

Interactive comment on “Simulating aerosol microphysics with the ECHAM/MADE GCM – Part II: Results from a first multiannual integration” by A. Lauer and J. Hendricks

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Reply to anonymous referee #4

We thank referee #4 for the work on the review and the comments on our manuscript, helping us to improve our paper.

Specific comments:

1. We agree with the reviewer that it is a good idea to mention current work on global aerosol models performed within AeroCom. We added two further examples of GCMs including aerosol microphysics and we included the following paragraph in the introduction:

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"Due to the high relevance to climate research, the representation of aerosols is currently also subject to improvement in some other general circulation models. Different approaches and techniques are applied regarding the representation of the aerosol size-distribution (modal with fixed standard deviation or bin scheme), the number of modes or bins, the aerosol components considered and the number of aerosol micro-physical processes included. The progress achieved so far is well documented under the framework of the AeroCom Aerosol Model Intercomparison Initiative (Textor et al., 2006). Model results and further information can also be found on the AeroCom web page <http://nansen.ipsl.jussieu.fr/AEROCOM/>."

2.+3. According to the literature, the coarse mode mostly has little effect on the sub-micrometer size-range for both, particle number concentration and particle mass concentration. We do not claim this is true for all cases found in nature (in particular for the source regions of sea salt and dust), but we think we won't lose too much accuracy due to neglect of the coarse mode when investigating average properties of submicrometer particles dominated by other components than sea salt and desert dust. To give some more details on the omission of the coarse mode in the manuscript, we added the following sentences to the model description of MADE (section 2.2):

"A calculation of Binkowski and Roselle (2003) for a typical average continental aerosol size-distribution showed, that the Aitken mode loses only about 0.1%/hr of particle number concentration and about 0.02%/hr of particle mass to the coarse mode due to intermodal coagulation. The calculated loss rates of the accumulation mode to the coarse mode are even lower (0.002%/hr and 0.0008%/hr for number and mass concentration, respectively). Thus, about 4 weeks would be needed to reduce Aitken mode particle number concentration to 50% due to intermodal coagulation with coarse particles, which is substantially longer than the typical residence times of Aitken mode particles. Hence, the coarse mode can be omitted without losing much accuracy when focusing on average properties of submicrometer particles under typical continental conditions. Nevertheless, the concentrations of sea salt and dust in the accumulation

mode could be overestimated by the model due the neglect of intermodal coagulation with coarse particles which can show comparatively large concentrations close to their sources. However, this overestimation is limited by the short residence time of the coarse particles due to efficient sedimentation."

4. We agree with the referee and replaced "aerosol dynamics" with "aerosol micro-physics" throughout the text.

5. The referee is absolutely right, that representing the submicrometer aerosol size-distribution by two modes (4 parameters) is a strong simplification. We added "in a simplified manner" to the first sentence of the MADE model description to point this out. For a discussion of potential impacts of the simplifications used within MADE (internal mixture, constant standard deviation, missing nucleation mode) we refer to the first part of this study: section 2.2.1 (sigma, internal mixture), section 3.3 and 4. (nucleation mode).

6. We are pleased to hear that referee #4 likes a even more detailed analysis in section 4. Thus we added a short discussion and a figure of the primary aerosol compound black carbon to section 4.4 to show the differences to the secondary aerosol compound sulfate. However, we think any further extension would lengthen the article significantly although referee #1 and #2 suppose the paper is already too long. Regarding section 3.1, we shortened all paragraphs as much as possible.

Technical corrections:

1.-3. Done.

4. To be more precise, we added "total" to "number concentration" to the caption of figure 6.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 7519, 2006.