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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Aerosol effects on ice clouds: can the traditional concept of aerosol indirect effects be applied to aerosol-cloud interactions in cirrus clouds?" *by* S. S. Lee and J. E. Penner

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This modeling study describes processes by which changes in aerosol concentrations may affect cirrus clouds, especially the ice water path (IWP) and hence radiative properties of cirrus. The increased IWP is due to the aerosol increasing the cloud ice number concentration (CINC), which increases the ice surface area and vapor deposition rates. The resulting latent heat increases updraft speeds which further add to the ice water content and IWP. While these results appear novel and interesting, some questions could be clarified:



1) It is commendable that ice crystal shape (the capacitance and mass-dimension expressions) is diagnosed as a function of temperature and ice supersaturation. This study uses Table 1 in Myers et al. (1997) for the habit diagnoses, but more recent work more relevant to cirrus clouds is found in Bailey and Hallett (2004, JAS, Vol. 61, 514-544). What differences in habit diagnoses are found between these two studies, and how would these differences affect deposition rates/IWP?

2) Section 4.4, 1st paragraph: The high- and low-aerosol runs are repeated holding CINC constant for the purpose of calculating vapor deposition rates, which is said to make the ice surface area constant. But ice surface area also depends on the ice particle size distribution slope. Was the PSD slope held constant too?

3) Section 4.6: Since cirrus clouds tend to be grey bodies (i.e. not black), microphysical changes often affect both LW and SW cloud forcing in comparable ways, with LWCF canceling SWCF more than reported here (only 35%). Hence the net SW cooling effect appears to be climatologically significant if many other case studies yielded similar results. This point could be addressed more to encourage research in this area.

Technical points:

1) Walko et al. is referenced for 1997 in text and 1995 under references.

2) Section 4.3, Eqns. 8 & 9: S is defined as both supersaturation and crystal shape factor. S should be uniquely defined.

3) Section 4.6: Consider changing "Those changes in LW offset changes in SW" to "Those changes in LW partially offset changes in SW". Also, is it correct to begin a sentence with "35%"?

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