

Interactive comment on “Examining aerosol indirect effect under contrasting environments during the ACE-2 experiment” by H. Guo et al.

H. Guo et al.

Received and published: 16 January 2007

We thank anonymous referee #2 for many useful comments and suggestions. We will incorporate the corrections and modifications in the revised version.

Page 11564, lines 1-4: I find this sentence odd: "changes in cloud optical depth (COD) from changes in the cloud LWP could be even larger than aerosol-induced changes of cloud droplet number concentration". What are you really comparing here?

This sentence will be changed to (see lines 1-4 on page 11564): "changes in the cloud optical depth (COD) were dominated by changes in the cloud LWP, rather than by changes in cloud droplet number concentration (N_d) for optically thin clouds (COD<15)."

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

Page 11566, lines 22-24: What does the size distribution for externally mixed sulfate look like? Is the difference in aerosol number between the clean and polluted case assumed to be entirely due to externally mixed sulfate. If so, is that realistic? In any case, please clarify.

In this study, we used a simple aerosol nucleation scheme following Chuang and Penner (1995), which assumes internally mixed aerosols. The aerosol size distribution was determined by the condensation of sulfuric acid vapor (H₂SO₄) on a prescribed pre-existing particle distribution and by aqueous-phase oxidation of SO₂ followed by the evaporation of cloud drops. The prescribed pre-existing particles for the marine cases followed a three-mode log-normal distribution with the mean diameters at 0.03, 0.15, and 0.5 μm . The resulting sulfate-containing particle size distribution grows to a larger size, which is close to the observed aerosol size distributions with prominent modes with diameters at 0.05, 0.16, and 0.5 μm for both the clean (June 26) and the polluted (July 9) cases (Snider et al., 2003).

We will add the above to the manuscript.

The major differences between the aerosol conditions in the clean and polluted cases are the total aerosol number concentration and nss-sulfate amount.

Reference:

Chuang, C., and J. Penner, Effect of anthropogenic sulfate on cloud drop nucleation and optical properties, *Tellus*, 47, 566-577, 1995.

Snider, J. R., S. Guibert, J.-L. Brenguier, J.-P. Putaud, Aerosol activation in marine stratocumulus clouds: 2. Kohler and parcel theory closure studies, *J. Geophys. Res.*, 108(D15), 8629, doi:10.1029/2002JD002692, 2003.

Page 11570, line 18: What is meant by "evenly-divided"? Why not give the height interval for each of the 5 cloud layers for clarification? It means "evenly-spaced".

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

This will be changed to include the five evenly-spaced cloud layers that are at the heights of 1.25, 1.29, 1.33, 1.37, and 1.41 km, respectively."

We will replot Fig.6 with the height of the each cloud layer on that plot.

Page 11573, lines 8-13: You state on the previous page that there is hardly any difference in the precipitation between PACM and CACM, but here you explain the difference in entrainment between the two cases by differences in precipitation. A clarification and quantification of precipitation changes would be good.

In both the PACM and CACM, the surface precipitation rates are very small or negligible (<0.05 mm/day). This means that the removal of liquid water from the coupled cloudy and sub-cloud layers by precipitation is negligible, so that the depletion of cloud water by precipitation is not efficient here.

But the precipitation rates within cloud layers are not negligible. The daily averaged values in the PACM and CACM cases are 0.02 mm/day and 0.34 mm/day, respectively. This means that the latent heat release associated with less precipitation formation in the PACM case (given the same amount of cloud water content) is smaller than that in the CACM case by a factor of 15. This condensation heating near cloud top (offsetting the longwave radiative cooling) and evaporative cooling at sub-cloud layers in the CACM case would help stabilize the boundary layer, and decrease the amount of kinetic energy that is responsible for the entrainment of warmer and dryer air above the cloud tops (see Fig. 9 on page 11594). Therefore, there is stronger entrainment of dry air in the PACM case than that in the CACM case, which causes a more efficient decrease of the cloud water.

Page 11575: Can one automatically assume that an offline calculation of the 1st indirect effect is practically the same as an online calculation? Please discuss the quality

of this assumption.

No, an offline calculation of the 1st indirect effect is NOT exactly the same as an online calculation. But it should be a very good approximation.

An offline calculation does not take any feedbacks into account, for example, the thermodynamic profiles would change as a result of drizzle formation or evaporation which might influence the online calculation of the 1st indirect effect. However, in our study this influence would be small due to the negligible formation of drizzle.

Technical corrections:

Page 11563, line 23: Oberhuber et al. (1998) is not on the list of references.

This will be added to reference.

Page 11566, line 18: Snider et al. (2000) should be Snider and Brenguier (2000).

This will be changed to 'Snider and Brenguier (2000)'. (see line 18 on page 11566).

Page 11566, line 20: Penner et al. (2004) is not on the list of references.

This will be added to reference.

Page 11568, line 19: Snider et al. (2000) should be Snider and Brenguier (2000).

This will be changed to 'Snider and Brenguier (2000)'. (see line 19 on page 11568).

Page 11574, line 18: The difference between 0.47cm/s and 0.47cm/s is not insignificant -it's zero.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

This will be changed to "As a result, there is almost no difference in the cloud top growth rates in the 'CAPM' case (0.47 cm/s) and in the 'PAPM' case (0.47 cm/s), which means that the difference in the entrainment drying is negligible." (see lines 5-7 on page 11574).

Page 11575, line 9: Why are you using the word "mainly"? What causes the first AIE other than anthropogenic pollution?

'mainly' will be deleted. (see line 9 on page 11575)

Page 11576, line 7: Using "the aerosol indirect effect" or "aerosol indirect effects" would be better.

This will be changed to 'aerosol indirect effects' (see line 7 on page 11576)

Page 11577, lines 24-25: Albrecht (1989) is not referred to in the paper.

This will be deleted from reference.

Page 11580, lines 21-26: Penner et al. (2001) is not referred to in the paper.

This will be deleted from reference.

Page 11581, lines 16-18: Stevens et al. (1998) is not referred to in the paper.

This will be deleted from reference.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper