

Interactive comment on “Characteristics of biogenically-derived aerosols over the Amundsen Sea, Antarctica” by Jinyoung Jung et al.

Anonymous Referee #1

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The authors present measurements of aerosol and ocean carbon from the southern ocean and Amundsen Sea linking biological processes to marine particle concentrations and composition. This is an important processes, though not well understood, partly due to the interdisciplinary aspect of the subject. Better understanding this process possibly has significant implication on understanding future climate change. The authors do well to discuss and provide evidence for their claims. I am suggesting the article be accepted after major revisions. First, I agree with comments from referees 3 and 4 and will not repeat them here. The other main concerns I have involve the claims made in section 3.3-3.4, specifically that a significant amount of nssSO₄ is from anthropogenic sources. While possible, I do not think the authors have provided strong evidence. Previous studies in the SO have shown that almost no continental/anthropogenic pollution is transported over the southern ocean particularly south of ~50S (See Hudson et al. 1998). While the Hudson et al. 1998 measurements are in a different part of the Southern Ocean, I expect the result to be similar. A back trajectory analysis would strengthen your case if there really is anthropogenic sources.

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Major Comments: You noted the weakness of using MSA/nssSO₄ to identify the contribution of biological nssSO₄ to the total nssSO₄, and yet you still rely heavily on this method. The nssSO₄ likely correlates strongly to MSA in the Amundsen Sea simply because the nssSO₄ source (MSA) is local. It is common for nssSO₄ to be transported large distance, often in the free troposphere, resulting in little to no correlation with local sources/tracers (Sanchez et al. 2018) as you have seen in the Southern ocean with MSA (section 3.3). The lack of MSA alone is not a strong argument for the presence of anthropogenic nssSO₄. Based on the fact that there are no anthropocentric sources remotely close to most of these locations, this is the perfect example on why this method of identifying biological/anthropogenic nssSO₄ contributions is flawed.

Also, while nitrate can be attributed to anthropogenic emission, particle nitrate concentration (and nssSO₄ concentration) can also be enhanced by aqueous phase processing (in clouds). On Figure 5d, with the exception of samples A1 and A13 (both of which are between 45S and 50S on figure 1a, and relatively close to anthropogenic sources) the nitrate concentration seems fairly consistent and likely have little to no anthropogenic influence.

I would be surprised to find that at times anthropogenic sources account for even close to half the nssSO₄ in the Amundsen Sea, but you state biological sources account for 39%-138% nssSO₄ (i.e less than half at times). There are no relatively nearby anthropogenic sources to account for this. More evidence would be needed to make such a claim. With the exception of the northern most stations, I find it hard to believe anthropogenic sources would be a major source of nssSO₄.

Hudson, J.G., Y. Xie, and S.S. Yum, Vertical distributions of cloud condensation nuclei

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spectra over the summertime Southern Ocean, *J. Geophys. Res.*, 103, 16,609-16,624, 1998

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