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**Geoscientific
Model Development
Discussions**

Interactive comment on "Description and evaluation of GLOMAP-mode: a modal global aerosol microphysics model for the UKCA composition-climate model" *by* G. W. Mann et al.

Anonymous Referee #2

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General Comments:

This paper describes and evaluates a mode version of GLOMAP. The manuscript is well-written and easy to read through. However, the model description and evaluation are probably too long. Since the modal aerosol process treatment mostly follows the bin version of GLOMAP and M7 (Stier et al., 2005). Many process description can be simplified, such as 2.1.2.-Aqueous chemistry, 2.2.2.-aerosol dry deposition, 2.2.5-2.2.7 nucleation/coagulation/condensation. The authors should document the main differences between this modal version versus bin version (which has been well published in the literature), and aerosol microphysics treatment between this work and

M-7 if there are any. I have also some technical comments below which need to be addressed.

Specific comments:

1. Page 653. Lines 18-20. Please be clear why the mass-only version unrealistically perturb cloud properties and precipitation. Do you mean that mass-only version gives too high droplet number? "precipitation autoconversion" should be "cloud droplet autoconversion".

2. It is not clear to me how you treat ammonium. What kind of formulation do you assume for sulfate (e.g., NH4HSO4 or (NH4)2SO4). Even though you don't treat ammonium, you need to account for ammonium amount for aerosol optical depth. Otherwise you will miss a significant amount of aerosol mass.

3. Section 2.2.2. How do you differentiate dry deposition/sedimentation of aerosol mass versus aerosol number?

4. Section 2.2.3-Aerosol scavenging. Can you justify why you choose 103 nm dry diameter for nucleation scavenging? Do you assume soluble fraction is 1 for all soluble modes (i.e., all aerosol in soluble modes with size larger than 103 nm will be in cloud water)? For impaction scavenging by rain droplets, why do you use dry radius of the mode since aerosol will uptake water especially for sea salt.

5. Section 2.2.10-cloud processing. Why do you assume an activation dry radius at 37.5 nm while in the nucleation scavenging you use 51.5 nm dry radius (or 103 nm diameter)?

6. Page 683. Lines 6-8. You need to move this part on aerosol nucleation over Antarctica to the above just after showing Figure 9.

7. Section 3.5. You evaluate aerosol number at several size ranges. I don't see here you evaluate size distribution (aerosol number vs. size: dN/dlogr vs r). Therefore, you can merge section 3.5 with section 3.4.

8. Page 693. Line 16. Number of aerosol tracers. Please move this part to the beginning of model description.

9. Table 5. “Terpenes and condensing organics” need to be consistent with those in table 4 “MONOTER” and “SEC-ORG”

10. All lon-lat figures need to have lon-lat labels.

11. Figure 21. Please include error bars (uncertainties) of observations (Clarke and Kapustin data)

12. Figure 22a) the line types are not correct.

13. Figure 23. Please add error bars (uncertainties) of observations (Petzold data).

Technical corrections:

1. Page 674. Line 7. “conistent” -> “consistent”

2. Page 684. Line 3. “10-3” -> “10-3”

Interactive comment on Geosci. Model Dev. Discuss., 3, 651, 2010.