

## ***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 #3**

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This manuscript describes model-measurement comparison between GEOS-Chem with various sea-salt aerosol (SSA) sources and measurements from circum-Arctic field sites and a research ship cruise. The manuscript compares three models of SSA sources, open ocean, blowing snow, and frost flowers. Through the improved agreement between the model using the ocean + blowing snow model, the authors conclude that blowing snow is the dominant wintertime SSA source. The model using frost flowers is unable to match the observed seasonal cycles, and thus is indicated to be incorrect, and the model using only open ocean sources underpredicts SSA. The writing and logic of the manuscript are good, and the metrics for comparison are well defined and appropriate. Therefore, I support publication in ACP, with minor revisions.

C1

### General Comments:

1) The modeling in this manuscript uses a simple model for blowing snow based upon purely windspeed. However, experimental evidence (e.g. Sturm and Stuefer, 2013) shows that winds speed (alone) is insufficient to explain blowing snow fluxes fully.

Sturm, M. and Stuefer, S.: Wind-blown flux rates derived from drifts at arctic snow fences, *J. Glaciol.*, 59, 21–34, doi: 10.3189/2013JoG12J110, 2013.

This experimental observation could be a partial explanation of deviations between the model and high time resolution data shown in Figure 2. However that citation also is not able to give a simple single equation for blowing snow, so is not a solution to this challenge, and the approach adopted by the authors is reasonable given the complexity.

2) The manuscript uses mass concentration data of SSA as the metric for model-measurement comparison. However, it would be useful to describe the rough size distribution of the modeled SSA and potentially some comparison between the model and observations. Table 1 shows this information, but it is only briefly discussed and it would be valuable to enhance the discussion. In addition, because SSA could be a source of cloud condensation nuclei, conversions of these numbers to number densities would also be valuable.

### Specific Comments:

Page 1, line 18: The manuscript later defines "Over the Arctic..." as >60 degrees. these statements (in the abstract) should also include the definition.

Page 2, line 2: I would say "waters are mostly covered by sea ice."

Page 2, line 11: It would be more accurate here to describe studies that support SSA formation from frost flowers, as well as ones that don't support frost-flower SSA. The section later (at the bottom of this page and top of next) contains the references that are relevant.

C2

Page 4, line 28: I believe that other measurements of Arctic surface snow could be compared to the 0.1 PSU concentration. Toom-Sauntry and Barrie (2002) measured fresh snowfall, and Krnavek et al. (2012) have fairly extensive data sets.

Toom-Sauntry, D. and Barrie, L. A.: Chemical composition of snowfall in the high Arctic: 1990 – 1994, *Atmos. Environ.*, 36, 2683–2693, doi:10.1016/S1352-2310(02)00115-2, 2002.

Krnavek, L., Simpson, W. R., Carlson, D., Domine, F., Douglas, T. A., and Sturm, M.: The chemical composition of surface snow in the Arctic: Examining marine, terrestrial, and atmospheric influences, *Atmos. Environ.*, 50, 349–359, 2012.

Page 5, line 9: "ease" instead of "easiness"

Page 7, around line 12: It would be useful to mention that modeled spatial maps will be presented later.

Page 8, line 30: The wording here is a bit confusing, because the normal conditions used for modeling frost flower formation include open water and cold temperatures. In this work, page 5, line 26 indicates that frost flowers are suppressed by the high winds (or are covered by drifting snow), which is the origin of the statement. Please reword this section to indicate clearly that the high winds (rather than open water and cold temperatures) are the reason for "inhibition of frost flowers".

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