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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The aerosol-climate model ECHAM5-HAM" *by* P. Stier et al.

Anonymous Referee #

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General comments:

The manuscript introduces the aerosol-climate modeling system ECHAM5-HAM and presents its application to predict aerosol distributions and radiative properties on global and regional scales. The simulation results are validated against an extensive set of measurement data and previous global modeling studies. On the whole, the manuscript is well written and organized, and addresses a highly important topic in the scope of ACP. In my opinion, following response to the specific comments and suggestions below, the study should be accepted for publication in ACP.

Specific comments:

1. The major deficiency of the manuscript is that it does not discuss the sensitivity of the results to the chosen model parameters. Although the model results agree relatively well with the measurement data, the basis on which certain values were chosen for the parameters remains unclear. Are they best guesses based on literature (which

should be cited) or have they been optimized to reproduce the observations as closely as possible? How stabile are the results to changes in these parameters?

2. The description of the aerosol size distribution relies on the modal approach with a fixed standard deviation for each mode. Under many atmospheric conditions, this approach is, however, notably inferior to a modal approach with varying standard deviation (e.g. Zhang et al., Aerosol Sci. Technol., 31: 487-514 (1999)). Given this, the authors should briefly discuss the effect that their choice of size distribution description has on their results.

3. The treatment of organic aerosol is not fully clear to me. In section 2.3 it is stated that the organic emissions are treated as primary emissions and in section 2.3.2 that 65% of the POM emissions are assumed soluble. What is meant by solubility in this context? What hygroscopic growth factor is assumed for the organic particles and does the chosen value agree with the measured ones (e.g. around 1.1 for terpene oxidation products)? Furthermore, the authors should mention the effects that neglecting SOA formation (i.e. assuming only primary emissions) has on simulating aerosol dynamics.

4. The model distributes the sulfate produced in the aqueous phase only to accumulation and coarse modes. However, aqueous phase sulfate production is also an important process growing Aitken mode particles to the accumulation mode and can thus affect the dynamics of the particles.

5. Section 2.7.5: To which mode are the particles produced in a collision of an insoluble particle with a smaller soluble particle placed? Is the intra-modal coagulation omitted only for the insoluble dust modes (and not for the insoluble Aitken mode)? If so, why?

6. One possible reason for the under-prediction of the aerosol number in the lower boundary layer is the nucleation mechanism used. Several studies have reported nucleation events in the troposphere that cannot be explained by binary sulfuric acid - water mechanism. The effect of other possible mechanisms (ternary, ion-mediated etc.) on the results should be briefly discussed.

ACPD

4, S2364–S2366, 2004

7. Titles and legends in some of the figures are very small and difficult to read.

Technical corrections:

1. Throughout the text: replace ‘Hereby is x’ with ‘Here x is’

2. Throughout the text: replace expressions of the form ‘after the condensation available sulfate’ with the form ‘sulfate available after the condensation’

3. p. 5555, line 25: replace ‘relaxate’ with ‘relax’

4. p. 5556: To help the reader, the assumption of 4 soluble and 3 insoluble modes should be written out in the text with a brief motivation of this mode structure chosen.

5. p. 5558, line 16: correct the parenthesis in the reference

6. p. 5560, lines 19-20: replace ‘allowed to be condensated – or nucleated’ with ‘allowed to condense – or nucleate’

7. p. 5561, line 8: the word ‘tracer’ is printed twice

8. p. 5566, line 15: correct the parentheses in the reference

9. Section 2.7.1: The first two sentences of the section are confusing if presented here. They should be moved to section 2.7.5 where the omitted coagulation processes are explicitly discussed.

10. p. 5574, lines 13-14: replace ‘is condensed’ with ‘condenses’and ‘are wet deposited’ with ‘is wet deposited’/’is removed by wet deposition’

11. p. 5580, line 20: replace ‘evaluation’ with ‘evaluation of’

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 5551, 2004.