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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Investigations of the impact of natural dust aerosol on cold cloud formation" *by* K. A. Koehler et al.

Anonymous Referee #2

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The paper by Koehler et al., "Investigations of the impact of natural dust aerosol on cold cloud formation" examines the heterogeneous freezing behavior of different dust samples (two natural samples collected on ground, and pure and SOA-coated artificial Arizona Test Dust). Measurements in the deposition and condensation freezing regime are introduced and discussed. The paper is well written and concise and presents interesting and new results, among them: 1) the different dust types abilities to nucleate ice in the different freezing regimes (deposition and condensation) and 2) the influence of SOA coating on the freezing. Work like this will eventually help to disentangle the still not understood procedures that influence heterogeneous freezing processes. Therefore I recommend publication of this work once the below given comments will have been addressed.

page 19349, lines 9-10: Later in the paper you discuss results for particles generated after submersion in water (see page 19361 and Fig. 5). So you might not want to explicitly exclude them, here.

page 19353, line 26: "(Delta-RHi=1.5% ...)" - between 200 to 400nm?

page 19356, line 2: In connection to the size dependence, please also stress that due to doubly charged particles, it could be the case that those particles that activated ice were largely the larger, doubly charged ones (you say earlier, that about 30% of the particle might be doubly charged). It could be the case that you always observed freezing of the larger doubly charged particles, only, and this should be discussed somewhere.

page 19359, lines 6-9: "It also appears ..." - I guess you refer to the fact that you only got one datapoint for each of the two smaller sizes, at about -35°C, while you got more datapoints for the 400nm? If so, then maybe stress here that for T>-35°C and for 200 and 300nm particle sizes freezing was not observed (as otherwise one could think that you just did not measure in this range.)

page 19360, line 21: Isn't SD shown as blue circles (not green)?

page 19360, line 24: Either also give the type of symbol used for coated ATD, or delete these mentions for the other dust-types, too (as they are given in the caption again).

page 19360, line 25: Isn't OLD green squares (not circles)? (This also seems to be wrong in the caption of Fig. 5.)

page 19361, paragraph starting at line 15: I find this whole paragraph very confusing: 1) The sudden appearance and discussion of wet generated aerosol seems to be somewhat out of place, in this paragraph (at its beginning and at its end), particularly as you said in Chapter 2.2 that you would not treat wet generated particles. 2) Also no tests were run with CID in aqueous suspension, however, you only say that explicitly for SD. 3) There is a break in the topic of the sentences ending and starting in line 19 that

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is confusing. 4) The size dependence of dry generated particle types is not shown in Fig. 5. And also, this is very hard to see from data for 200, 300, and 400nm in general. 5) There is again a break in the topic of the sentences ending and starting in line 25. 6) I'm don't agree that the RHi required for onset of ice nucleation is nearly invariant (it varies by at least as much as 25%.

page 19362, lines 10-12: Sullivan et al. (2010, still an ACPD-paper) found that for ATD particles coated with sulphuric acid the IN fraction in the deposition freezing regime was greatly reduced (compared to untreated particles), while the IN fraction was reduced to a lesser degree for the condensation freezing regime. Would this mean that coating with SOA and coating with sulphuric acid can do comparable things to an IN? It could be worthwhile discussing this in your work.

page 19366, line 15: I think you mean "ice formation on 1% of the particles at temperatures warmer than -25°C was only observed ..." (i.e. move the "was only observed")

Figures 1-5: Datapoints in the region that is shaded in the lighter grey differ from other datapoints of the same type (i.e. you made the interior somewhat lighter). However, I found this not explained anywhere. You might want to think about excluding these points, anyway. Or you have to explain at least that and why they are somewhat lighter . Also, black and the blue that you used are VERY hard to distinguish, so I suggest you use a lighter blue or cyan, instead.

Figure captions 1-5: In captions of Fig. 1-3 and in the main text you quote ICIS-data as being for ice nucleation on 1% of polydisperse particles, while in caption to Fig. 5 you quote them as 0.1%. Please correct. Also I suggest you only explain the general layout of the figure once (in the text or in the caption of Fig. 1) and then refer to this. (E.g. explaining the grey areas, the Koop-line, ...) Also, for all captions, the data is NOT shown as a function of sizes, but as a function of temperature and for different sizes.

References: Sullivan, R. C. et al. (2010), Irreversible loss of ice nucleation active sites in mineral dust particles caused by sulphuric acid condensation, Atmos. Chem. Phys.

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Discuss., 10, 16901-16940.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 19343, 2010.