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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global impact of mineral dust on cloud droplet number concentration" *by* Vlassis A. Karydis et al.

Anonymous Referee #1

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This is an interesting study of the role of dust in droplet nucleation. Although some of the conclusions are compromised by neglect of droplet collision, I don't think those concerns need to be addressed in this study. There might even be value in neglecting droplet collisions, although that raises questions about the evaluation.

Minor comments

Lines 65-58. Confusing text. I suggest instead "Reports of hygroscopic growth âĂĺmeasurements of dust particles indicate solubility to be very low, so that activation of observed cloud condensation nuclei (CCN) has been attributed to soluble ions âĂĺpresent in the particles".

Line 71. Wouldn't the "fraction of soluble material on the particles" correspond to the soluble ions referred to above? âĂĺOr is the critical distinction between soluble material

within and on the surface of the particles? And between the fresh dust and aged dust? Perhaps even fresh dust is coated with soluble ions. This is not to say that adsorption or condensation of secondary soluble material are not important, but why neglect soluble material in the emitted dust. Surely some types of dust (clays?) must contain soluble material.

Line 90. Start new paragraph with "Hatch".

Line 96. Start new paragraph with "Based".

Lines 117. Start new paragraph with "Soluble", as the previous text describes mechanism while the following text describes conclusions above dust activity sampled in the atmosphere.

Line 143. Drop "Only", as "few" implies it.

Line 159. I think you mean "aged dust can substantially deplete in-cloud supersaturation ", and replace "eventually" with "hence".

Line 179. Replace "which " with "that".

Line 201. Replace "is" with "are".

Section 3.1. This discussion never mentions the role of droplet collision in depleting droplet number concentration. Droplet activation is not the only process that determines droplet number concentration. Please consider the role of collision in your discussion, or show that it is not important (perhaps in thin warm clouds).

Line 336. Are these in-cloud means?

Line 338. Replace "are" with "is".

Line 381. The grid cell mean is typically less than 1 cm/s in global models. How large is the mean velocity over the central Asian deserts?

Line 384. Is 113 the global annual mean?

Section 3.2 I'm not sure what the purpose of this section is, since the aerosol and updraft velocity are not evaluated. Are you trying to show that the activation process is realistic, or just that droplet numbers are realistic? I'm not sure that you can achieve the former without validating the aerosol and updraft velocity too (or stratifying droplet number by aerosol and updraft velocity), and the latter is of limited value because EMAC neglects collision (as we learn later).

Line 408. In-cloud values?

Line 441. Spatial and/or temporal variability?

Line 468. Now we finally learn that collision is neglected in the simulations. This should be noted before the comparisons are presented.

Line 493. This gets confusing. Please be explicit about whether you are referring to addition or subtraction of mineral dust.

Line 502-503. This is the first time we learn about nudging. This should be reported in the experiment design.

Section 4.2. This is written very clearly and is quite interesting.

Line 607. Over over.

Lines 665-667. Should note again that the simulation neglects droplet collision. . . . .

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