Dear Editor,

We would like to thank the editor and reviewers for your professional comments and suggestions, which are very helpful in improving our manuscript. We have implemented the technical corrections in the revised paper, and the zenodo dataset is now fully accessible. Our point-by-point response to the comments raised by reviewer is shown as follows. The comments are in black, and our responses are given directly afterward in blue.

Reply to the comments of Reviewer

I would like to thank the authors for thoroughly addressing the comments raised by all three reviewers. The revised manuscript has been significantly improved. I have only a few minor comments on this version of the manuscript:

• To improve clarity and organization, please consider moving the description of the observational datasets (reflectivity and lightning locations) and their associated uncertainties from the Results Section (3.1 Model validation) to Section 2, which is dedicated to the description of data and methodology.

Reply: We appreciate your comment. The description of the observational datasets is moved to Section 2.3.

• Lines 137-139: The initial sublimation break-up parameterization has two slightly different formulations—one suited to dendritic snow and the other to graupel particles. Am I correct in understanding that you used only the formulation appropriate for ice/snow particles and did not apply the one suited for high-density solid particles (graupel/hail)? Please clarify this here.

Reply: We appreciate your comment. Yes, we only considered the breakup of ice/snow collision and did not apply the one suited for high-density solid particles. This is now clarified in the paper.

• Line 237: Please specify in the revised manuscript the threshold (10^{-6} g/kg) used to define "in-cloud" conditions, as indicated in your response to the reviewer document.

Reply: We appreciate your comment. This is now clarified in the paper.

• In Lines 465-469: Please update the reference from Fig. 18 to Fig. 17. Additionally, it would be helpful to provide a quantitative estimate for the "remarkably enhanced" flash rate with higher aerosol concentrations or SIP inclusion. For instance, you can mention the maximum factor of increase (e.g., up to tenfold) with increasing aerosol levels. It also appears that the flash rate reaches a “plateau” beyond an aerosol concentration of approximately 1000 cm^{-3}, as there seems to be little difference between the 2000 and 4000 cm^{-3} cases.

Reply: We appreciate your comment. The reference is updated from Fig. 18 to Fig. 17. In addition, the following discussion is added: *“Without SIP processes, the flash rate in the case with a CCN concentration of 4000 cm^{-3} is 2-3 orders of magnitude greater than that with a CCN concentration of 400 cm-3. The flash rate reaches a “plateau” beyond a CCN concentration of approximately 1000 cm^{-3}, as there is little difference between the noSIP-2000 and noSIP-4000 cases. The addition of SIP processes can also slightly enhance the flash rate. For the cases with a CCN concentration of 400 cm^{-3} and 4000 cm^{-3}, the average flash rates between 16:00 May 29th and 04:00 May 30th increase by 66.8% and 44.3% due to the SIP processes, respectively. Therefore, the flash rate from the 4SIP-4000 experiment is the largest.”*