**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 #1

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I begin by stating that I have become quite cynical about the scientific merits of intercomparison studies, especially for those that are idealized cases with no real data basis to anchor the results of the study. This paper is no exception to that view. The paper shows a great deal of variability amongst the models, but there is no way to know which, if any, modeling approach is the most correct nor if specific parameterizations and physical modules provide the most realistic results. The paper also shows large variability from one idealized case to a second idealized case. In fact, this case-to-case variability provides the nucleus for an interesting scientific investigation. Unfortunately a systematic investigation in which cloud base temperatures vary over a range from those providing a deep warm cloud layer to one with a more limited depth warm cloud

layer, in which there is a flip-flop from a region where enhanced CCN suppresses riming to a regime where LWP's increase and riming is enhanced, is not provided. The result that some models suggest such a flip flop in regimes is likely, is the most important scientific contribution of the paper. Because this paper exposes a possible regime dependent response to aerosols that I am not aware of in the literature I recommend publication of this paper after major revisions. Overall the paper is generally well written.

Specific comments:

Why is the resolution so course given that it is a simple 2D study.

In COSMO is a binned approach used or is it a simple single-valued riming efficiency? Saleeby and Cotton(2007) showed that use of a single-valued bulk approach results in over-depletion of supercooled water amounts and thus loss in sensitivity of riming to CCN concentrations.

It is important to provide documentation of the differing fall speed equations or fall speed curves for each model as it might explain differences in snow and graupel accumulations rather than be speculated.

Some documentation of the size or number concentrations for each model when CCN is increased is needed to help understand the reversal in the riming process with different cloud regimes.

In the case of COSMO why do both riming and aggregation increase with increasing CCN in the warm case while both decrease in the cold case?

It would be nice to include how each model predicts supersaturation with respect to ice and water as well as vapor deposition growth to help us understand the great disparities in the relative amounts of hydrometeor mixing ratios.

In the discussion of the CLASE field campaign it would be informative to tell us the typical values of kappa inferred from the measurements.