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Atmospheric Chemistry and Physics
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Discussions

Interactive comment on "A comparison of two chemistry and aerosol schemes on the regional scale and resulting impact on radiative properties and warm and cold aerosol-cloud interactions" *by* Franziska Glassmeier et al.

Anonymous Referee #1

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This paper compares two very different aerosol modules embedded within the same model framework. They first explored the impact of parameters/oxidant fields that may affect the aerosol formation and distribution and then they compared the impact of the two modules on AOD, CCN, INP and formed cloud droplets/ice numbers. The final main conclusion is the structural differences between the two models (like chemical reaction schemes, species amount) play the major role in determining the aerosol production or burden, which is well expected. Another main conclusion is that the differences of aerosol burdens and nucleation schemes have impact on the formed cloud droplet and ice particles numbers but the impact is diminished or buffered by the cloud

microphysics.

Overall, the paper is well written and the study is thorough and contributes to the understanding of aerosol formation and their impact on clouds. Yet it is not clear in many places, I recommend the authors address my comments below before it can be accepted for publication.

General comments: 1) Using (f1-f2)/(f1+f2) to see the percentage changes can be confusing and misleading, especially when f1 and f2 are quite different. Suggest show both fields and then show the percentage differences. 2) I also suggest the authors add an acronym list at the end of the paper. 3) I also suggest the authors show the precipitation field from the simulation.

Specific comments/questions: Page 3, show full name of MADE

Page 4, Fig 1, caption. Show the meaning of the 2-letter abbreviations in the caption and add an acronym appendix.

Page 4, line 13. If there is not nucleation scavenge, does impact scavenge take the hygroscopicity of aerosols into consideration? In another way, can increased SO_4 coating affect the wet deposition of non-sulfate aerosols?

page 5, line 14, how many insoluble modes in M7? seems 3 in Fig. 1.

Page 7, How a PDF of updraft velocity is used in the activation scheme? Please add a few sentences to explain it.

Page 8, line 20. Add "excess" in front of water vapor.

Page 11, Line 7/8, why use "ca." instead of "$\sim$" which is more straightforward?

Page 11, last line, is the impaction scavenge scheme in the models able to describe such effect? If so, please add a few line describing the impaction scavenge scheme in the previous section.

Page 12, Line6, please clarify how you calculate the size distribution of internally mixed mode (like as,cs in M7) and how they are used to calculate the distributions of each species showed in Fig.5.

Page 12, line 16. From table 4, sea salt in M7 is 12% more (or ∼24% actually). Is this the mainly reason rather than being smaller?

Page 13, Figure 3. Why use (f1-f2)/(f1+f2) instead of ((f1-f2)/(f1+f2)*0.5) to show the percentage changes. By using (f1-f2)/(f1+f2), you are essentially diminishing the percentage changes by a factor of 2 in all your discussions.

Page 14. Does BC in accumulation mode in M7 have more SO4 coating? If so, this may explain less BC in this mode via wet deposition.

Page 14, last line. does SO4 coating affect the impact scavenge? Is there nucleation removal or other removal mechanism beside this?

Page 15, line 2. Switch “4,3”. What is SIA?

Page 16, fig 5. What is the “Total distribution” here, which curve? How are the distributions of each species calculated is not clear from the caption.

Page 19, Line 5. Is SO4 coating from aqueous production of SO4 assigned to accumulation mode only or mainly? how is this determined?

Page 19, last 4 lines. What is the purpose of this compensation of sulfate burden in MADE ? Is it simply because M7 has more sulfate and MADE has more species? Need to justify why you compare it this way.

Page 28, line 5. Suggest change CN=CCN, INP and N=. . .. Make it clearer. Also how is the CCN calculated? Use certain S or use the w* mentioned on page 10?

Page 28, 26, “riming-splintering” has very narrow temperature range to apply. Is it possible to show the ice formation from this mechanism to the INP?

Page 29, last line. Please explain why larger aggregation number actually makes it closer to the 1:1 line.

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