Geoscientific
Model Development
Discussions

Interactive comment on "Droplet activation parameterization: the population splitting concept revisited" *by* R. Morales Betancourt and A. Nenes

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We thank both reviewers for their positive, thoughtful feedback and constructive comments. Specific points raised are in bold while responses are in italics.

1) Although it is never stated, I think that the "population splitting concept", i.e. all that is described in Section 2.1 has to be applied "bin-wise" where the bins are bins in critical supersaturation. On first reading it was not clear to me which of a spectrum of critical supersaturations are meant, for instance in eq. 6. It should be stated clearly whether the concept has to be understood bin-wise, or if not, how I should interpret an integral like in eq. 6.

We thank the reviewer for pointing out this potentially conflicting issue.

The "population splitting" concept can indeed be applied bin-wise in supersaturation space (as done in Nenes and Seinfeld), or it can also be applied to a supersaturation spectra described by a continuous function, e.g., a lognormal distribution (as is done in Fountoukis and Nenes, Barahona and Nenes, and in our manuscript). We now state this explicitly, as well as what we mean by supersaturation spectrum.

*Eq. 6 describes the condensational growth of **a single droplet**. Different approximations are then used to relate its size at maximum supersaturation with the critical supersaturation of the aerosol particle that served as condensation nuclei. These different approximations "split" the condensation integral Eq.4. The criteria to "split" the population determines which approximation to the growth of each size particles is used.*

We made several amendments to the manuscript attempting to clarify this potentially confusing issue.

2) The discussion of Figure 1 and eq. 10, is a bit hard to follow, because you use at least three different types of terminology: The Dp scale, the s scale, the discriminant scale, and the Populations I-III. It might be good to have a table where all the conditions and Population numbers are presented together.

We included some explicit mention to this in the revised manuscript so we avoid this potentially confusing point.

3) Last line of page 2911: "has no real solutions" is better.

This suggestion was adopted and included in the manuscript.

4) The description in the 2nd paragraph of Section 2.1.1 is a bit unclear. Do you mean that Barahona et al. had replaced $D_p = D_p^{(2)}$ by $D_p = D_p^{(2)}/sqrt(3)$? Please rewrite the section.

We rephrased parts of this section to make it more precise.

5) Page 2914, line 25: "As smax approaches _c from above" is better.

This was corrected.

6) Last sentence of 1st par. in Sect. 3.1 is incomplete.

We corrected this issue.

7) Description of Figure 2 in Sect. 3.1 (panel letters) is inconsistent with the figure.

Thank you for pointing this out. The wording in this section was modified and it is now consistent with the labeling of the figure

8) Description of Figure 3 in Sect. 3.1: please mention that you describe the results of your own parameterisation now.

We now make this explicit in the manuscript

9) Page 2918, line 16: "similar improvement". Similar to what? (You may refer to table2).

The wording was changed to make this unambiguous. The intended meaning was that the decrease in the bias of dN_d/dn_a with the new parameterization was similar to that shown by N_d.

10) Caption of Figure 4: Please correct.

This was corrected.

Interactive comment on Geosci. Model Dev. Discuss., 7, 2903, 2014.

C1573