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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Intercomparison of aerosol-cloud-precipitation interactions in stratiform orographic mixed-phase clouds" *by* A. Muhlbauer et al.

Anonymous Referee #2

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General comments:

The authors report some interesting model results of aerosol effect on precipitation in orographic mixed-phase clouds for four idealized cases (combination of initial sounding and topography) from three different cloud-resolving models. Detailed impacts of increasing aerosol number concentration on cloud microphysical processes are evaluated and inter-compared between models. Interestingly, the conventional hypothesis that an increase in aerosol number concentrations reduces orographic precipitation by suppressing cloud droplet collision-coalescence and riming in mixed-phase clouds is not robustly and consistently supported by all models in the cases considered. It is sug-

gested in the manuscript that some compensation effects by other microphysical pathways are even more important in regulating orographic precipitation in mixed-phase clouds. It would be nice to see more discussion on these compensation effects. The manuscript is well written and in general the scientific methods and assumptions are clearly outlined. I recommend for publication in ACP after the comments are addressed upon revision.

Specific comments:

1) There is a lack of description of the vertical coordinates, vertical grid spacing and model top of the models. Potentially, different vertical coordinates could have significant impact on the model results because the complex terrain is involved. Indeed, as shown in figures, the temperature fields, wind speed and vertical velocity predicted by the models vary substantially in a few hours. My feeling is that the fairly large model-to-model variability in aerosol effect on precipitation may not be just a reflection of differences in microphysics.

2) Advection is known to be important in scalar transport and cloud-scale modeling of aerosol-cloud interactions. There are specific descriptions of advection scheme in the COSMO and UMNMS models, but not for the WRF model. Which advection scheme is used in the WRF model simulations?

3) "Negative" distance is used in a few figures. It sounds rather odd to me. The horizontal "distance (km)" axes in figures can be simply replaced by something like "x (km)".

4) The aerosol size distributions (modes and mean size in particular) shown in Figure 2 don't match well with those summarized in Table 3. Please clarify. Did the bin-aerosol scheme in WRF take the same initial log-normal size distribution as the other bulk schemes?

5) Are there source terms in prognostic equations of CCN/IN number concentrations?

More specifically, are aerosol particles recycled in the microphysics schemes after droplet/drop evaporation and ice sublimation?

6) In Figs. 3 and 13, why the values of integrated water vapor are different between models even at time zero? Also, domain average vertical velocity is often very close to zero like the NWNMS model shows, but the other two models show quite a departure. Any explanation on this?

7) The terminology of “inverse/reverse sensitivity” of precipitation to change in aerosol number concentrations used in the manuscript is confusing. It’s better to be explicitly described in the text.

8) Some minor technical corrections:

10494.21-24: the model names are unnecessarily repeated.

10505.3, 10514.22: change “negligible small” to “negligibly small”?

10515.14: “decrease is riming” to “decrease in riming”?

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 10487, 2010.