

# ***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 #2**

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The authors compared impacts of two different aerosol module, MADE with full gas-phase chemistry and M7 with a constant-oxidant-field-based sulfur cycle, on aerosol burden, as well as aerosol-cloud interactions. They found that aqueous-phase sulfate production, the selection of aerosol species and modes and modal composition are more important than parametric choices for aerosol populations. Differences in cloud droplet and ice crystal number concentrations are buffered by cloud microphysics. This study could improve the understanding on implication of aerosol schemes in air quality and climate models. Before this manuscript can be considered for publication, I have a few comments that need to be addressed by the authors.

Major comment:

The author compared MADE designed for air quality applications and M7 for climate projections in this study and concluded the importance of different processes or parameterization. However, one of the interesting information is not clearly presented and should be discussed. That is which processes are most important for air quality models and which processes are important for climate models, and possible improvement of future models based on your results.

Other minor comments:

Page 5: I suggest the authors to add a table to compare the detail of aerosol processes between these two aerosol modules.

Page 7 Line 3: Change 2.2.1 to 2.3, because Aerosol-radiation interactions are not relevant to 2.2 Sulfur chemistry.

Page 8 Line 23: Why the author chose a Saharan dust outbreak reaching Europe in May 2008?

Table: MADE passive simulation aqueous-phase chemistry and climatological oxidant fields. It may confuse readers if it shows 'y' as the same as M7. The authors should clarify it in table caption.

The authors used  $(f_1 - f_2) / (f_1 + f_2)$  to quantify relative differences in this study. I think the it should be  $(f_1 - f_2) / [(f_1 + f_2)/2]$  instead.

Page 19 Line 10: It may not be valuable to compare secondary inorganic aerosol between MADE and M7. Although M7 only simulate sulfate, the particle is actually  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{HSO}_4$  in the atmosphere. Many climate model consider sulfate mass as  $\text{NH}_4\text{HSO}_4$  instead of  $\text{SO}_4$ . The author did not describe how is sulfate mass treated in M7.

Page 28 Line 13: Because the authors are comparing two aerosol modules, it is better

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to show the figures for both of the two modules. Do they have the same information with the combined data?

Page 28 Line 16: Change smaller to lower.

Page 31 Line 13: Please clarify these conclusions are probably region-dependent. As I know, the aqueous oxidation of sulfate is sensitive over Europe, but some other regions are not. Also, please change chemical reactions to aqueous oxidation, because chemical reactions may mislead readers.

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Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1092, 2017.

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