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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Impacts on cloud radiative effects induced by coexisting aerosols converted from international shipping and maritime DMS emissions" *by* Qinjian Jin et al.

Anonymous Referee #1

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Jin et al. used an Earth system model with two aerosol schemes that differ in size modes and mixing assumption to study the impact of international shipping emissions (ISE) and natural DMS emissions on cloud radiative effects (CRE) over vast oceanic regions. They found that the regular ISE emissions have a significant global net CRE, which can be further enhanced in a model configuration with reduced DMS emissions. The study also demonstrated that the different aerosol treatments can influence the magnitude and spatial pattern of ISE-induced CRE. The authors suggest a re-evaluation of the ISE-induced CRE with the DMS variability considered. The impact of ISE on CRE is very uncertain. The findings of this study partially explain why the magnitude of ISE-induced CRE has a large spread, shown in the literature. The

paper is well written in general and results are clearly presented. However, there are some places in the manuscript that would benefit from further clarification and improvements. I recommend it for publication after the following comments and suggestions are considered.

1) L31-37: Only sulfur emissions are mentioned in the literature review. How about primary particles such as black carbon (BC) and organic carbon (OC)? If both BC and OC from shipping are fixed at the standard emission rate in the various model experiments, please comment on the role of these primary particles, compared to the secondary sulfate converted from sulfur dioxide.

2) L74: I don't think the word "diagnose" is properly used here.

3) L78-79: This is inaccurate. Aerosol in CAM5 does not have a direct microphysical influence on convective clouds, but can have an impact indirectly.

4) L80-96: Are there other differences in aerosol-related treatments between MAM3 and MARC, for example, gas condensation, new particle formation, cloud processing including aqueous-phase chemistry and particle resuspension? What differentiate the BC, OC and sulfate mass for each of the relevant size modes upon emissions? Answers to these questions are critical to understanding the model results in this study (Sect. 3.5), so I suggest including them here.

5) L115-116: What is the purpose to treat BC and OC differently in ShipZero and the other three experiments? This is not clearly noted when interpreting the model results (e.g., Figs 4 and 5).

6) L148-150: Are the contributions by aerosol modes or types derived from radiation diagnostics? It is unclear to me whether the radiation diagnostics are done in such a detailed way (by aerosol types). It is counterintuitive to see positive DRE for OC but negative DRE for BC (Figure 3). Any explanations?

7) L196-197: Needs clarification on the three numbers. How do they compare to the

base case (e.g., Shipzero_DMSref)? It would be interesting to have some discussion about the relative changes in CDNC, compared to the role of sea salt and other types of aerosols.

8) L200-208: I wonder if clouds in any of these regions are more susceptible to DMS emissions than the others (i.e., relative forcing changes normalized by relative emissions changes).

9) L220: this sounds like an important claim. The role of any specific type of aerosol in affecting high-latitude clouds depends much on the background total aerosol concentrations. What's the model performance in simulating high-latitude natural and anthropogenic aerosols?

L230-242: The two aerosol schemes gave very different results on the magnitude of the ISE-induced CRE, which is my biggest concern. The current explanation is too vague. More in-depth analysis is required here. Have the two schemes been systematically compared in terms of the global aerosol direct and indirect forcing?

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