Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-674-RC1, 2020

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Effects of Marine Organic Aerosols as Sources of Immersion-Mode Ice Nucleating Particles on High Latitude Mixed-Phase Clouds" *by* Xi Zhao et al.

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Received and published: 25 September 2020

General comments: The authors present a very interesting study on the effect of marine organic aerosol (MOA) on mixed-phase clouds. In particular, they present and validate results from three different MOA emissions schemes, quantify the resulting spatial cloud condensation nuclei and ice nucleating particles (INP) number concentrations and compare it to modeled INP concentrations of dust, using state of the art parametrizations. In contrast to previous work by other authors, they present data comparing the INP population of MOA to INPs of dust.

The writing (from an editorial standpoint) is to be commended. The methodology is

stringent and valid. The assumptions made are to a majority stated and their impact on the result comprehensibly assessed. The work addresses relevant scientific atmospheric questions with impacts on global climate simulations. The topic of the paper is well suited for ACP. I recommend the manuscript for publication if the following minor comments are addressed:

Specific comments: Page 2 (line 12/13). I do not fully understand why the three regions are stated. Are mixed-phase clouds only observed in the Arctic, Antarctic, and over the Southern Ocean? As the paper is also not focusing on these regions, I would propose to rephrase the sentence. E.g., include all regions or specify what is unique about mixed-phase clouds in the three stated regions.

Page 3 (lines 44-48). Kanji et al, 2017 provide an excellent overview of the different modes of freezing. The stated mechanism, however, was not introduced by Kanji et al., 2017. Please cite the original source or e.g. Vali, G., DeMott, P. J., Möhler, O., and Whale, T. F.: Technical Note: A proposal for ice nucleation terminology, Atmos. Chem. Phys., 15, 10263–10270, https://doi.org/10.5194/acp-15-10263-2015, 2015.

Page 15 (line 399). Is for the NULL approach the annual global MOA or sea salt emission 4.6 Tg yr-1? Please specify.

Page 23/24 (lines 652-683). The missing representation of secondary ice formation is nicely formulated. However, the study also does not model other IN species, such as ash, biomass-burning particles, or other land-borne bio particles. Please elaborate on the impact of this (valid) simplification on the study's results.

Page 32 (Table 1). Please explain variables in the caption, such as g, to support the reader's quicker understanding.

Page 46 (Figure 6). No need to change anything, just a general comment. With INP measurements, we are often divided about how the show the INP concentration most representatively over a long period. If we calculate the mean concentration, the result

will be “biased” towards higher INP concentrations if a few events with INP concentrations in the order of 102 to 103 are present. IMHO showing presenting the reader also with the median concentration provides a complete picture.

Supplement (Figure S1). The unit of plot d) is not fully visible.

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