



## ***Interactive comment on “Biogenic, anthropogenic, and sea salt sulfate size-segregated aerosols in the Arctic summer” by Roya Ghahreman et al.***

**Becky Alexander (Referee)**

beckya@u.washington.edu

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Ghahreman et al. report observations of size-segregated concentration and isotopic composition of sulfate aerosol collected in July during an Arctic cruise. The sulfate and sodium concentrations along with the sulfur isotopes are used to apportion the sea salt, marine biogenic and anthropogenic sources of sulfur in the different size bins. They find that the majority of the sulfate in the fine-mode aerosol originates from biogenic sources.

The paper is generally well written. One important thing to address is the magnitude of Na<sup>+</sup> blanks on the filters. On page 6 they mentioned the lack of a sulfate blank, but Na<sup>+</sup> was not mentioned. Since they use Na<sup>+</sup> to correct for sea-salt sulfate, and sea-

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salt sulfate is such a large fraction of total sulfate, this is critical as it strongly influences the value of their calculated  $\delta^{34}\text{S}_{\text{SO}_4}$  and thus their conclusions. Also, I think it would be much more informative to give the total sulfate concentration, and then the fraction of each source. Instead the authors give the absolute concentrations of each source. I can't tell how important each source is unless I go back through the text and figures to find out the total sulfate concentration. If you still want to focus on the absolute concentrations of each fraction, please also give the fractions in parentheses.

Other, more specific issues:

Page 6: What is the analytical precision of the S-isotope measurements and how was it determined?

Page 7: Wind speed also influences DMS emissions.

Page 7 and throughout the paper: There are a lot of seemingly quantitative statements in the manuscript without the numbers in the text to back them up. For example, on page 7 line 13, how much less sea salt sulfate does it contain? Page 8 line 8, "the majority of sulfate" – what fraction is "majority"? Page 9 line 10, define what you mean by "high" and "low". Page 9 line 22: what percent makes this "important"? Page 9 line 23, what percent makes this "dominant"?

Page 8 line 17: Also should cite Jaeglé et al. [2011].

Page 10: The FLEXPART-WRF model results should be presented. I was expecting to see a plot of the back trajectories but this seems to be missing.

Page 10 line 2: There is no evidence from the isotope data for a significant contribution. . .

Page 10 line 19: How were sensitivity tests performed? Are you running a model? More detail is needed here.

Page 11 line 20: Again, plots showing the results of the back trajectory calculations

would be useful to show in a figure and referred to here.

Paragraph beginning on Page 11 Line 21: Shouldn't you be discussing the biogenic contribution here? It seems weird to ignore it here when it's so important.

Page 12 line 6: replace "in solution" with "the aqueous phase".

Page 12 lines 6-8: Cloud pH also strongly influences the rate of aqueous-phase reactions.

Page 12 lines 14-19: How were these numbers calculated? You have to assume some value for  $\delta^{34}\text{S}(\text{SO}_2)$  which is not stated here.

Page 13 line 4: Would this make these samples biased high in the calculated anthropogenic fraction?

Page 13 line 22: from 0.49 to 0.95

Table 1: Include fraction of nss-SO<sub>4</sub> here.

Figure 4: What do the error bars represent in Figure 4 and how were they calculated? There is no dashed line in my version of the figure.

Figure 5: I would find this figure more useful if b and c showed fractions instead of absolute concentrations.

References: Jaeglé, L., P. K. Quinn, T. S. Bates, B. Alexander, and J.-T. Lin (2011), Global distribution of sea salt aerosols: New constraints from in situ and remote sensing observations, *Atmos. Chem. Phys.*, 11, 3137-3157, doi:doi:10.5194/acp-11-3137-2011.

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