

## ***Interactive comment on “Impact of the modal aerosol scheme GLOMAP-mode on aerosol forcing in the Hadley Centre Global Environmental Model” by N. Bellouin et al.***

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This is a well-written description of a comparison between estimates of aerosol radiative forcing by two very different representations of the aerosol. All conclusions are supported by analysis.

Only one comment will require considerable effort: distinguishing direct forcing by each aerosol component. It is not essential, but would strengthen the message significantly.

1. Line 113. Ghan et al., 2001 is not a sectional model, so remove this citation. It is a modal model (same as Easter et al., 2004), so you can cite it when discussing modal models if you wish.

C7833

2. Line 125. Add reference to Liu, X., et al., 2012: Toward a minimal representation of aerosols in climate models: Description and evaluation in the Community Atmosphere Model CAM5. *Geosci. Model Dev.*, 5, 709–739, doi:10.5194/gmd-5-709-2012.

3. Figure 1 should make it clear that number concentration is predicted for each mode.

4. Line 358. Why does the parameterisation of wet deposition yield smaller sulphate wet deposition rates in GLOMAP-mode? Why isn't wet deposition treated the same in both models? Is this a result of the feedback of sulfate on precipitation?

5. Line 364. According to Table 2, the difference in BC lifetime is 10, not 12 days.

6. Line 375. But the jet mode could influence the particle surface area, which influence the competition for water and hence the activation of accumulation mode particles. Compare the surface area of the modes and decide.

7. Lines 395-399. It does not appear that dust AOD has been removed from the AOD shown in Figure 2, and shouldn't be if the simulated AOD is to be compared with the assimilated distribution. So delete this sentence?

8. Line 524. For which measure of mode radius are the optical properties determined? Surface mode radius?

9. Figure 4. Is the SSA the column mean (AOD-weighted) or the value at a particular level?

10. Lines 734-756 and Figure 7. It should not be difficult to distinguish between the direct forcing by each aerosol component (sulphate, black carbon, organic carbon). Just call your radiation scheme with each component zeroed separately. This provides valuable information about the cause of the difference in the total direct forcing, and just requires one more set of runs (1850 and 2000 emissions) for each model. An example of this is Ghan et al. *J. Climate*, October 2012.

11. Lines 865-868. The longer residence time of BC in CLASSIC would also raise the direct forcing. It would be helpful to have separate estimates of forcing by BC and

C7834

sulphate. 12. Lines 911-912. The correct reference is Abdul-Razzak and Ghan (2000), which is designed for modal schemes.

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C7835