Reviewer responses are highlighted in blue, and changes made to the manuscript are marked in red for ease of reference.

1, All the major findings presented in this study have been documented elsewhere as cited by the authors. Then what is the point of innovation brought by this follow-up study?

Re:

Rimed particles play a pivotal role in cloud microphysical processes and precipitation formation. Through the accretion of supercooled droplets, riming accelerates particle growth, modifies particle density and morphology, and significantly affects the particle size distributions, melting layer depth, and precipitation efficiency. However, most existing studies are primarily based on observational results, which are often limited by spatial and temporal coverage and cannot fully resolve the vertical evolution of ice particles or their microphysical transformations. In addition, conventional numerical models are generally unable to accurately track microphysical processes such as the riming of ice particles, and there is still a lack of proper parameterizations for the evolution of ice particle size distributions. To overcome these limitations and investigate the microphysical processes and spectral evolution of ice particles from the supercooled layer to the melting layer, as well as their key influencing factors, we combine in-situ observations with the McSnow model. McSnow has unique advantages in tracking the detailed evolution of individual ice particles in different stratiform and convective regions of stratocumulus systems. Building upon this, we further analyzed the characteristics of the simulated particle spectra and conducted sensitivity experiments to investigate the effects of supercooled layer thickness (SLWLT) and supercooled liquid water content (SLWC) on particle size distributions.

Our results show that in convective regions (CR), stronger updrafts and higher liquid water content enhance riming and aggregation, producing larger and denser ice particles (maximum rime density of 0.45–0.5 g cm^{-3}) and a deeper melting layer. In contrast, in stratiform regions (SR), weaker riming results in a thinner melting layer (400–500 m thinner than in CR). Sensitivity experiments further demonstrate that increasing SLWC and SLWLT promotes the growth of rimed snow (100–1000 μm) and slightly raises rimed ice crystal concentrations, while decreases in these parameters reduce the number of rimed particles but favor the formation of larger rimed snow. SR responds more strongly than CR to variations in SLWC and SLWLT, and rimed snow is more sensitive to these changes than rimed crystals.

Furthermore, gamma distribution fitting of both observed and simulated particle spectra indicates that the intercept parameter N_0 is generally larger in SR than in CR above 5000 m, while the shape parameter μ and slope parameter λ exhibit opposite trends. The quantitative relationships among the spectral parameters were also fitted through regression analysis: $\lg(N_0) = -5.48\lambda - 3.1$, $\lg(N_0) = -0.46\mu - 3.25$, $\lambda = 0.06\mu + 0.06$. In sensitivity experiment, N_0 is found to be highly responsive to SLWC changes. These findings provide new insights into the microphysical processes of stratocumulus rainfall systems and offer practical references for improving numerical cloud parameterizations. These aspects are rarely addressed in previous studies.

A discussion on the comparison with previous studies has now been refined in Sec. 5 Summary and Conclusion (L. 414–422):

Current research on stratiform clouds with embedded convection is mostly based on observational data and Eulerian numerical simulations. The study on cloud physical processes often focuses on the temperature layer below 0 ℃ or the ML, and there is limited research that connects both the two layers and precipitation processes (Hou et al., 2021; Hu et al., 2025). As the Lagrangian method of the McSnow model has unique advantages in studying the ice-phase process (Bringi et al., 2020; Delafrance et al., 2024), demonstrating good simulation results for the microphysical evolution of ice particles. Research on the spectral parameters of ice-phase particles in stratiform clouds remains limited. Previous studies primarily focused on raindrop size distribution, such as the gamma distribution analyses in stratiform and convective regions by Caracciolo et al. (2006) and Niu et al. (2010), and the investigation of particle size evolution in cirrus and stratiform precipitating clouds by Heymsfield et al. (2002). Xiong et al. (2023) had examined the present case but using a two-parameter negative exponential distribution. Additionally, the effects of supercooled water content and supercooled layer thickness on particle size spectra have rarely been explored. This paper studies a precipitation case of stratocumulus clouds on 22 May 2017, using aircraft measurements and weather radar data. By combining the WRF-SBM and McSnow numerical simulations, a deeper understanding of the microphysical evolution of ice particles in different cloud regions of stratocumulus clouds has been achieved.

2. For microphysics studies, WRF simulations is commonly used to compensate for the limited spatiotemporal coverage of aircraft observations and validate the newly discovered hypothesis. However, the modeling results do not provide additional insights or novel understanding, as the simulation results largely reiterate the findings of in-situ observations, e.g., CR having stronger updrafts and more riming. The manuscript's core arguments and conclusions would remain entirely unaffected if the WRF component were removed, suggesting these simulations contribute little substantive value to the study.

