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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Summertime sources of dimethyl sulfide in the Canadian Arctic Archipelago and Baffin Bay" *by* E. L. Mungall et al.

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RC1: *"This paper reports data and analyses from a recent field campaign made in the Canadian Arctic during the summer, with a particular emphasis on the observations of DMS in air by high time-resolution mass spectrometry, associated with some seawater DMS data obtained by gas chromatography. The authors investigate the role and impacts of oceanic and land sources of DMS in combination with a chemistry-transport model. The data in this region in this season is very valuable to fill the database and to test our understanding of the air-sea sulfur cycle. The measurements are sound and the analyses are thoroughly made. The paper is generally well organized and written. With the above three reasons, I would support publication after minor and technical revision."*

AC1: We thank the reviewer for the very helpful comments and suggestions.

Manuscript change page and line numbers refer to the marked-up version of the revised manuscript.

RC2: *"P35557, L10: The authors use primary productivity as a proxy of DMS in seawater. The first question is why primary productivity not Chl-a? There exist some parameterizations using Chl-a and MLD for the global oceans (Simo and Dachs, GBC, 2002) and SST and SSN for the North Pacific (Watanabe et al., Marine Chem., 2007). A recent paper suggested that primary productivity can be a good proxy in predicting seawater DMS (Kameyama et al., GRL, 2013). It seems to me that the authors' phrase sounds a bit awkward. The authors can be a bit stronger in phrasing this sentence by referring the Kameyama et al. paper. Also I wonder how seawater DMS is parameterized from primary productivity and where this primary productivity data came from (e.g., satellite?). As the model simulations were often used in the analysis later in the paper, the authors are encouraged to elaborate more details here."*

AC2: We thank the reviewer for pointing out these helpful references, which we have used in our manuscript revision. We revised the text to more clearly indicate the source of the primary productivity data and added details about our methodology. The essential point is that very limited information exists regarding DMS_{sw} in the Hudson Bay System, but we felt that a sensitivity test could still provide important information as to its possible role in the sulfur cycle of the summer Arctic.

While we did not use any literature parameterizations in our work, the parameterization of Dachs and Simo gives values that are roughly equivalent to the values we used (less than a factor of 2 difference) if we assume a mixed layer depth of 20 m and use Chlorophyll-a data from the MODIS colour. We do not have enough information to use the parameterization of Kamayama et al., as it would require us to know the net community productivity in the HBS, which to the best of our knowledge is not known.

Manuscript Changes:

p. 8 line 256: "We assumed that a) previously measured primary productivity values were representative of the year of our cruise and b) that the ratio of DMS_{sw} in Baffin Bay to DMS_{sw} in other bodies of water is the same as the ratio of primary productivity in Baffin Bay to primary productivity in other bodies of water. In effect, we assumed a linear relationship between DMS_{sw} and primary productivity. This assumption is in keeping with the Simo and Dachs (2002) parameterization for DMS_{sw}. We also note that Kameyama et al. (2013) use a related quantity, net community productivity, to parameterize DMS_{sw}, but net community productivity data was not available for the HBS. Ferland et al. (2011) found that the waters of Hudson Strait are as productive as those of the North Water (Northern Baffin Bay), while Hudson Bay and Foxe Basin are about a quarter as productive. Thus for our simulation we set the DMS_{sw} in Hudson Strait to be equal to that measured in the North Water, and the DMS_{sw} in Hudson Bay and Foxe Basin to a quarter of that value. In the absence of measurements, it is not possible to further constrain what the DMS_{sw} values might be in the Hudson Bay System."

RC3: *"Table 2 and Figure 1b: Clearly indicate atmospheric measurements, please."*

AC3: We thank the reviewer for drawing our attention to the need for clarification here. Figure 1b has been amended to indicate atmospheric measurements. Table 2 refers to atmospheric mixing ratios and is referenced in the text as pertaining to DMS_g.

Manuscript Changes:

p. 28 (Figure 1b)

RC4: *"Section 4.4: Although the investigation of non-marine sources is interesting and worth trying, some parts of the analyses are not strong. I feel better if the authors say 'speculative'. Otherwise, the authors should try to add more robust evidence from the observations or supporting information from the model runs."*

AC4: We agree that our investigation of non-marine sources should be viewed as sen-

sitivity studies because the related emissions are associated with considerable uncertainty. Throughout the revised manuscript we are now careful to identify uncertainties and indicate that these simulations should be viewed as sensitivity studies.

Manuscript Changes:

p. 2 line 22: "Sensitivity tests indicated that non-seawater sources (lakes, biomass burning, melt ponds and coastal tundra) could make additional episodic contributions to atmospheric DMS in the study region"

p. 4 line 114: "Section 4 presents sensitivity studies with the GEOS-Chem chemical transport model and the FLEXPART-WRF particle dispersion model, which examine the potential of seawater and non-seawater sources to contribute to the measured DMS_g."

p. 7 line 208: "The GEOS-Chem chemical transport model (www.geos-chem.org) was used to conduct source sensitivity studies."

p. 12 line 380: The title of Section 4 was changed to "Source sensitivity studies with GEOS-Chem and FLEXPART"

RC5: *"P35557, L9: In order to assess"*

AC5: We thank the reviewer for noting this error.

Manuscript Changes:

p. 15 line 474: "To assess the impact" was changed to "to investigate the impact that"