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Atmospheric Chemistry and Physics Discussions

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

A. Lauer and J. Hendricks

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Reply to anonymous referee #1

We thank the referee for the comments on our manuscript, which helped us to significantly improve the quality of the paper.

1. We are sorry that the referee thinks that our paper is much too long. In our opinion, the section about aerosol mass distribution is essential to provide a complete and consistent picture of the aerosol properties simulated and presented in this paper. This is necessary to go into further details on the simulated composition, size-distribution, and in particular on the impact of aerosol microphysics for the simulation of submicrometer particle mass and number. We agree with the referee, that the basic findings on the

mass distribution are not new. Nevertheless, we think this section provides the basis for a better understanding of the results presented in the following sections. Thus, we don't think it's a good idea to remove the section on aerosol mass distribution only to reduce the length of the paper. However, we shortened all paragraphs of section 3.1 as much as possible.

2. We agree with the referee that adding the word "submicrometer" to the paper's title would characterize better what the article is focusing on. However, this is the second part of two closely related papers. In order to stay consistent with the title of part I, which cannot be changed any more, we do not want to change the common first part of the title. Thus, we added "submicrometer" to the second part of the title: "Results from a first multiannual integration of the submicrometer aerosol".

3. Directive 1999/30/EC of the European Council is not a voluntary guideline, but gives mandatory limit values for PM10 since 2005. We rewrote the sentence as follows: "Recently, aerosols received increasing attention in environmental policy as the directive 1999/30/EC of the European Council obliges mandatory limit values for particulate matter (PM10) in ambient air since 2005."

4. Done.

5. In this study, we did not consider aerosols calculated by MADE in the models radiation and in the cloud microphysics. Our motivation to do so was to study the effect of including aerosol microphysics on the aerosol distribution alone without altering any model dynamics. If we had chosen to allow feedbacks, we wouldn't know whether differences in aerosol properties simulated by MADE were related to altered model dynamics or to the newly considered aerosol microphysics. However, we agree with the referee, that an additional statement on our motivation is needed. Thus, we inserted the following sentence: "This allows us to study the impact of aerosol microphysics on aerosol properties alone. Changes introduced by altered model dynamics and cloud properties would introduce additional uncertainties in investigating the relevance of

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aerosol microphysics to the simulation of global submicrometer aerosol."

6.-11. Done.

12.+14. There is particle formation by nucleation in the boundary layer. However, on global annual average nucleation is much more effective in the upper troposphere than in the PBL. Near the surface, high production of sulfuric acid vapor coincides with a high particle surface concentration. This results in predominant condensation and prevents efficient nucleation. Due to the coarse spatial and temporal resolution of the model, individual nucleation burst that might occur are not resolved. To make things clearer, we added the following sentence: "Since a high production rate of sulfuric acid vapor in the boundary layer usually coincides with a high particle surface concentration, condensation prevents efficient nucleation in the model. Due to the coarse spatial and temporal resolution of the model, local nucleation bursts cannot be resolved resulting in a potential underestimation of nucleation in the boundary layer."

13. We agree with the referee, that it is not clear why our analysis is restricted to sulfate. In order to be consistent with section 4.1, 4.2 and 4.3 we decided to include the net-production/-depletion of black carbon. The analysis now considers sulfate and black carbon as representatives for the secondary and primary aerosol compounds.

15. Aerosol number is removed by both, stratiform and convective clouds. The scavenging coefficients are calculated separately for both cloud types from current cloud and aerosol properties applying the same parameterization.

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