Re: The WRF model serves as a valuable supplement to observations in both spatial and temporal dimensions. For example, the simulations provide a complete depiction of the vertical structure and evolution of clouds in different regions. Both observations and WRF simulations reveal that convective regions exhibit higher supercooled water content (LWC in region B ≈ 0.45 g m^{-3}, compared to 0.32 g m^{-3} in A and 0.18 g m^{-3} in C), stronger riming, and broader ice particle spectra (graupel sizes 50–500 μm in B vs. 80–500 μm in A and 200–500 μm in C). Stratiform regions remain more stable with narrower spectra.

In addition, the validated WRF-SBM simulation results are used as the background fields to drive the Lagrangian particle model, primarily including vertical profiles of pressure, water vapor, and temperature.

While now, to strengthened the analysis of the MCSNOW model results regarding the evolution of ice particles, the WRF results (L. 306–340) in Sec. 4.1 have been removed from the main text and are now provided in the appendices. The content previously in Sec. 4.2 has been merged into Sec. 4.1. Specifically, we have deleted the subsection title at L. 342 and removed the phrase "as well as the uneven vertical resolution in the WRF model" at L. 343. The numbering of Fig. 14 has been updated accordingly to Fig. 11. Specifically, we have deleted the subsection title at L. 342 and removed the phrase "as well as the uneven vertical resolution in the WRF model" at L. 343. The numbering of Fig. 14 has been updated accordingly to Fig. 11.

Additionally, we have included a new section on the sensitivity experiments, which is now designated as Sec. 4.2. Please refer to the file "SensitivityExperiment.pdf" included in the submitted ZIP package. for details. The introductory discussion of Sec. 5 Summary and Conclusion (L. 414–422) has also been revised as follows:

Current research on stratiform clouds with embedded convection is mostly based on observational data and Eulerian numerical simulations. The study on cloud physical processes often focuses on the temperature layer below 0 °C or the ML, and there is limited research that connects both the two layers and precipitation processes (Hou et al., 2021; Hu et al., 2025). As the Lagrangian method of the McSnow model has unique advantages in studying the ice-phase process (Bringi et al., 2020; Delafrance et al., 2024), demonstrating good simulation results for the microphysical evolution of ice particles. Research on the spectral parameters of ice-phase particles in stratiform clouds remains limited. Previous studies primarily focused on raindrop size distribution, such as the gamma distribution analyses in stratiform and convective regions by Caracciolo et al. (2006) and Niu et al. (2010), and the investigation of particle size evolution in cirrus and stratiform precipitating clouds by Heymsfield et al. (2002). Xiong et al. (2023)

had examined the present case but using a two-parameter negative exponential distribution. Additionally, the effects of supercooled water content and supercooled layer thickness on particle size spectra have rarely been explored. This paper studies a precipitation case of stratocumulus clouds on 22 May 2017, using aircraft measurements and weather radar data. By combining the WRF-SBM and McSnow numerical simulations, a deeper understanding of the microphysical evolution of ice particles in different cloud regions of stratocumulus clouds has been achieved. The following conclusions are drawn:

Item (2) in the conclusion (L. 434–443) has been removed, and the original item (3) has been renumbered as (2). The new item (3) has been rewritten as follows:

(3) The sensitivity experiments reveal that variations in supercooled water content (SLWC) and supercooled layer thickness (SLWLT) significantly influence the riming growth and size distribution of ice-phase particles. Increasing both SLWC and SLWLT enhances rimed snow within the 100–1000 μm range and slightly increases rimed crystal concentrations, while reducing the abundance of particles larger than 1000 μm. Decreases in SLWC and SLWLT lead to fewer rimed particles overall but favor the formation of larger rimed snow due to reduced secondary ice production. SR respond more strongly to these changes than CR, and rimed snow is generally more sensitive than rimed crystals. Gamma distribution fitting shows that spectral parameters (N_0, μ, λ) vary mainly between 2000 m and 5500 m, with N_0 highly responsive to SLWC changes. The impacts of decreasing SLWC and SLWLT are stronger than increases, particularly in SR, highlighting its dominant role in riming processes.

3. While the paper provides a detailed microphysical analysis of ice particles in stratocumulus clouds, its fundamental limitation lies in being a single case study (22 May 2017 over northern China). This narrow scope significantly restricts the broader applicability and scientific impact of the findings.

Re: As another reviewer pointed out, similar studies in China are still limited but highly necessary. Although our work focuses on a single case, we conducted a comprehensive investigation from both observational and numerical modeling perspectives and further performed sensitivity experiments based on the existing analyses. We hope that this case study will enhance our understanding and provide new insights into the cloud microphysical structures and the mechanisms of ice particle growth in different regions of such stratocumulus systems.

Specific comments

Line 40. Should be "Research has".

Re: Line 40 "Researches have" has been revised to "Research has".

“McFarquhar” is incorrect cited as “Mcfarquhar”.

Re: Both “McFarquhar” in the L. 161 and “McFarquhar” in the references have been corrected to “Mcfarquhar.”