**Geoscientific
Model Development
Discussions**

Interactive comment on "Adaptive method of lines for multi-component aerosol condensational growth and cloud droplet activation" *by* S. Arabas and H. Pawlowska

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This is a nicely written and thorough paper that introduces a new procedure to solve particle behavior at activation to cloud droplets. The formulation of the procedure is clearly described and the first tests presented are fairly convincing. I also highly appreciate the authors' decision to release their code as a part of their submission. I recommend the manuscript to be published after the following comments have been addressed.

Main comments:

1) I would expect numerical diffusion to be an issue with the chosen bin splitting pro-

cedure and it could explain the lower end tail of the distribution in Fig 7b. The authors should quantify numerical diffusion in their approach e.g. by running their model back to the initial state (if growth is the only process considered, the aerosol should return back to the initial distribution).

2) How much does the bin splitting and the fact that solver will need to return to the beginning of the time step slow the calculations? Could the same accuracy and computational efficiency be achieved using an unevenly spaced bin spectrum to start with, i.e. narrower bins in the critical region?

3) Why is LWC dependent on the number of bins? Overall, the reasons for the sensitivity of the different quantities to the bin number (Figure 4) merit more discussion.

Minor comments:

1) Almost half of the abstract is dedicated to describing the motivation behind the new model; this can be done in the Introduction. I would rather see the abstract highlight the new aspects presented in THIS study: explain how the new procedure improves the old ones ("adaptive spectrum refinement" does really say much) and summarize the evidence for its good performance (rather than just state that certain things have been compared).

2) Page 1272, last three lines: This discussion of the content of the manuscript is oddly placed. Could it be moved towards the end of the Introduction?

3) Page 1273, lines 15-20 from "all being however —": these lines can be deleted

4) Page 1275, line 15: tables and figures should be referred to in the text in numerically descending order. Easiest solution is to reassign table 3 -> table 1, table 1 -> table 2, etc.

5) Page 1292, line 4: that -> than

6) Page 1292, first full paragraph: "observed" is easily taken to mean measured, should

be changed to simulated/modeled/predicted.

7) Figure 7: I doubt it would change the results much, but I think it be fairer to use 69 bins in the non-adaptivity case (roughly the same computational expense?).

8) Page 1296: Some discussion on how well the modeled distributions agree with the Twomey aerosol parameters is needed.

9) Figure 8: I'm confused about the coloured areas for Twomey upper bound solutions. Equations 27 and 28 imply single values for each updraft velocity value.

10) Page 1297, line 25: how can the method be used in nucleation studies?