Atmos. Chem. Phys. Discuss., 8, S3794–S3796, 2008
www.atmos-chem-phys-discuss.net/8/S3794/2008/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Monte Carlo simulations of two-component drop growth by stochastic coalescence" *by* L. Alfonso et al.

Anonymous Referee #2

Received and published: 16 June 2008

General comments: The use of stochastic simulation to evaluate the Long kernel is novel. However, I have some concerns with other aspects of the paper:

1. Section 3.1 (Comparison of the Monte Carlo algorithm with analytical solutions) does not have any new results.

The simulation method used in this paper is that of Laurenzi et al. (2002), as explained by the authors in the first paragraph. Each result in Section 3.1 was also published in the Laurenzi paper. Inasmuch as Laurenzi et al. already showed that their algorithm reproduces the results of the KCE, this section offers no substantial contribution to scientific progress.

2. Section 3.2 (Simulations with realistic initial distributions and hydrodynamic kernel)

The motivation for the paper is stated on the first page: "In the marine environment, the aerosol recycling process is believed to be the major mechanism responsible for the bimodal shape of the aerosol size distributions (Flossmann, 1994; Feingold et al., 1996)."

However, bimodal size distributions are not observed in this paper. That is, the distributions shown in Figs 11 and 12 are not clearly bimodal. Presuming there is a time point at which the distribution *is* bimodal, will your simulations show such bimodality in the absence of aerosol? I suspect the "second peaks" in Figs 11 and 12 are consequences of gelation induced by the quadratic kernel, and have nothing to do with aerosol formation.

3. Page 7292: "Where $N(m, n; t)$ is the average number of species with water mass from size bin m and aerosol mass from size bin n. The water mass in size bin m equals the volume of a droplet in the smallest (monomer droplet) bin multiplied by m, the aerosol mass in size bin n equals the volume of an aerosol in the smallest bin (monomer aerosol) multiplied by n"

This is not strictly true. n and m are the number of monomers in an aggregate of composition (n, m). Were these mere indices for "bins", Eq. 1 would be meaningless. Eq. 1 is a population balance equation - a statement of conservation of mass for all types of aggregates.

Thus, I am concerned that the "binning" causes a loss of mass in the system. That is, does "bin 2" represent particles with masses exactly twice that of "bin 1"? If so, then a simulation with 1000 particles may require up to 1000 bins in one component, instead of 30. If not, then the simulation will inevitably loss mass as particles of different masses coagulate and are placed into a "bin" that does not represent their true mass. This is an old problem with numerical solution of the KCEs. The binning should be described in greater detail.

4. Long's kernel uses the volumes of colliding particles in cubic centimeters, *not* the

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masses [Long. J. Atmos. Sci. 31, 1040 (1974)]. This a potentially major issue with the paper and must be addressed. If the masses discussed are in grams and the density of the water is 1 g/cc, then the authors should explicitly say so. The units of the quantities in Eqs. 19 and 20 must be discussed, as must the cloud volume used in the simulation.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 7289, 2008.

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Interactive Comment