

Review of “Global relevance of marine organic aerosols as ice nucleating particles” by Huang et al.

General Comment:

This study uses the ECHAM-HAM global climate model to examine the importance of the marine organic aerosol (MOA) in ice cloud formation when acting as ice nucleating particles. The authors evaluated different parametrizations in their climate model and found that the relative importance of MOA over mineral dust strongly depends on the used parametrizations. Additionally, it was found that the influence of MOA in the microphysical properties and radiative balance is mostly insignificant.

Given the large attention marine aerosol particles have recently gain due to the potential they have to catalyze the formation of ice clouds, and the large uncertainties coming from both observations and modelled predictions, it is necessary to conduct more research in this direction. This is an interesting study and it is a valuable addition to the literature. The paper is well written, and it can be accepted for its publication in ACP after the following minor and technical comments are incorporated in the final version. The reviewer has expertise in field and laboratory work and therefore, the following comments mostly focus on this part.

Minor comments:

1. Is ice multiplication considered in the ECHAM-HAM model? The present results indicate that MOA can nucleate ice particles at temperatures ranging from 0 to -10°C. This is the same temperature range at which the Hallett-Mossop mechanism is believed to take place. What is the influence of ice multiplication in the ICNC reported by the model, and if it is not considered what could be the uncertainty associated to this “omission”?
2. Tables 2, 3, and 4. Please add the meaning of the first column abbreviations in the table’s caption. This will help the readers to follow the manuscript.
3. The reviewer have the impression that a deeper explanation on why high concentrations of MOA are not obtained in the Southern oceans when using the Rinaldi et al. (2013) emission.
4. P24 L10: Are additional uncertainties associated with this 10 additional years?
5. The grammar can be improved in several places.

Technical Comments:

1. The use of the word “aerosols” in the title and along the manuscript is incorrect. Aerosol refers to several particles, therefore it is not necessary to use the “s”. Either use “Aerosol” or “Aerosol particles”.
2. P1 L5-6, L18-19: I am wondering if the Wegener-Bergeron-Findeisen process is the only pathway for cloud glaciation. How about ice multiplication?

3. P1 L13: Please clarify if this statement refers to a global or regional scale.
4. P1 L17: Add a reference after “homogeneously”.
5. P1 L18: Add a reference after “temperature”.
6. P1 L20: Add more references after “precipitation”.
7. P2 2: Add a reference after “effects”.
8. P2 L4: I suggest to replace the Cziczo et al. (2017) reference with a more appropriate one (e.g., Kanji et al., 2017, Coluzza et al., 2017).
9. P2 L7: Why MOA is not as effective INP as mineral dust? This is based on who?
10. P2 L9: Replace “Marine organic aerosol” with “MOA”.
11. P2 L9: Add a reference after “bursting”.
12. P2 L11: Add a reference after “ocean”.
13. P2 L12: Why insoluble organic matter only?
14. P2 L16: “heterogeneously frozen ice crystals” sounds a bit awkward.
15. P2 L18: Spell out ISCCP.
16. P2 L26: Add a reference after “robust”.
17. P3 L22: Delete “cloud droplet number concentration” as this was already defined.
18. P4 L5: Why is sea salt independent of MOA?
19. P4 L10: A hygroscopicity parameter of zero is based on who?
20. P6 L7: Were the droplet freezing experiments conducted using a glass plate and a metal mesh? I don’t think so. This sentence is confusing.
21. P15 Figure 4: Add “(left)” after “Island” and “(right)” after “Head” in figure caption.
22. P22 L7-8: How about ice multiplication? This also takes place at this warm temperatures in the presence of ice and supercooled drops.
23. P22 L17: Delete “(Wilks, 216)”.
24. P25 L19-20: How about Burrows et al. (2013) and Yun and Penner (2013)?
25. P32 L12-13: Delete <http://www.atmos....>
26. P32 L18: Correct the page numbers.