

# ***Interactive comment on “Effects of Cloud Condensation Nuclei and Ice Nucleating Particles on Precipitation Processes and Supercooled Liquid in Mixed-phase Orographic Clouds” by Jiwen Fan et al.***

## **Anonymous Referee #2**

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### General Comments:

The response of cloud microphysical processes and precipitation to changes in aerosol particle concentration is still uncertain. This article presents numerical sensitivity tests on how the cloud processes and precipitation from mixed-phase orographic clouds are changed due to changes in the concentration of cloud condensation nuclei and ice forming nuclei. The results are interesting and are generally well presented. It should be publishable in ACP if the following specific issues could be considered in revision.

### Specific Comments:

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- 1) Line 51-53: Remove “Supercooled liquid occurred commonly in clouds over the Sierra Nevada during the cold season (Rosenfeld et al., 2013)”, since the similar sentence also appears in line 54-55.
- 2) Line 67: "pollution aerosols" may be replaced by "anthropogenic aerosols".
- 3) Change Line 73-74 to “The impacts of aerosols on clouds not only depend on aerosols properties, but also on the dynamics and thermodynamics of the clouds”.
- 4) Line 146: “which is referred to as INP concentration”: this notation may not be proper, because the concentration of aerosol particles with diameter larger than 0.5  $\mu\text{m}$  is not the concentration of INP, just as a factor.
- 5) Line 166: The scheme for deposition nucleation should also be briefly described, since it dominates ice formation in the cold case.
- 6) Line 185: “. . .with the initial INP concentration of 0.1, 1, 10, and 100  $\text{cm}^{-3}$ , respectively”: these are concentrations of coarse mode aerosol particles, not IN. This should be clarified.
- 7) Line 192: “. . . are around 30 (2) and 120 (4)  $\text{cm}^{-3}$ , respectively”: the concentrations of INPs should be the coarse mode aerosol particles. When we talk about the concentration of INP, we must indicate at which temperature.
- 8) Line 237-239: This is most likely caused by the treatment of snow particles in the model. Since most of the droplets transferred to snow when INP was high, the concentration and mass of water droplets must be lower. How the large drops are treated when they are frozen? Are they also transferred to snow?
- 9) Line 296: “. . .have ice nucleation occurring (Fig. 6b)”: through which nucleation mechanism?
- 10) Line 372: “Atmospheric rivers” are mentioned several times, but it is not a commonly known concept. It should be explained at the beginning.

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- 11) Line 401-404: It should not be the upper limit, if deposition nucleation and condensation freezing are not included.
- 12) Line 405-406: the CCN effect is much more significant than INP when the concentration of CCN is 1000 cm<sup>-3</sup> or above.
- 13) Line 438-439: Remove “in our model simulation with the fast version of SBM in which ice habits are not considered”.
- 14) Line 441-442: Remove “in the model simulation”.
- 15) Page 42: The ordinates should be provided for Figure 10.
- 16) Page 43: The ordinates of the left panel should be provided for Figure 11.
- 17) Page 44: The unit of temperature in the figure should be corrected.

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