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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Dependence of aerosol-precipitation interactions on humidity in a multiple-cloud system" *by* S. S. Lee

Anonymous Referee #1

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This paper presents the aerosol-precipitation interaction in a mesoscale cloud ensemble (MCE). The author concludes that aerosol-precipitation interaction is determined by the competing effects of entrainment and low-level convergence. Since both entrainment and low-level convergence are sensitive to ambient humidity, aerosol effect on precipitation also depends on relative humidity. Model simulations indicate precipitation enhancement under high RH (in CONTROL run) and medium RH (CONTROL-15%) conditions; whereas precipitation suppression occurs under low RH (CONTROL -35%) condition. Subsequent sensitivity tests demonstrate the robustness of these conclusions to ice physics, downdraft, and higher model resolution (=50m). However, in the 'Conclusion and summary' section, author discussed that there is a possibility

that precipitation suppression could be changed to precipitation enhancement if even higher model resolution was used for the RH-35% case. What is the optimal model resolution that can resolve entrainment sufficiently?

The paper needs substantial editing before it can be published. I found the current version is hard to read. Additionally, the paper needs to be reorganized, for example, there are two sections named 'Idealized cases' (4, 5.2). Those 'idealized cases' are simply the mid- and low-humidity cases. Using titles (such as 'Reduced humidity cases') that are more informative to the readers would improve the readability of the paper. The title of section 5.1 should be capitalized (CONTROL) to be consistent. Specific comments:

Author used 'increase in aerosol' throughout the paper, which should be 'increase in aerosol concentration'.

In the abstract the author state that "Hence, there is not only a competition between the effect of evaporation on vorticity and that on low-level convergence but also the variation of the competition with humidity'. This sentence needs clarification. To my understanding, humidity controls the strength of entrainment and low-level convergence. Therefore, it is the competition between entrainment and convergence that determines the changes in precipitation.

Abstract 'It is found' should be 'The author found'.

Page 1, line 20, 'between a single cloud', it is really a single cloud or a single-layer cloud or a single-cloud system?

Page 6, line 10, 'provide initial and large-scale forcings of humidity' to 'provide initial large-scale forcings of humidity'.

Author indicates that 'Up to the top of the planetary boundary layer (PBL) around 2km, potential temperature and humidity do not change significantly . . .'. But judging from Fig. 1, both potential temperature and water vapor mixing ratio change quite a bit from surface to 2km. Author also mentioned balloon soundings of winds, temperature and

dew-point temperature, was profiles shown in Fig. 1 based upon the balloon soundings?

Fig. 4, author states that 'The comparison of precipitation between observation and the high-aerosol run in Fig. 4 demonstrates that precipitation is simulated reasonably well'. It seems to the reviewer that low-aerosol run is the observed aerosol condition that is measured by ACTIVE (see Section 3). Therefore, low-aerosol run should simulated the observed precipitation better than the high-aerosol run, since low-aerosol is the (near-) real aerosol condition. Does this imply the deficiency of the model? Furthermore, the author listed the averaged cumulative precipitation for high- and low-aerosol runs, but not the observed cumulative precipitation. Adding the observed cumulative precipitation will help the reader to decide which run simulated the precipitation better.

Page 16, line 18, 'This factor is applied from when the average . . .', remove 'from'.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 25287, 2010.