

Summary/recommendations

The authors present gas-phase MSA and particulate MSA, DMA, SO₄, etc. results from ship cruises taken in the northern Atlantic ocean. The results indicate that DMS chemistry may not greatly impact aerosol composition or concentrations in the study region. I think that it is a good look at the problem, but that there is still more research to be done before declaring this finding as fact. The authors did not collect gas-phase DMS, they were only out for a single season, and their study range was small. I think the paper should be published with more caveats and care to not over-state their findings. The paper was well cited and generally well written, but there are several sentence fragments throughout the paper. I have pointed out a few but I do encourage the authors to carefully go through the paper again.

General comments

Introduction: it would be helpful to define the different Arctic regions more rigorously- currently the authors refer to 'low', 'high', and 'coastal'. Please provide latitude ranges or similar.

As a general comment, it's helpful to define 'uncommon' acronyms in each major section when they first come up. (For example, AO and PO).

Methods: How did the authors quality control their datasets to remove ship emission influences (that is, emissions from the R/V Xuelong)? This is an important but missing detail.

Methods: there is no discussion of the size range of aerosol collected, which is relevant for climate and human health. Was there any differentiation by size?

Results: Since there was no direct measurement of DMS in the atmosphere, the findings are somewhat speculative. The authors should state this limitation and be careful to not definitively state anything. The authors write as if they have solved this particular question for all of the AO (that DMS emissions and chemistry "scarcely impacted the atmospheric aerosols in the high AO" but I don't think this is so definitively solved. This study is a good look but requires more measurements/modeling over more seasons and a much larger area than the ship tracks covered. These caveats need to be discussed.

Lines 107-109: provide latitude ranges for LL, ML, SL, and HL. These ranges appear to be in Table S3 but I think this is relevant enough to be in the main text as well.

Lines 113-114: "The variations in the MS_{Ag} level were not always consistent with those of the MS_{Ap} along the cruise tracks, indicating that the formation mechanisms of MS_{Ag} and MS_{Ap} from oxidation of DMS are different." This is an interesting statement, I think the authors could

expand upon it some. Consider providing a supplemental figure or table showing the ratio of MSAg / MSAp. This may be of research interest to some.

Line 119-120: “The variations in MSAp levels in the SL region during leg I and II were associated with the phytoplankton activity in these regions (Fig. S6).” It is not easy to make this association based on looking at Fig S6 and Fig 1. The authors need to do more work here to make this association more clear. It would be nice to have some sort of statistical measure of how well associated MSAp and phytoplankton are - this could be an average for the region or more high-definition. The authors may also consider adding a supplemental figure that shows this association more clearly, like the ratio of phytoplankton to MSAp along the ship tracks, if possible.

Line 209-210: I recommend that the authors state “That is *likely* the reason why...” as the authors did not do a comprehensive analysis (for example, a principal components analysis) on where emissions were coming from for each species.

Line 212: do the authors have the measurement precision to state that a ~1% difference in amine is significant?

Technical comments

Line 22: HL not defined in the abstract

I recommend against using undefined acronyms in your short summary.

Line 29: “The Arctic is known for its amplified *rate?* of global climate change...” there is a missing word, perhaps the authors meant rate? Or Amplification instead of amplified?

Line 34: no comma needed between “increase, when”

Line 48 - I recommend adding a citation for “The loss of sea ice in the AO promotes the air-sea exchanges and subsequently increases dimethyl sulfide (DMS) emissions.” - unless the Sharma et al 2012 citation was appropriate for this statement as well? This isn't clear to me.

Line 53: “The observations carried out in the Ny-Ålesund revealed...” Do the authors mean Ny-Alesund *region*?

Lines 98-99: the sentence here is a sentence fragment.

Results: the authors are inconsistent in whether or not they capitalize ‘leg’.

Line 116: I think the authors meant “confirming” not “conforming”?

Line 135: the sentence here is a sentence fragment, I believe it belonged to the previous sentence?

Lines 167-168: the sentence here is a sentence fragment, I believe it belonged to the previous sentence?

Line 213: sentence fragment.

Line 258: suggest “strong positive...” rather than good. This is a more common way of phrasing it. (E.g. strong, moderate, weak correlations)

Line 277: Suggest “Sulfuric acid is more effective *for* new particle formation”

Line 305: The authors may have meant “concerning” , not “concerned”.

Citation for “Croft, B., Martin, R. V., Leaitch, W. R., Tunved, P., Breider, T. J., **D’Andrea**, S. D., and Pierce, J. R.: Processes controlling the annual cycle of Arctic aerosol number and size distributions, Atmos. Chem. Phys., 16, 3665–3682, doi:10.5194/acp-16-3665-2016, 2016. “ - fix the D’Andrea, and this is erroneously “**Crof** et al 2016” in the main text, line 59. Fix to Croft.

Figures/Tables

All figure with spatial maps (e.g. Fig 1): I recommend considering explicitly drawing out the different characterized regions (ML, SL, HL, LL). For example, you could make the land/sea masses a lighter gray, then add dashed lines to separate each region + a label on the figure for each region. This would make the results more distinct.

Figure 2: it’s not clear to me why ML and HL have dark cross hatchings over them? This makes the figure harder to read for me. I think the vertical lines are enough to provide distinctions. If the authors want to keep the cross hatchings, please make them a much lighter color, like light gray.

Table S3, Figure S3, Figure S4: define ML, SL, HL, LL in the table or figure caption.