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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Piecewise log-normal approximation of size distributionsfor aerosol modelling" *by* K. von Salzen

Anonymous Referee #4

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Review of "Piecewise log-normal approximation of size distributions for aerosol modelling" by K. von Salzen, submitted to Atmospheric Chemistry and Physics Discussions.

This paper discusses a new method of representing the particle size distribution. I believe the new method appears reasonable, however the comparison with the discrete-bin method chosen appears not to be so useful. As such, I believe the comparisons should be redone before the paper is published.

Specifically, Appendix A.2. shows the method used by the author to obtain total particle number concentration in a discrete size bin. However, the total number and mass concentration in a discrete bin can be obtained nearly exactly simply by breaking the

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bin into several hundred sub bins, calculating the number and mass concentration separately in each sub bin from the continuous equation(s), then summing the number and mass concentrations separately over each sub bin of the main bin. This is what was done, for example, to initialize models for the intercomparison shown in Zhang et al. (Aerosol Sci. Technol, 31, 487-514, 1999).

Unless I am missing something, it appears that the conversion from an observed, continuous distribution to a discrete distribution is done only once during a model simulation, during initialization (as it is done in at least one of the papers mentioned above). As such, the use of a computationally-intensive integration procedure such as that just described, would not appear to have any disadvantage (with regard to computer time) when applied to discrete bins. The author should clarify exactly how frequently the conversion from a continuous to discrete size distribution is needed in his model and if the conversion is used for anything aside from initialization.

Once the method above is compared with the proposed method, it will be easier to see whether the proposed method results in an advantage.

Additional comments:

1. Abstract. “A third parameterĚ” Please describe briefly or omit from abstract since “a third parameter” is not helpful to readers.

2. “The accuracy of the method is considerably higher than the accuracy of the frequently used bin method in these tests.” This conclusion applies only to the discrete-bin representation assumed by the present author and not necessarily to those used by other authors (e.g., as described above), so the conclusion should not be generalized to apply to all bin methods as it currently implies.

3. The paper examines application of the method with nucleation, condensation, and settling, all processes that the modal methods treat fairly well, but ignores transport, coagulation, and change in particle composition/size due to chemistry, which model

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methods treat less well. As such, the conclusion in the abstract is somewhat misleading. The author should state, for balance in the abstract, something to the effect that processes that modal models often have trouble with were not treated in the calculations.

4. P. 3962. “Aerosol number concentrationsĚare obtained from diagnostic relationships.” This is not true in Jacobson (1997, Atmos. Environ. 31, 131-144), where both number and mass (volume concentration) are prognostic variables (Equations 1 and 2, 5 and 6, etc.).

5. P. 3964. A disadvantage for application of the modal approachĚ” Please also mention treatment of transport, coagulation, and change in composition/size due to chemistry are difficult to treat with the modal approach.

6. Results. To separate out feedbacks from the overall model formulation, a comparison of the different approaches in a box model should also be shown where the comparison shows the size distribution after individual physical processes (e.g., condensation, nucleation, settling) have been solved separately over a short time (in other words, a figure for each process). An exact solution (e.g., at high size resolution and low time step) should also be shown.

7. Figures 5, 7, and 9 seem to provide little useful information and are difficult to interpret. How do we know which one is correct?

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 3959, 2005.