

Interactive comment on “Impact of cloud-borne aerosol representation on aerosol direct and indirect effects” by S. J. Ghan and R. C. Easter

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Received and published: 28 July 2006

1. It would be helpful for the reader if the paper already from the start separates between: (1) particles presently dissolved in cloud water (cloud-borne), (2) particles chemically/physically produced in cloud droplets (e.g. aqueous sulfate) and then suspended after evaporation, and (3) particles having been collected by cloud droplets or activated as CCNs and then re-suspended after evaporation. [Similar types could be defined in connection with cloud ice, which is not discussed in the paper.] This can be helpful in order to avoid confusion, e.g. when interpreting the NOADV experiments. I believe that advection is neglected only for type (1), but I can not be sure from the text alone.

AC: MIRAGE does not distinguish between cloud-borne particles formed by different mechanisms. As described in section 2.1, it represents each of the different mecha-

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nisms. But once the AP become cloud-borne all knowledge of how they got there is lost. The computation cost of carrying separate cloud-borne species for each formation mechanism is simply too high.

2. Second sentence in Introduction is particularly hard to read with all its slashes indicating alternatives. This also applies to several of the first paragraphs in the Introduction where sentences and words in brackets are frequently used. Is this a sign of the perfectionist who wishes to account for all strange possibilities in a few sentences, at the expense of readability?

AC: We have rewritten the first two sentences for readability.

3. I'm not quite sure why GE uses nudging towards ECMWF analyses for the 3 year period. Frequently, this is done to enable comparison with campaign data or other date-specific observations or retrievals. This is not the case here. They mention natural variability as the reason. If the model aerosols influence physical terms in the model, I understand this. But I had the impression that the aerosol forcing is calculated off-line. If I am wrong, I think a clarifying sentence is needed.

AC: Aerosols do indeed influence the physical terms in MIRAGE. We have added a sentence in section 4 stating this.

4. On the top of page 4348, it is explained that CPU-time is decomposed into dynamics, physics and the coupling between. It is not clear to me what is included in coupling between. Physics terms influenced by aerosols define effects of aerosols on dynamics, and advection and diffusion define effects of dynamics on aerosols. Hence I am confused.

AC: The coupling mainly involves copying data from one data structure to another. The amount of data copied depends on the number of aerosol species that are transported.

5. (Important!) Lines 7 and 8 on p. 4349 are a surprise to me. Why are cloud-borne aerosol particles re-suspended when freezing? When droplets evaporates, that's fine,

but I need an explanation of the processes responsible for re-suspension when cloud glaciates. GE present this as the main reason why RESUSP has much smaller concentrations of accumulation-mode particles in the mid-troposphere. This is therefore a potentially very important point!

AC: This version of MIRAGE does not treat the Bergeron-Findeisen process, instead predicting only the total cloud condensate and diagnosing the cloud phase from temperature. So the statement in line 7 is inappropriate. A more likely explanation for the larger differences near the poles and in the middle troposphere is the longevity of precipitation combined with the abundance of aerosol. We have modified the text accordingly.

6. My last point concerns the choice of figures. The scatter-plots are quite numerous, yet only column burdens of particles are shown. A similar figure to Fig.3, but a zonal average in a meridional-vertical section, would be interesting to see. I am also eager to see plots analogous to Fig. 6 for different vertical portions (0-2 km; 2-5 km; above 5 km).

AC: We have removed some scatter plots, and have added a figure showing the meridional-vertical distribution of the zonal mean bias in total aerosol number. We have looked at the vertical distribution of cloud-borne aerosol number, and have not anything particularly interesting.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 4341, 2006.

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