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Interactive comment on "A global off-line model of size-resolved aerosol microphysics: I. Model development and prediction of aerosol properties" *by* D. V. Spracklen et al.

Anonymous Referee #1

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Review of Spracklen et al., "A global off-line model of size-resolved aerosol microphysics: I..." This manuscript describes the development of a sulfate and sea salt aerosol microphysical model (GLOMAP) that is run in the TOMCAT chemical transport model. GLOMAP uses a sectional 2-moment scheme, including nucleation, condensation, coagulation and cloud processing of the aerosols. The model appears to be well formulated. Model evaluation is limited because comparison with observations is to be done in a subsequent manuscript. I feel this is the primary limitation of this study as I discuss further below. A list of recommended revisions follows.

General comments: 1. The separation of model formulation and model evaluation is quite limiting. First, it is difficult to detect flaws in formulation apart from comparison with observations. But a greater difficulty may arise if the next manuscript detects flaws in the formulation which by that time would be already published. A couple broad comparisons with observations is included here; more should be added so that some further model assessment can be done. The detailed comparison can then be done in the later manuscript.

2. a)Related to the 1st comment, it is noted that the model underpredicts CN over continental regions (p190, line 7) and that the possible reason for this will be discussed in a later manuscript. Some discussion of this should be included here, since it may relate to the model formulation. b) Perhaps the reason is that carbonaceous aerosols are not included? The likely impact of not including carbonaceous aerosols on the CN and CCN for the 2 months should also be discussed.

3. Additional citations are needed and comparison with other models needs to be added. a) p181 L19. Add some (more recent) carbonaceous aerosol simulation studies. b) p181 L 21. Add more examples of models using empirical-relationship indirect effect (e.g. Lohmann et al, Menon et al., others) c) p181 Describe other aerosol indirect effect approaches, such as Chuang et al., Ghan et al. d) p181 L 27. Describe some examples of aerosol models that use sectional, modal and moment microphysical formulations. e) Add a section comparing results with other aerosol microphysical models.

4. Budget tables should be added.

5. How much sulfate deposits on sea salt? This might be best shown in a figure.

6. This study would be very greatly enhanced if it were repeated with natural sulfur emissions only. How much are the CN and CCN affected by the anthropogenic emissions? Difference plots (full emissions - natural) for surface and zonal CN and CCN for the 2 months could be provided. Since this is a first step toward the indirect and direct

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forcing calculations, this would make an important addition.

Detailed comments:

1. Abstract, final sentence: "'For this sulfur-sea salt system,' it is estimated" (since other aerosol types might contribute).

2. p181 L6. Clarify: "usually the largest" , largest subset, largest particles?

3. p183 L13. Why is HO2 needed?

4. p183 L14 What is a " 6-hourly monthly mean"?

5. section 2.1: Table 1 includes reactions for H2S, CS2 and COS. Are these actually used? What emissions are used for these?

6. p186, L19 Describe formulation for dry deposition of gases?

7. p186 L 20 Is there no aqueous-phase oxidation in convective clouds?

8. p186 L7 Make condensation description a new paragraph, so that each microphysical process gets its own paragraph.

9. p195 L10 Why not include settling of large particles from upper layers? It would be straightforward to add this.

10. Figure 12. The observations are for which season? If they are from winter then there are many small particles in the model.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 179, 2005.