

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

Anonymous Referee #1

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The authors have presented an interesting study on the aerosol indirect effect (AIE) in both clean and polluted environments on a regional scale. This is an important topic due to the current discrepancies in the magnitude of the AIE. The paper suggests that the total AIE is negative (i.e. cooling), although the magnitude is still in question depending on factors such as meteorological conditions, e.g., large-scale subsidence.

The study is thorough, although the topic is too vast to be conclusive in one paper alone. Nevertheless, this paper has presented an important comparison between model results (here, the Active Tracer High-resolution Atmospheric Model, ATHAM) with observations from the Second Aerosol Characterization Experiment (ACE-2). Results show that the model simulates cloud properties with reasonable accuracy.

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General remark:

1. Is a 24-h simulation enough? For example, over this time period, is there sufficient information on the moisture flux to rule out possible effects that it may have on the boundary layer?

The following minor revisions would help clarify some points:

1. Page 11563, line 10: Remind the reader of the magnitude of currently accepted total forcing from greenhouse gases plus natural causes.

2. Page 11564, line 21: The abbreviation "(CF)" should be placed after the first mention of "cloud forcing" on line 20.

3. Page 11565, line 8: "The two aforementioned studies had different (or even contradictory) conclusions" is a repetition of line 5-6 "However, Xue and Feingold (2006) presented opposite results". These two sentences can be combined or one can be omitted.

4. Page 11569, line 1: Clearly state the height of the cloud base.

5. Page 11569, lines 1-2: The LWC increases with height above cloud base and N_d is constant only to a height of approximately 1.4 km for CACM, and 0.9 km for PAM. Some words about what is happening at higher levels would be interesting.

6. Page 11569, line 11: Clearly state the height of the cloud top.

7. Page 11569, lines 8-10: Is the discussion pertaining to CACM or PAM, or both?

8. Page 11569, lines 19-21: This sentence seems rather ambiguous. The standard deviation "might" be larger due to the limited representation of heterogeneous mixing in ATHAM. Is it possible to be more clear as to why the standard deviation is larger?

9. Page 11570, line 18: "evenly-spaced" rather than "evenly-divided".

10. Page 11571, line 6: The discussion of Figures 7 and 8 would be much clearer if

Table 1 and the description of CAPM and PACM were introduced first, rather than in Section 4.

11. Page 11572, line 16 and 17: Add in the word "respectively": "(~ 100% and ~ 95%, respectively)" and "(~ 75% and ~ 45%, respectively)".

12. Page 11574, line 13: "first" rather than "1st".

13. Page 11574, line 15: Explain ρ_w and describe β .

14. Page 11575, equations: Explain F_{net} .

15. Page 11575, line 21-25: This seems a bit confusing. The authors state that the magnitude of ΔF_t ("CM") is smaller than ΔF_1 ("CM") resulting in a positive ΔF_2 ("CM"), but the positive ΔF_2 ("CM") is dominated by a negative ΔF_1 ("CM") leading to a negative net effect. So, which is the cause and which is the effect?

16. Page 11576, line 4: Add " W/m^2 ", i.e. " $0 W/m^2$ ".

17. Page 11584, Table 2: Why is this table not discussed in the CACM/PACM section, Section 4.1.1?

18. Page 11588, Figure 3c, f: How different is the curve if N_d is set to 40 cm^{-3} rather than 50 cm^{-3} , which seems closer to the observations? Similarly, what if N_d is set to 25 cm^{-3} above a height of 1.4 km?

19. Page 11589, Figure 4: What causes the large difference in modeled and observed d_v around a height of 0.75-0.8 km?

20. Page 11589, Figure 4c, f: How would the curve vary if N_d was set to 200 cm^{-3} when the height is above 0.9 km?

21. Page 11589, Figure 4: A comment about why modeled LWC and d_v compares well to the adiabatic LWC and d_v around 0.8-0.85 km when the observations are higher would be interesting.

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22. Page 11591, Figure 6: "evenly spaced" rather than "evenly-divided".

23. Page 11592, Figure 7: "with "*" and vertical error bars" would be clearer than "with "*" and vertical bars".

24. Page 11593, Figure 8a: What is the strange black line/symbol? It does not appear to be an asterisk with error bars.

25. Page 11596, Figure 11: Please enlarge this figure so that it is easier to read.

Xue, H. W. and Feingold, G.: Large eddy simulations of trade wind cumuli: Investigation of aerosol indirect effects, *J. Atmos. Sci.*, 63, 1605-1522, 2006.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 6, 11561, 2006.

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