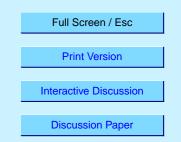**Atmospheric
Chemistry
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Discussions**

Interactive comment on "Simulating aerosol microphysics with the ECHAM/MADE GCM – Part I: Model description and comparison with observations" *by* A. Lauer et al.

Anonymous Referee #1

Received and published: 27 October 2005

This paper describes the coupling of the aerosol module MADE with ECHAM4 to include aerosol size distributions in a global climate model. It gives a summary of the aerosol physics and chemistry that are parameterized and then compares model predictions with a number of observations of aerosol concentrations and size distributions. From the comparisons a number of deficiencies are highlighted including too small aerosol sizes in the upper troposphere resulting from too slow growth of freshly nucleated particles and a global over prediction of surface BC concentrations probably due to incorrect source strengths. The paper is well written and presented in a clear and logical manner.

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The proper treatment of aerosol size is an important issue in dealing with the evolution of aerosols, in getting the aerosol-cloud connections right and in predicting radiative forcing. Since this is the first paper about this model it obviously focuses on describing the model features and making the case that it can predict aerosol sizes reasonably well, rather than exploring any new science. Furthermore it is not really a new model, but rather a coupling of existing models. Even though there are other models that also have global aerosol sizes I would say that this endeavour was justified since its simplified modal approach should allow more sophisticated chemistry and physics to be included.

There are some minor modifications that are needed. Most importantly the abstract, which is often all a reader will check, should include some of the limitations. In particular it must state 1) that the coarse mode is not being simulated, 2) that it is being run in a passive mode, and 3) there is no interaction with radiation. I would also like to see some further discussion about how activation of aerosols to cloud droplets is treated and how the CCN aerosols are separated from interstitial aerosols within the cloud since these are some of the important processes that can be handled by having an explicit aerosol size distribution. Also there should be more discussion about the relative humidity controlled swelling of aerosol sizes and how their modal approach takes it into account.

Although compromises have to be made to allow the model to run quickly with a global domain, I would like to see a bit more discussion about some of the fundamental limitations in the aerosol module, in particular 1) assuming fixed standard widths in the log-normal modes, 2) assuming full internal mixing of all components. I would also like to see some preliminary assessment from the authors on why they think their new model is better than existing models. Has it really been worth the effort of adding MADE to ECHAM? I realize these issues will be treated more in future papers, but it is important to convince the audience in this first paper that they really have a better model with excellent future potential.

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Typos Line 29 on Page 7990, "peek" should be "peak" Line 2 on Page 7996, delete "are"

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 7965, 2005.

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