Atmospheric Chemistry and Physics Discussions

Interactive Comment

Interactive comment on "The effects of aerosols on precipitation and dimensions of subtropical clouds; a sensitivity study using a numerical cloud model" *by* A. Teller and Z. Levin

Anonymous Referee #2

Received and published: 27 September 2005

Review of A. Teller and Z. Levin, The effect of aerosols on precipitation and dimensions of subtropical clouds; a sensitivity study using a numerical model.

General comments:

The authors use a two-dimensional cloud model with a detailed microphysics scheme to investigate the effects of giant cloud condensation nuclei (GCCN) and ice nuclei (IN) on the development of precipitation and cloud structure, under different concentrations of background aerosol. The most important findings of the paper are: (1) polluted clouds produce lees precipitation, the initiation of precipitation is delayed and

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the lifetime of the cloud is longer; (2) GCCN have a minimal effect on precipitation enhancement, that is only observable in polluted (as opposed to) clean clouds.

Overall, the article is well written, fluent and organized with only a few minor grammatical errors. It addresses the problem of aerosol-cloud interaction and, as such, touches upon a very important and current problem in atmospheric science, well within the scope of ACP. Although the results and discussion are presented clearly, logically and concisely, I feel there are some problems with the scientific method/assumptions regarding the model that need to be addressed (see specific comments below).

Specific comments:

My first major concern with this article is the limited discussion of the cloud model used and, in particular, its implications on the conclusions reached. There are two subpoints to be made: (1) No mention is made of the resolution of the computational grid used. Too large a grid spacing will comprimise the ability of the model to resolve small-scale features (such as downdrafts or discrete entrainment events) within the cloud; (2) 2-D slab-symmetric models can cause a spurious cascades of energy into larger scales, such that cloud features do not "break down" resulting in unrealistic (visually and energetically) clouds. Again, this is responsible for insufficient entrainment and unrealistically high (adiabatic) liquid water content across a much larger width of the cloud than observed. How do these deficiencies impact the conclusions reached?

Secondly, there is no discussion of the activation mechanism, other than it is derived from classical Kohler theory. I feel this needs elaboration, in particular: (1) Is the early development of haze particles calculated below cloud base? If so, are the distributions shown in Figure 1, dry or ambient aerosol size distributions? (2) If not, how is an equilibrium aerosol size distribution obtained that will provide some partial representation of the lag that would characterize the growth of the largest CCN (GCCN)? If GCCN were introduced at equilibrium sizes corresponding to 100% relative humidity, they would be unrealistically large and would have an extreme effect on the development of coales-

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cence.

Technical comments:

pg. 7214 line 18: aspects -> aspect line 26: RAMS -> Define... Regional Atmospheric Modeling System

pg. 7215 line 8: extend -> extent

pg. 7216 line 1: Consider rewording the first sentence. It reads as though GCCN and IN modified the production of cloud dimensions. line 7: extend -> extent

pg. 7221 line2: This sentence needs rewording... This finding shows that the time to produce large raindrops by microphysical processes in clean clouds is shorter than the time it takes for the cloud to spread over a large area.

pg. 7225 line 16: cloud -> clouds

pg. 7229 line 20: cloud -> clouds

References: The Koren et al. article has now been published and needs to be updated.

Figures: Some of the figures are a little blurry and not up to publication standard

Fig. 5 (a) is OK but (b) and (c) need work

Fig. 6 is of low resolution. When I contrast Fig. 6 with Fig. 7 and 8 (both similar but fine) this may just be a problem with the PDF file I received. Nevertheless, Fig. 5 and 6 should be checked.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 7211, 2005.

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