

Atmos. Chem. Phys. Discuss., referee comment RC1  
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## Comment on acp-2021-509

Anonymous Referee #1

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Referee comment on "Marine aerosol properties over the Southern Ocean in relation to the wintertime meteorological conditions" by Manu Anna Thomas et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-509-RC1>, 2021

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This study presents a detailed investigation into sea spray aerosol properties over the Southern Ocean. Sea spray aerosol is an important contributor to total aerosol radiative forcing and poorly constrained in climate models; hence how it may change in a warming world is not well understood. The analysis is thorough and gives a comprehensive picture of sea spray aerosol properties (which are assumed to be the dominant source of marine aerosol during austral winter). Where I would like to see improvement (which I think will also enhance the impact of the paper), is in thinking about how the results are meaningful. They are nicely summarised in the conclusions, but a discussion/synthesis regarding importance and outlook is missing. The authors discuss that climate models represent SSA poorly in the introduction (lines 90-109) – can the work be linked back to that discussion, for example? Do the results shed new insight into what climate models are doing wrong and how SSA parametrizations could be improved? The end of the introduction (lines 121-127) could also be modified to address the significance of the objectives.

Methods – I was interested to know how often cloud-free pixels were found in the data – after fulfilling all the selection criteria, what fraction of data are included in the analysis?

Lines 158: A reference is needed to justify the use of the 700 hPa GPH. Eg  
<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2005GL022419> or  
<https://journals.ametsoc.org/view/journals/clim/18/5/jcli-3284.1.xml>

In the paper's present form, the readers are supposed to take it as read that the 25<sup>th</sup> and 75<sup>th</sup> percentile thresholds of GPH correspond to ascending and descending air masses;

further explanation/references are needed here, which links to my next point.

Line 184. I follow the logic here, but because cyclonic conditions are defined as less than the 25<sup>th</sup> percentile in GPH, it's slightly confusing that they are also representative of the mean state. A plot of the GPH distribution (either in the Methods or Supplementary info) would help.

Figures: the use of the red/green colormap cannot be interpreted by those with colourblindness; see e.g. <https://www.scientificamerican.com/article/end-of-the-rainbow-new-map-scale-is-more-readable-by-people-who-are-color-blind/>

Instead of labelling the figures with 'P25' and 'P75' in the legend, using the labels 'ascending' and 'descending' (or similar) would make interpretation easier.

Minor comments:

L45. Aerosol radiative forcing has been updated toward more negative values, and is estimated to be between -2 to -0.4 W m<sup>-2</sup> (90% likelihood).  
<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019RG000660>

L203-204. Definitions of efflorescence and deliquescence are given here; it would be helpful to include these in the introduction also, around lines 59-65.

L 80-81. Unclear – at what wind speeds are 26% of the accumulation mode particles sea salt?

L146-147. I assume that avoiding the sea-ice zone further reduces the risk of contamination from DMS-derived sulfate aerosol (which should have low concentrations during austral winter anyway).

Line 198. Further explanation needed – why is it remarkable that linear depolarization is not sensitive to varying winds?