Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2021-245

Anonymous Referee #2

Referee comment on "The effect of $(NH_4)_2SO_4$ on the freezing properties of non-mineral dust ice-nucleating substances of atmospheric relevance" by Soleil E. Worthy et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-245-RC2, 2021

General comments

This paper presents results from experiments investigating the impact of ammonium sulfate additions on the freezing properties observed for suspensions containing dust and non-dust INPs. The paper has a clear structure and is well written. The visual presentation of experimental results is adequate. The findings presented in this study are interesting, but a much larger emphasis should be put on enabling the translation of these findings into atmospheric implications, i.e. through a more thorough analysis delivering a quantification of the measured effects which is not dependent on the experimental parameters chosen for this study (e.g. dust mass).

The following points need to be addressed before this paper can be published:

- To be able to compare against other experimental studies more easily, results should also be reported as ice nucleation active surface site densities (i.e. normalized to mass or surface), so that at least relative changes at a fixed ammonium sulfate concentration could be quantified independently from the INP concentrations. Ideally, I would like to see measurements at different INP and ammonium sulfate concentrations, so that these results could be used more readily in climate models.
- Also, there is no discussion of statistical uncertainties associated with the observed frozen fractions.
- Lastly, I don’t agree with the authors’ conclusion that ammonium sulfate solutions can be used to reliably detect the presence of dust INPs. There are no experimental results showing how sensitive this method would be to variations in concentration (INPs, ammonium sulfate). Along the same lines, it is not clear what the results would be for complex particles, e.g. agricultural soil dusts that are mixtures of mineral dust and organics.

Specific comments:

- l. 90: Reference for selected ammonium sulfate concentration?
- Fig. 2-5: How do you explain the substantial variability in the blank measurements or between different microlayer samples? And how does this variability impact the interpretation of your experimental results?

Technical comment:

- Fig. 5: Please change 'control' to 'blank'.