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The effects of solubility and aerosol recycling on warm phase orographic clouds and precipitation: A modeling study using a WRF coupled with bin microphysics scheme

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Most of the current Cloud Resolving Models do not consider the aerosols that are released back to the atmosphere following the evaporation of the cloud particles. These recycled aerosols may have large impact on precipitation from the secondary clouds that becomes more polluted.
In this study we evaluated the possible impact of aerosol solubility and regenerated aerosols on warm-phase orographic clouds and precipitation. The sensitivity evaluation is performed by simulating cloud formation over two two-dimensional idealized mountains using a detailed bin microphysical scheme implemented into the Weather Research and Forecasting (WRF) model version 3.
The cloud over the second mountain is affected by regenerated aerosols advected from the cloud over the first mountain.
The effects of aerosol solubility and regenerated aerosols were investigated under wet and dry conditions for both clean and polluted background aerosol concentrations.
The main findings of the study are:
1) Decreasing the solubility results in a decrease in total drop numbers both in clean and polluted conditions. High solubility of the particles suppresses precipitation in both clean and polluted clouds because more drops are activated.
2) Consideration of aerosol regeneration increases cloud drops and reduces the precipitation compared to a case when regeneration is not considered.
3) Increased solubility of regenerated aerosols due to in-cloud chemical processes increases cloud drop concentration and reduces precipitation to a level lower than that of the clouds generated by the original solubilities.