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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A semi-analytical method for calculating rates of new sulfate aerosol formation from the gas phase" *by* J. Kazil and E. R. Lovejoy

Anonymous Referee #2

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General:

The manuscript provides a computationally efficient way (parameterization) of calculating new-particle formation rates starting from sulfuric acid-water nucleation. Both neutral and ion-related nucleation pathways are taken into account. Effective yet accurate parameterizations dealing with new-particle formation are essential for current large-scale atmospheric models simulating aerosol dynamics. The work presented in this manuscript is highly relevant in this respect and appears scientifically sound. I find the paper acceptable for publication in Atmospheric Chemistry and Physics after the authors have considered the (mostly minor) comments given below.

Comments:

The authors should present a more general motivation for their work in the introduction. They could mention the importance of nucleation as a source of new aerosol particles in the atmosphere, the need to include effective ways of dealing with new-particle formation in atmospheric models, and the current situation with regard of existing parameterizations on different nucleation mechanisms. It is also important to point out that the role of chemical compounds other than sulfuric acid and water nucleation in atmospheric nucleation is likely to be very important, at least in the boundary layer of the lower troposphere.

The interpretation of results presented in Figures 5 and 6 (pages 2185 and 2186) should be enhanced a little bit. Most importantly, the authors have not really discussed the totally different roles of self-coagulation (coagulation of nucleated clusters with themselves) and inter-modal coagulation (coagulation of nucleated clusters with larger pre-existing particles). For example, inter-modal coagulation always reduces the formation rate of 2.5 nm particles compared with the nucleation rate (because it is always a sink of nucleated clusters). The role of self-coagulation is more complicated because it acts as a sink of clusters but at the same time enhances the growth rate of nucleated clusters. Furthermore, while inter-modal coagulation is active practically always, self-coagulation is important only at very high nucleation rates. The different roles of these two coagulation mechanism are clearly visible in different regions of Figures 5 and 6. The authors give the wrong impression that the method by Kerminen and Kulmala (2002) does not take into account coagulation at all. In reality, the method includes inter-modal coagulation but not self-coagulation (which is important only at high nucleation rates).

The level of agreement (given by percentages of values within a certain limit from a numerically accurate value) in sections 8.2, 8.3 and 8.4 depend very much on the chosen value range of different parameters and their statistical distribution. This should be brought up explicitly in the manuscript.

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Finally, the authors should help the readers a little bit in the “conclusions” section by writing a short paragraph that summarizes the “good” and “bad” features of their parameterization compared with existing parameterizations. Also, it would be nice to see some recommendations by the authors for further work in this field.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 2169, 2007.