Biogeosciences Discussions

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Comment on bg-2021-252

Anonymous Referee #3

Referee comment on "Sea ice concentration impacts dissolved organic gases in the Canadian Arctic" by Charel Wohl et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-252-RC3, 2021

Within the present publication a unique data set of arctic sea water measurement of methanol, acetaldehyde, acetone, DMS and isoprene is presented by the authors. These measurements were conducted during 17/07201 to 08/08/2017 onboard of CCGS Amundsen. The measurements are distinguished between different sea ice cover periods and thus provide a very interesting insight in how sea ice cover is able to influence production of organic materials relevant for the atmosphere. From the measured sea water values the corresponding emission fluxes are calculated afterwards. The results of the paper fit very well into the scope of Biogeosciences.
The paper is well structured and the results are logically discussed. A deep discussion of the results with measured values from literature is done, too. However, I think in some parts more discussion is mandatory, especially in the conclusion on the atmospheric oxidation capacity. Furthermore, I find the figures 2 to 6 hard to interpret. I recommend publication after the addressing of my questions and comments.

General comments:

I find it hard to understand the figures 2 to 6 in which the depth profiles are presented. How am I able to know what concentrations was measured? In the legend are bars sketched that represent a certain concentration range, but these are not presented in the figure. These have to be added for the measurement points, otherwise the further discussion cannot be well comprehended.

Line 271
Here discussion text is missing.

It would be worth to compare the measured DMS values also with the values in Lana et al. (2011) and Hulswar et al. (2021). These are often used in global models to determine the

effect of DMS on climate. I suggest a small discussion of these data in comparison with the measurements due to the possible benefit for the model community.

Line 437 and following
In Dani and Loreto (2017) it was stated that "globally (i) marine phytoplankton taxa tend to emit either DMS or isoprene, and (ii) sea-water surface concentration and emission hotspots of DMS and isoprene have opposite latitudinal gradients". The results presented here reveal that this might not be true for oceans in interaction with sea ice, and coastal areas. A small discussion has been already done, but I miss a bit one in regards to the statement of Dani and Loreto (2017).

Regarding the emission calculation of DMS I think it is not so easy to neglect the gas-phase concentration. For gas-phase DMS in the Northern Atlantic up to 35 ppt and in the Antarctic more than 200 ppt were measured (see review of Yu and Li, 2021). The Henry's Law coefficient for DMS is 1.55 at 273°K. This results into a steady state water concentration of 0.05 and 0.31 nmol dm^{-3}, which is 4% and 22% of the mean measured sea water value. Therefore, it is my opinion that for DMS the gas-phase concentration cannot be easily neglected without some bias that has to be discussed.

I think the discussion of the assessment of acetone and methanol towards the lifetime of methane and other pollutants has to be deeper. Regarding the applied background values of methanol and acetone in this study together with the 1.8 ppm methane the first order reaction rate of methane with the OH radical is more than 2000% higher than that of methanol and acetone combined. The possible higher emission rates of DMS and isoprene might have a stronger effect. This discussion has to be done more deeply.

Minor comments

Line 124
What method has been used to correct the 16m wind speed to the 10 m neutral wind speed?

I would recommend to add a table into the supplement that displays the physico-chemical characteristics of the gases for the air-sea flux calculation.

Line 375
I suggest to delete are significant, as this has already been stated.

References

Lana, A., et al. (2011), An updated climatology of surface dimethlysulfide concentrations and emission fluxes in the global ocean, Global Biogeochem. Cycles, 25, GB1004, doi:10.1029/2010GB003850.

Hulswar, S., et al. (2021), Third Revision of the Global Surface Seawater Dimethyl Sulfide Climatology (DMS-Rev3), Earth Syst. Sci. Data Discuss. [preprint], doi:10.5194/essd-2021-236, in review.

Dani and Loreto (2017), Trade-Off Between Dimethyl Sulfide and Isoprene Emissions from Marine Phytoplankton, Trends in Plant Science, 22, 361-372, doi: 10.1016/j.tplants.2017.01.006.

Yu and Li (2021), Marine volatile organic compounds and their impacts on marine aerosol – A review, Sci. Total Environ., 768, 145054, doi: 10.1016/j.scitotenv.2021.145054.