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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Technical Note: A new SIze REsolved Aerosol Model (SIREAM)" *by* E. Debry et al.

Anonymous Referee #2

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The authors present a detailed description of SIREAM, a size-resolved aerosol module within the POLYPHEMUS modelling system. It is, on the whole, a well written and detailed account of the physical and numerical parameterisations used by SIREAM. I recommend that it is published in ACP subject to the revisions below.

Specific Comments:

1) Please could the authors add a brief paragraph to the introduction summarising which programming languages SIREAM has been written in, as well as dependancies on other packages (and which versions).

2) I note that SIREAM has been used by Sartelet et al. (2006) for comparison with the modal model MAM in a couple of mass-transfer testcases, however the only settings

for SIREAM that they list are the number of bins. As no testcases have been given in this paper I believe it would be helpful for the reader if the authors were to include the lower two panels of Figure 2 from Sartelet et al. (2006) and a short paragraph on which of the settings detailed in this paper were used in the testcase.

3) In the abstract and the first paragraph of Section 3.1 the authors describe the numerical method used for solving condensation/evaporation as a “moving sectional” approach. This description does cover the method used to calcualte the new particle sizes after such growth, but makes no reference to the redistribution of particles on to a fixed size grid which is necessary for using such a method within a 3-D model. As the redistribution process is integral to the method I believe that a more appropriate description would be “quasi-stationary” (as used by Jacobson, 1997). Please could the authors change these two uses of the phrase “moving sectional” to either “quasi-stationary” or another such suitable label.

4) p. 11846, line 7: The description “hybrid method” is a little vague. Please could the authors expand this; I would recommend “hybrid equilibrium/dynamical mass-transfer method”.

5) Having not studied cloud activation schemes I am a little confused by the first two paragraphs of Section 2.3.1. In the first paragraph the default value of the critical diameter for cloud activation is given as $d_{activ} = 0.7\mu\text{m}$. In the second paragraph, however, it is stated that the activated distribution has a median diameter of $0.4\mu\text{m}$. Are these values correct? If so please could the authors state if are they dry or wet diameters and better explain how they are related?

6) p. 11858, line 25: The default pH value for the cloud droplets is given as 4.16. Please could the authors explain why is it this value, and is an accuracy of three significant figures justified?

7) In Section 3.2.2 (pages 11865–11866) two methods are described for redistributing the particle distribution onto a fixed size grid after condensational growth. I believe

the first is from Debry (2004), while the second is the same as the quasi-stationary method used by Jacobson (1997). It would help the readers understanding of the scientific context of these methods if the authors were to include references in their paper for other examples of these methods being used within the published literature.

8) It would be very useful to be able to ensure that both the aerosol mass and number are conserved during the redistribution of the particle distribution. However it does seem to me that, while it does this, the first of the redistribution methods (page 11865) is also very unstable. By redistributing equal proportions of the particle number and mass distributions within a Lagrangian bin, to bins on the fixed size grid, you set the average mass of each of the new bins to that of the original Lagrangian bin. So, while the average mass of one of the new bins will be within the boundaries of that bin, the average masses of the other bins will all be outside of their boundaries. In the middle of the aerosol distribution this effect is likely to be mitigated by the addition of mass from the other Lagrangian bins. However such mitigation will not occur at the edges of the aerosol distribution, and so the average masses in these bins will be unreasonable. Please could the authors explain how they have overcome this problem?

Technical Comments:

1) The reference to Koo and Pandis (2004) should be to Koo, Gaydos, and Pandis (2004).

2) The journal and page numbers for Stockwell et al. (1997) are 102 and 25847–25879 respectively.

References:

Debry, E.: Numerical simulation of an atmospheric aerosol distribution, Ph.D. thesis, ENPC, CEREA, in French, 2004.

Jacobson, M. Z.: Development and application of a new air pollution modeling system — II. Aerosol module structure and design, Atmos. Environ., 31, 131–144, 1997.

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Koo, B., Gaydos, T. M., and Pandis, S. N.: Evaluation of the equilibrium, dynamic, and hybrid aerosol modeling approaches, Aerosol Sci. Technol., 37, 53–64, 2003.

Sartelet, K. N., Hayami, H., Albriet, B., and Sportisse, B.: Development and preliminary validation of a Modal Aerosol Model for tropospheric chemistry: MAM, Aerosol Sci. Technol., 40, 118–127, 2005.

Stockwell, W., Kirchner, F., Kuhn, M., and Seefeld, S.: A new mechanism for Regional Atmospheric Chemistry Modeling, J. Geophys. Res., 102, 25847–25879, 1997.

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