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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosols' influence on the interplay between condensation, evaporation and rain in warm cumulus cloud" *by* O. Altaratz et al.

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This is an interesting paper addressing the issue of aerosol's impact on microphysical properties and precipitation of coastal, warm, and precipitating cumulus. The authors have used a two-dimensional axisymmetric (radial vs. vertical) cloud model with a bin (liquid phase only in this case) microphysics in the study. By driving the model with additional polluted aerosols (prescribed as particles larger than 300 nm) above the initial aerosol spectrum and then comparing the results with those obtained from a reference clean case, the authors found that the added particles have created considerable changes in the cloud microphysical structures as well as resultant precipitation. The general responses of the modeled cloud to the increase of aerosol number concentration is quite similar to the ones found in previous studies of warm and shallow clouds, i.e., with reduced cloud particle size and weak while delayed precipitation. An interesting result is the finding of larger (fewer in number) raindrops from the polluted cases.

Apparently, this work adds a new content to the current discussions on aerosol-cloud-precipitation interaction. The research is original. The paper is relatively well written and the presentation is well organized.

A general suggestion to potentially improve the current manuscript is to add in discussion some details of the dynamic and thermodynamic responses. Regarding the evaporation issue, useful information to help the discussion is the flux (net or bi-directional) of water particles and water vapor across cloud boundary, or (perhaps more complicated in calculation) the precipitation efficiency of the cloud vs. total loading of condensed water. Another useful information is the vertical velocity bias in responding to the change in aerosol concentrations.

Specific Comments

Page 12692, before line 20, model description: There are a few details the authors might want to provide: what are the lateral and vertical boundary conditions as well as initial wind field (I guess that is all zero, but needs to be told), whether radiation is included in the model (in case of no radiation, the authors might want to comment on the potential influence of this assumption on the results)? Also, what is the number concentration of particles larger than 300 nm in the clean case?

Page 12693, paragraph 3, "The differences... ": the maximum droplet concentrations in all cases exceed the values described in the previous section for particles larger than 300 nm. A calculation could tell (since the Kohler equation was used) the likely value of the maximum supersaturation reached in various cases based on the prescribed aerosol spectra. This should be useful to understand the core strength and water budget among others. In addition, adding dynamic or thermodynamic results could enhance the discussion about evaporation here.

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Interactive Comment

Page 12693, 3 lines from the bottom: 2200m vs. 2100m, it is only one grid interval. The difference in cloud top height at this step seems not significant.

Page 12694, line 6, "indicating that there are... ": does this suggest that the cloud width has been changed due to aerosol effect? An averaged number would be helpful.

Page 12694, generally on Figure 2 and 3: The maximum number concentration of droplet appears in the upper cloud at 20 minutes while near the cloud base in the later time particularly in the polluted cases, what are the corresponding dynamic features?

Page 12695, line 3: "a strong horizontal buoyancy gradient...", the modeled temperature change against aerosol number concentration should be able to tell whether this is the case.

Page 12698, line 26: "the resultant downdrafts" was not specifically demonstrated in the previous text. The authors might want to add the discussion based on results, or describe it here as a hypothesis.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 12687, 2007.