

Interactive comment on “Microphysical processing of aerosol particles in orographic clouds” by S. Pousse-Nottelmann et al.

Anonymous Referee #1

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This manuscript studied how clouds regulate aerosol and how such cloud-processed aerosol impact the subsequent cloud formation using the COSMO model coupled with the M7 aerosol module and an enhanced version of Seifert and Beheng microphysics scheme. By simulating orographic clouds over two bell-shaped mountains in an idealized two-dimensional setup, the authors identified different routes of aerosol cycles in warm- and mixed-phase clouds. It is also found that the aerosol spatial distribution, mixing state and size distribution are modified by cloud processing and such processed aerosols impact the cloud formation in downwind areas.

The manuscript is well written and organized. The numerical tool and model setup are appropriate for the problem. The findings of aerosol-cloud interactions in mixed-phase clouds are important and novel. I recommend accepting this manuscript for publication

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on ACP after my two concerns are addressed.

1. The aerosol is still treated in a bulk manner even the size distributions and mixing states are parameterized in the model. When the regenerated aerosols are released, the proportions of different components are assigned to the same values as the background aerosols, since only one set of “dry” aerosol category is used in the model. That says, the mass of soluble and insoluble aerosols are not exactly conserved (to more precisely calculate the soluble and insoluble mass of processed aerosols, more separate sets of “regenerated aerosol” should be used). Therefore, the difference in Aiken mode between SCAV-ALL and AP experiments showed up in Figs, 9, 10, 15 and 16. Physically, the only difference between SCAV-ALL and AP should be the enhanced accumulation and coarse modes by regenerated aerosols. However, the Aiken mode in AP is completely missed. The authors can force the Aiken mode of AP to be the same as SCAV-ALL in an ad hoc manner. And discussions on the potential impact of such deficiency should be provided in the manuscript.

2. I found the double mountain setup and general approach of this study are similar to Xue et al., 2010 and 2012. I expect to see more comparisons and discussions of the approach and results between the current one and those two studies. For example, how the cloud-processed aerosols change the riming process in downwind orographic cloud.

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