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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Using a combined power law and log-normal distribution model to simulate particle formation and growth in a mobile aerosol chamber" *by* M. Olin et al.

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Review of Olin et al.

The authors present a new moment-type method for simulating aerosol microphysics, in which the size distribution is assumed a sum of a power-law part for the smallest particles and a lognormal part for larger ones. The performance is tested against a high resolution sectional model, and additionally compared with low resolution sectional methods as well as a pure lognormal method. The topic is in the scope of ACP but some more work is needed before publication.

In my view there are two major (and necessary!) issues to work on a bit more:

1. The new method is tested only in 0-D. For direct 0-D simulations we do not need

faster methods - even PC:s can handle as many sections as are needed for very good accuracy. However, as the authors state in the conclusions, page 19, lines 19-23: "The PL+LN model is useful in simulations involving the initial steps of aerosol formation where a sectional representation of the size distribution causes too high computational cost, such as in multidimensional simulations or in the case of obtaining input parameters as the model output through inverse modelling." I suggest that the authors show the usefulness of their method in either of these cases: a spatially multidimensional system or an inverse modelling case! The authors have already done some inverse modelling with the method, however it was mentioned to be simple trial and error and not many details of this work were shown. E.g. applying the method with some automatic 'fitting' routine to search for some unknown parameters (such as nucleation rate, condensable vapour concentration or growth rate) would be much more impresssive.

2. The role of the fitting parameter gamma is a little bit troublesome. The authors show that their choice of gamma produces very nice results in the chosen example case. How about other systems? Is a high resolution sectional method always needed to complement the new method? And what about spatially multi-dimensional cases or inverse modelling? Will a single value work in a spatially multidimensional simulation with varying conditions? And, will results of inverse modelling be sensitive to the choice of gamma? Some more advice to the readers/model users would be very valuable! In addition, I would very much like to see figure 4 also for other selections for gamma.

Minor comments:

3. Page 1, line 17: Why is the sectional method called 'shape-preserving'? In my view, e.g. lognormal models are shape-preserving and in contrast, sectional methods allow the shape to evolve according to the dynamics.

4. Page 2, lines 3-4: In addition to moving centre method, similar so-called two-moment methods suffer also from less numerical diffusion than 'regular' fixed sectional methods (e.g. Adams and Seinfeld, JGR 107, D19).

5. Is equation 1 correct? Shouldn't there be delta_D_(j-1) in the denominator of the first term on the right hand side of the lower equation?

6. Page 5, line 30: The lognormal features can arise also because of intramodal coagulation, resulting in a self-preserving distribution that resembles lognormal shape. (Friedlander, Smoke Dust and Haze)

7. Pages 9-10, gaussian quadratures: Such details of numerical integration would be more suitable in an Appendix?

8. Page 16, lines 8-14: Please explain in detail how the size distributions of the different instruments are combined.

9. Page 16, line 15: 'diameters around 15 nm' is very vague.

10. Page 17, line 15: To get a nice result as in figure 6, is the LN distribution needed at all? If not, then it is no wonder that the LN result is much worse than the PL (which is in accordance with theory)?

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