

## ***Interactive comment on “Wintertime enhancements of sea salt aerosol in polar regions consistent with a sea-ice source from blowing snow” by Jiayue Huang and Lyatt Jaeglé***

**Anonymous Referee #2**

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This is a well-written paper that explores in a model the relative influence of three sources of sea salt aerosol in the polar regions. Although the blowing snow source has been explored in a model with a similar parameterisation in another model, this is the first time that all 3 sources have been tested in a similar setup. The paper compares model output with aerosol data at a number of polar sites, with rather impressive results in terms of concentration, seasonality and episodicity. It is able to conclude on the importance of the blowing snow source in wintertime, and provides reasonable evidence to dismiss the frost flower source as a significant player in most circumstances. Overall, it is a good paper, clear and well-argued, and certainly worth publishing in ACP. It provides a basis for exploring other aspects of the influence of different sources of sea

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salt aerosol. My only substantial quibble with the authors is that set store by the fact that they get the concentrations right and that they are testing the balance between the sources. However this ignores the fact that they have had to take several decisions (such as the number of salt particles per snowflake, the salinity of the snow, and the scaling factor (Page 5, line 29), which are essentially tunings (ie they chose them in order to match the data). I think the paper should be a little clearer in recognising this, and in admitting that the relative strength of the different sources is influenced by this rather strongly. Detailed comments

Page 1, line 18. Here and elsewhere in the paper the authors refer to submicron aerosol, meaning the range which elsewhere they describe as the 0.01-0.50  $\mu\text{m}$  radius range. It would be helpful if they would clearly state this usage, perhaps on page 4, line 17, where after describing the accumulation mode they could add “which we refer to as sub-micron based on its diameter”.

Page 4, mid. I don't quite understand the description that for the blowing snow they treat just two size ranges. My understanding was that the Yang parameterisation that they are following uses many more size bins than that, and relies on this for many of its characteristics. Could the authors explain what they mean? Presumably they maintain different sizes in calculating the mass flux with respect to the number of snowflakes, so in what respect do they not use different size ranges and what are the likely impacts?

Page 5, line 5-6. I don't understand at all why they choose a lower salinity in the Antarctic, or why the higher Antarctic precipitation is relevant to that. It reads as if they think the snowfall somehow dilutes the salinity but this of course makes no sense as the salinity is more likely a function of snowpack thickness, which is likely lower in Antarctica. Please explain –at the moment this just looks like a correction factor chosen at random.

Page 5, line 28. I think you mean “geometric mean diameter” and “geometric standard deviation”. Geometric diameter doesn't seem meaningful.

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Page 7, line 8. Please explain what M and O are; as written your explanation of what NMB is is unclear. I assume it's the percentage mismatch between model and data – why not call it model-data mismatch? The word “bias” seems wrong when you are simply comparing alternative partial sources to the data.

Page 9, line 22-25. I assume that you are saying that, for the same size and place the lifetime is the same whatever the source (this must be true), but that the lifetime is longer because the blowing snow sourced aerosol tends to form when it's colder. It might be clearer if you explain it more in this way.

Page 9, line 24. Just a question from my ignorance: wouldn't we expect sea salt to become an efficient ice nucleus below its eutectic (ie about 250K), when it would become a solid?

Fig 1 caption. Please explain here as well what NMB is: the reader should not have to read a quite difficult bit of text to understand the figure.

Fig 3 caption. I struggled to understand the text about the coloured circles. Do you mean that the larger circles (which are anyway hard to see) represent the ship's position between 15 and 19 April. If so, why not say this. If not, it needs a new explanation.

Fig 4 and 5 caption, just for clarity please add “submicron” in the phrase “spatial distributions of wintertime submicron SSA”.

Supplement, section 1. Much of this text duplicates what is already written on page 4, para 1.

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