

## ***Interactive comment on “A novel model to predict the physical state of atmospheric H<sub>2</sub>SO<sub>4</sub>/NH<sub>3</sub>/H<sub>2</sub>O aerosol particles” by C. A. Colberg et al.***

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11. I do not understand sections 2.1.3 and 2.2, but I would like to. These are the sections concerning trajectories. Of all aspects of the manuscript, this is the area where my personal background and knowledge is weakest, so I may personally need a more detailed explanation to fully understand. I will ask my questions and perhaps the authors can discover a manner to make this section clearer to folks like-minded with me:

11a. "The aerosol on a trajectory entering a grid box..." Isn't the ASR climatology fixed on a grid? It does not advect "on a trajectory". Should this sentence read, "The aerosol in a grid box is subjected to RH and T of a trajectory passing through it..."?

11b. Why are there 10080 trajectories and 12800 grid boxes? Sections 2.1.3 and 2.2

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seem to be describing the same numbers?

11c. How do the 12800 grid boxes on a 5 deg by 5 deg grid connect to section 2.1.2, having the chemical compositions on a 4 deg by 5 deg grid? Was interpolation necessary?

11d. "analyzed for all intersecting trajectories". Do the trajectories intersect each other? If so, how is RH averaged? [Or does ECMWF constrain intersecting trajectories to have same RH?] Or does one trajectory intersect one grid box? If so, then at any one given time point (i.e., 6 hr interval), shouldn't there be one trajectory intersecting each and every grid box? If so, then why are there white points in Figure 9?

11e. "the fraction.. relative to the total number of all... particles" Isn't this a dry mass fraction? Where does aerosol number come from? This sentence suggests the particles are externally mixed as some crystalline and some aqueous. In fact, doesn't the model offer an internally mixed aerosol?

11f. From my inferences of how I think the modeling was done, it seems to me the agent and the object are inverted in many sentences. For instance, "upon further transport the solid components survive as long as the trajectory does not enter a grid box whose (RH, ASR)-pair is above the corresponding DRH." In fact, my understanding (wrong?) is that this sentence should be written: "solid components in the grid box survive as long as trajectory passing through does not bring with it a (RH, T) above the corresponding DRH."

12. Page 12 and Figure 7. Where does RH come from in this treatment? For  $RH > DRH$ , is this condition for initial water uptake or complete dissolution (i.e., the difference between a eutonic value and disappearance of last of solid)? Why cannot Figure 7 also be represented with mass fraction solid, instead of binary "present" / "not present" presentation?

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Reading and commenting on this excellent and provocative manuscript has been a pleasure and highly useful for my own thoughts. I hope the authors will find my comments useful in improving their manuscript.

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