Interactive comment on "Summer aerosol measurements over the East Antarctic seasonal ice zone" by Jack B. Simmons et al.

Anonymous Referee #1
Received and published: 21 December 2020

The authors thank referee 1 for their time spent reviewing this manuscript and their valuable advice in suggested improvements. We have edited the manuscript in line with the suggestions from referee 1 as detailed below.

Figure 1: Why are there no observations in one of the north/south transects of the SO? Ship exhaust? Or is it the software malfunction? Yes, referee 1 is correct: measurements were not taken on one transect due to software malfunction. This has been clarified in the figure caption.

… results on the other half of the measurements would be nice to provide a more complete picture, even if the air mass origin is not as precisely known…
Thank you for this suggestion. Total-voyage plots for CN_3, $CCN_{0.55}$ and ^{222}Rn have been included in Figure 4, along with the 'Southern' and 'No category' wind classifications. A total voyage median size distribution can now be found in the supplementary. I have also added a paragraph describing the overall voyage observations at the start of the results section. We agree that this adds useful depth to the manuscript.

Why might transit aerosol (CN3, CCN0.55, distribution modes) be higher than the Ferrel cell category if the transit is largely in the Ferrel Cell?
Thank you for this comment. The transit category of measurements represents a 'classic' remote marine bimodal aerosol distribution and encompasses the transit of the Investigator back to Hobart, whereas the 'Ferrel' category is representative of the southern extent of this regime where greater influences from, for example, biological secondary aerosols is expected. It is also likely that measurements from the Transit period of the voyage are influenced by continental and anthropogenic aerosol sources at their northern extent. In the 'Ferrel' category, these sources have little to no influence on local aerosol population as measurements are taken below 56°S. It must also be mentioned that homogenous aerosol concentrations in such large-scale atmospheric circulations are not expected- rather local sources and sinks will have a greater impact. I have clarified this and added an additional reference.

Line 298-309 It is a little hard to follow this paragraph, but more importantly, it's unclear what the point of this paragraph is. If you are going to point out differences in mode diameters, some reasoning as to why they are different is necessary to justify the importance of identifying them. I am not sure you can provide some context for some of these small differences between mode diameters, but without it, the figure alone is enough to show the differences.
Line 343-352 Similar to the previous comment, you are essentially describing what is seen in the figures, but not providing context on why these differences are important or what they mean.
Upon reflection, we agree this paragraph is difficult to understand and adds little useful detail to the manuscript. There it has been removed, (along with the similar paragraph at lines 343-352) and replaced with the following text.
"Significant differences between the modal size bins do exist between categories when calculating the uncertainty using this method. However, these differences are small (less than 12 nm in each case) for both wind and AH categorisations. It is therefore difficult to draw any conclusions from this result."

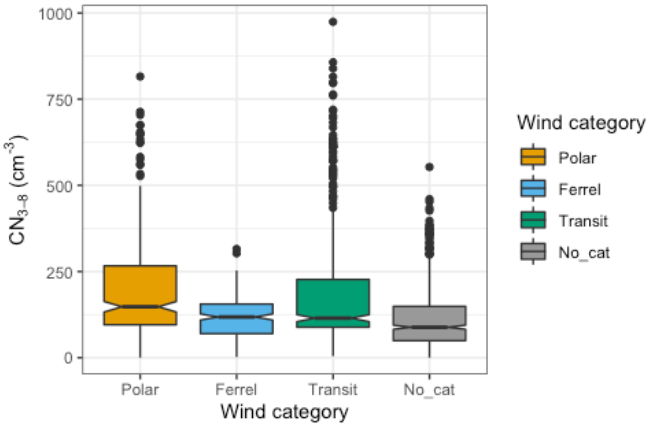
Line 318 – 339 Much of this comparison to Chambers et al. 2018 requires the reader to read Chambers et al. 2018 to understand it. It would be helpful to briefly include the necessary details from Chambers et al. 2018 to understand the comparisons you have made so that the reader does not have to read another manuscript to understand yours. Thank you for making this section more comprehensible. More details have been added to this section in an attempt to clarify how the present work compares to Chambers et al. (2018) in order to improve the clarity of the manuscript.

Section 3 is organized as if sections 3.1-3.4 are results and section 3.5-3.7 is the discussion. If you intend to keep the results and discussion separate, I suggest labelling the sections as such (I.e. change section 3 to results and add a section 4 titled Discussion which would included section 3.5-3.7). Otherwise you leave the reader wondering where the discussion is (as I have shown in my previous comments).- Thank you for this suggestion. The authors believe sections 3.5-3.7 contain most of the discussion, though some results are still being presented in these sections. Therefore, I have decided to leave the structure organised as it is, however, have included a clarifying sentence at the end of Section 3.4 ("The significance and implications of the results presented above will be discussed in the following paragraphs along with other supporting evidence.")

I suggest moving Figures S2 and S3 to the main text as they provide important context. – Thank you for this suggestion. The authors are not sure this is the best approach- these figures have been included in the main text in previous versions, but on the advice on multiple co-authors have moved them to the supplementary to improve the flow of the manuscript. With this in mind, we choose to leave these figures in the Supplementary.

Line 421. While this statement may hold true, comparing the tail of the size distributions is not the same as calculating the value of CN3-10. While you do not have CN10, you could still calculate CN3-8, which is a similar comparison. Good suggestion, thank you. Further analysis has been completed at this size fraction. As might be expected, the CN3-8 fraction is most highly concentrated in the 'Polar' measurements. In terms of magnitude the results are similar, however they are fractionally quite different.

Median concentrations	Polar	Ferrel
CN_3 (cm^{-3})	594	265
CN_{3-8} (cm^{-3})	148	118
CN_{3-8}:CN_3	0.25	0.45



This suggests a greater proportion of fine aerosol in the total population in the Ferrel cell measurements, despite these measurements being significantly less concentrated. I have added this information to the text.

Minor comments/suggestions:
The manuscript formatting does not follow the ACP requirements. – I have done my best here and used the Copernicus template, though recognise the references font is too small. Are there other areas I need to change?

Line 56. Change 'far' to 'remote' – Thank you, this has been changed.

Line 121. add space between 'L min-1' - Thank you, this has been changed.
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Figure 2. Maybe define the Ferrel cell wind direction as WNW to be consistent with the text. The width of Ferrel cell sector is 73 deg, not 68 deg. – Thank you, this has been changed.

Line 202. What are 'these' measurements – Thank you, this has been clarified.

Line 207 15% of figure 2a or 2b? – Thank you, this has been clarified.

Line 211. I know you defined the bin width elsewhere, but it may be worth restating here. – Thank you, this has been clarified.

Line 212. Stick with 'sectors' and remove 'windows' – Thank you, this has been changed.

Line 223. The measurements are labelled "Southern" in Figure S1 (not "No Category")- Thank you, this has been changed.

Line 282 Reference the relevant figure – Thank you, this has been changed.

Line 292 What finding? - Thank you, this has been clarified.

Line 299 Reported where?- Thank you, this has been clarified.

Line 334 It would be better to explain what a 'Type 3 and Type 4' day is in Chambers et al. (2018) – As mentioned earlier, this section has been edited for improved clarity.

Figure 6. change atmospheric pressure to atmospheric sea level pressure – Thank you, this has been changed.

Section 5 – Please provide a direct link to the data. – The DOI for these measurements is currently being processed. This link will be provided when the archiving is complete.