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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A statistical-numerical aerosol parameterization scheme" *by* J.-P. Chen et al.

Anonymous Referee #2

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The authors present a method for parameterising the size distribution of a modal model with improved accuracy via statistical fitting of numerical results. The methods avoid the need to simplify the growth kernel and are mostly computationally more efficient than numerical integration. The methods introduced here are potentially useful to model developers and as a result might be better placed in GMD after some revisions.

My main comments are centred around the introduction which could be improved to improve readability and focus the reader on what is addressed in the remainder of the paper. I will provide more detailed comments but mainly the use of examples to explain all the problems is distracting and the comparison of bin and modal models could be improved.

Page 12035, Line 8: The references here could include more recently developed aerosol models. Are the methods here an improvement of even the most up-to-date models?

Page 12035, Line 16: I find the interchange between aerosol and cloud models distracting. Perhaps add in some information about which types of model this is applicable to and how it will improve them but don't interchange throughout the text.

Page 12035/6: The details of specific model processes as examples is unneccessary in the introduction since the same can be applied to further processes. Perhaps list a few of the processes that will benefit from improving current models but don't detail them here.

Page 12036, Line 4: Mann (2012) also compare a modal and bin aerosol model version. What models are compared?

Page 12036, Line 10: Some more recent modal models should be cited.

Page 12036, Line 12: What is the significance of this example? Is this the model that is the focus of this study? Please clarify.

Page 12036, Line 14: 'avoid some of the problems' - this seems a bit vague. A more concise comparison of the differences between the modal and bin schemes would be of benefit here (perhaps this will result when specific examples are removed).

Page 12036, Line 23: 'Therefore...' - it sounds like this study is aimed at improving the Brownian coagulation but this is an improvement on all processes where the kernel has to be simplified. Again, perhaps a list of a few processes that would be improved rather than a specific example would be better.

Page 12037: The comparison to Chen and Lui seems oddly place. A discussion of their work would be better placed in the introduction along with a review of other current methods and a discussion of how this work aims to improve upon these.

Page 12037, Line 15: This is a comparison of bin and modal models so should be earlier in the introduction.

Page 12037, Line 20: The mention of modes here is confusing when talking about the bin model - can you reword this somehow?

Page 12037, Line 24: 'If not designed properly...' - if it is designed properly this is not a weakness, is there some reason why designing the experiment properly is not possible?

Page 12038, Line 12: With a more concise discussion of the advantages/disadvantages of using a bin or modal scheme i think the reference back to bin modals is unneccesary here.

Equation 1: Make sure all parts are defined (n) and state whether they related to the particular mode or the entire distribution (n, N and σ).

Equation 2: Is n(r) = n(ln r)?

Page 12039, Line 14: Why have you picked 3 tracking variables? Explain why 3 are necessary.

Page 12039, Line 14: What's the relevance of the current CMAQ model here? Earlier you mentioned CMAQ used BS95? Is this the model you have used? Which scheme does it use?

Page 12040: The description of the gamma distribution is unneccesary. It is fair to say that the method is applicable to it but the extra maths is hard on the reader when it's not directly relevant. Perhaps it could be worked through in an appendix.

Page 12041, Line 1: With the gamma distribution description it is necessary here to remind the reader that what follows is a result of the log normal distribution.

Page 12041, Line 6: Can you explain more about the growth kernel, what it typically looks like and why it's important?

Page 12041, Line 9: I would remove the word 'the' from 'the parameterisation as it sounds like you are referring to a particular parameterisation.

Page 12401, Line 25: 'four methods'? It's not clear that the methods you are investigating are new.

Page 12042, Line 9: Is this the usual assumption? Is it sensible?

Equation 10: I got a little confused by the use of 'i' and 'k' - is it possible to clarify when one is used rather than the other?

Equation 16: Can you define K_k in this first instance since there is an appearance of r^k that isn't in Line 7 or Equations 1 and 9.

Page 12045: This example seems out of place here. In the other cases you have only explained the method.

Page 12046, Line 10: How is this method better than than Whitby et al?

Page 12046, Line 10: This paragraph seems very negative about the method and so it's difficult to see why this example is included.

Page 12047, Line 5: Is this a particular artefact of the software you are using and could a better software be used?

Page 12047, Line 18: What does 'strong function' mean?

Page 12048, Line 17: What about SNAP-B? It already sounds like it's been outdone by C and D?

Page 12049, Line 9: Why is it not included and will it be in future?

Page 12049, Line 14: Explain modes here since it is unrelated to the modal scheme.

Page 12050, line 11: What is meant by the modal size? The mode covers a range of sizes.

Page 12051,Line 16: How long does the trial by error take? Is this valid only for this model or is it transferable?

Page 12051, Line 18: I don't understand the use of the word 'might' here. Does it?

Page 12052, Line 2: What is the 'whereas' referring to?

Page 12052, Line 9: How difficult is it to decide which formulas to use? Is it normally quite straightforward or would someone else perhaps choose a different formula?

Page 12052, Line 19: Can you compare the CPU times too?

Page 12057, Line 16: When might SNAP-B be practical? Is there a general sense of when there is no point even trying it?

Page 12060, Line 18: Which SNAP method is applied here?

Page 12061, Line 8: 'Apparently,....' according to who? Why?

Page 12063, Line 11: Will this have any impact on the robustness of the results?

Page 12064, Line 14: Which processes was SNAP applied to?

Page 12065, Line 12: Is there a reason for the specific areas with large errors?

Page 12065, Line 14: A SNAP parameterisation of the Kelvin effect is included?

Page 12066, Line 18: Do the specific formulas apply to other models or would new coefficients/formulae be required?

Page 12067, Line 11: I would say that the conclusion regarding the Kelvin effect was reached by application of SNAP - otherwise it seems out of place and unrelated to the SNAP methodology.

Figure 3: What's the scale of the coloured dots - it's hard to see how large/small the deviations are.

References: Intercomparison of modal and sectional aerosol microphysics representa-

tions within the same 3-D global chemical transport model. G. W. Mann, K. S. Carslaw, D. A. Ridley, D. V. Spracklen, K. J. Pringle, J. Merikanto, H. Korhonen, J. P. Schwarz, L. A. Lee, P. T. Manktelow, M. T. Woodhouse, A. Schmidt, T. J. Breider, K. M. Emmerson, C. L. Reddington, M. P. Chipperfield, and S. J. Pickering Atmos. Chem. Phys., 12, 4449-4476, 2012

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