of microplastics in this study."

"The smallest particle identified in this study was 44 µm (non-plastic), meaning particles less than this size were not accounted for due to the workable limit."

Table A2 describes the size of particles, but particularly for fibres with one long and another short axis, the issue of size is ambiguous and the caption of this table could be expanded to clarify this.

This may have been a misunderstanding; we state in the caption for Table A2 that: "'Size' indicates the width for fragments and length for fibres."

The discussion of sources is thoughtful and interesting, although necessarily inconclusive. As I understand it the remote sampling sites are generally south and west of the main nearby stations (Mcmurdo and Scott Figure 3) and the airflow was generally from the south and east (Figure 6). In line 357 I think the authors imply that air masses containing the sampled snow would have passed over "the bases" before reaching the deposition sites and in line 300 they suggest the bases are the main source. Their data shows higher microplastics closer to the bases, so there clearly is a source there, but I'm not sure that their data does imply the bases are the sources for the microplastics at the sampling sites further from the Scott and McMurdo stations. I would say you cannot conclude if the source is from there or from very long range transport, but maybe I am missing something in the argument.

We have reworded this sentence to address this issue on line 300 and line 357 respectively:

"Short-range transport of microplastics from the bases to ~~the~~ sampling sites close by (e.g. S14-S19) is more likely than long-range transport, given the sites' proximity to research bases and the climatology of the area. Yet sites further away may have more influence from long-range transportation, showing the potential influence of both short range and long range inputs."

"…it is likely that ~~the majority of identified~~local inputs were a contributor to the microplastic pollution identified. ~~microplastics originated from local inputs from surrounding research stations.~~"

We do know, as the authors document, that long range transport of other material than microplastics does occur to Antarctica, so this is clearly a potential source. In that context I did not really understand in line 203 what the authors mean by the residence time. I think their figure of 156 hours is the longest trajectory they considered. However, assuming that microplastics can remain suspended in the air (my understanding of the term residence time) for longer than that, they could have been derived from further afield, or indeed have been deposited and resuspended from land or the sea en route. I would suggest the argument here might be clarified.

These values have been taken from previously hypothesised residence times of airborne microplastics, as shown in the following paper: Brahney, J., Mahowald, N., Prank, M., Cornwell, G., Klimont, Z., Matsui, H. and Prather, K.A., 2021. Constraining the atmospheric limb of the plastic cycle. Proceedings of the National Academy of Sciences, 118(16).

At the first mention of residence time in line 182 we have added the following to expand on and clarify this:

"The residence time is the length of time that a particle can remain in the atmosphere which was estimated by Brahney et al. (2021) to be as long as 156 hours prior to deposition at the sampling site. We acknowledge that microplastics could be suspended in air for longer than the time periods used, although highly unlikely, and that they could have been derived from further afield or have been deposited and resuspended from land or the sea enroute."

References

Brahney J, Mahowald N, Prank M, Cornwell G, Klimont Z, Matsui H, et al. Constraining the atmospheric limb of the plastic cycle. Proceedings of the National Academy of Sciences 2021; 118.