We are grateful for the two anonymous reviewers for their second round suggestions, especially on polishing figures and correcting typos. Please see your original questions in black, our responses in blue, and the revised text in the manuscript in red.

Comments from Reviewer #1:

I thank the authors for their detailed responses to all comments. All comments were fully addressed, either through comprehensive replies or additions to the paper. I believe that the paper is suitable for publication. I have only one small note below regarding units:

The use of italics for units is inconsistent. For example, km is written in italics in line 197, but not in line 102. This occurs elsewhere also. Similarly, there is sometimes a space missing in between the number and the unit.

Thank you for pointing out the formatting inconsistencies. We have gone through the latex source file carefully to conform with consistent mathematical conventions. To be more specific:

(1) we've added space in front of every unit;
(2) every unit and number are written in italics now (except "UTC", "mins", "hour", which are not SI units);
(3) IWP, IWC, TB, PD, r are all written in italics.

Comments from Reviewer #2:

I appreciate the effort of the authors put into improving the manuscript and the figures! The new title much better describes the content of the paper. In addition, the authors provide detailed answers to my questions. These are, however, only partly reflected in the revised manuscript and I still have some remaining remarks, which should be addressed before publication of the manuscript (line numbers refer to the new manuscript):

Thank you very much for improving the figures. Is there a reason, why Fig. 3 and 6 show 17.2 to 17.6 only, while Fig. 7 and 8 show 17.0 to 17.8 and Fig. 9 16.2 to 17.4? If not please unify.

Yes. Fig. 3 and Fig. 6 focus on showing the details of one cell at 17.4 UTC, while Fig. 7 and 8 strive to show that the hydrometeor classification method can produce the best match for forward simulation of CoSSIR not only for one convective core, but also for the system during an earlier period (17.0 UTC vs. 17.4 UTC). And then Fig. 9 is demonstrating that using the detailed hydrometeor classification, one can achieve a high-quality IWC retrieval from radars that are highly agreeable with in-situ reference not only for the cell shown in Fig. 3/Fig. 6, but also for this system during the evolution (16.2 UTC, 17.0 UTC and 17.4 UTC).

Fig.1, lower row: The black dashed line partly overlaps with the titles, either move the line downward or extend the y axis to 16km, and maybe start and end the dashed lines (horizontally) at the edges of the rectangles to avoid overlapping. In addition, the P3 airplane symbol partly overlaps with the tick label. I am really sorry for being picky here, but ACP is a high-quality journal and figures looking as if quickly stacked together do not give the reader the impression of a high-quality work.

Thanks for being a very responsible reviewer! I really appreciate your level of scrutiny to make sure readers will not turn away because of these nuances. Fig. 1 is updated in the manuscript.

Section 3.2: Concerning my remark related to the Liu et al. (2026) companion paper and the neural network training. I understand that Liu et al. take a different approach and appreciate the additional information added to the manuscript (and the now available preprint helped to clarify differences). However, if the methods presented here are a new approach I, in particular, miss a bit more motivation and information in the manuscript about the new method presented here and a justification that the applied training methods and hyper parameter settings for the non-PD and PD cases are valid here (see my original comments on that).

We have elaborated in this section the second point in Section 4 (Line 457-464) about the difference between Liu et al. (2026) and our paper regarding hydrometeor profiling. They employ a more strict, widely acknowledge physical algorithm (hybrid Bayesian and optimal estimation, or in short BMCI-OEM method), but they (1) don't use polarimetric signals at all; (2) because of not using the polarimetric signal, the vertical hydrometeor phase (liquid, ice, mixed) is purely determined by ancillary temperature from model outputs, and for frozen phase, one ice habit is assumed and there is not constraint on what is the best ice habit assumption. This paper paves a promising pathway to improve the Liu et al. (2026) algorithm: first, one can retrieve the hydrometeor phase and ice habit using our ML model elaborated in Section 4.2; then we can further employ the BMCI-OEM method to obtain a better retrieval (hence, the last sentence in Line 463 provides a vague outlook). As a matter of fact, as I'm writing this response, we just received the news that we are going to be funded to do further development along this pathway.

In short, this paper has demonstrated enough difference and novelty that can differentiate from Liu et al. (2026)'s work, and we believe the paragraph in Line 457-464 provides adequate discussion about the latitudinal comparison about their differences and how we envision both methods can supplement each other.

L. 190 (l. 180 in preprint): if possible, please add a short version of your explanation about horizontal ice crystal orientation and the reference from your answer to the comment also to the manuscript.

RICE working mechanism is different from other cloud image probes. RICE has an oscillation probe with a sensing cylinder in the middle. When ice builds up on the sensing cylinder, the oscillation frequency will change subsequently, which is related to the rate of ice accretion. Therefore, one can only "retrieve" particle mass and phase (RICE is sensitive to SCLW in particular) but not directly "observing" the particle shape, size or orientation. We have added this explanation in the manuscript in Line 183, which read as:

"RICE has an oscillation probe with a sensing cylinder in the middle. When ice builds up on the sensing cylinder, the oscillation frequency changes subsequently, which is related to the rate of ice accretion Finlon et al. (2026)."

The same applies to the answer to my comment on l. 212 in the preprint. It is completely valid to state that an improved solution exists (and very briefly explain it) but that it was too computationally expensive to applied and there was a good reason for the choice of the simpler assumption.

Admittedly 3D radiative transfer is necessary for enabling full-use of PD signals, which is prohibitive in our case due to computational cost, our major concern is the non-unique solution. We face an ill-posed retrieval problem with more degree of freedom (ice shape, particle size distribution, vertical mass distribution, distribution of orientation) than observables (TB and PD). Even with multi-frequency TB and PD measurements, due to the broad weighting function shape of passive radiometer, we still cannot retrieve every microphysical variable from the observables even with the most advanced RT modeling. Using only 52.8 deg view-angle to eliminate the dependence on one of the variables (a.k.a., distribution of orientation) which plays a major role in impacting PD magnitude is hence the rationale here rather than concerns of computational cost.

Fig. 5: I agree that the version with the hatched mixed-phase region in panel (a) does not help much in differentiating the different regions. Instead of hatching the mixed-phase region, I rather suggested to show the IWC as previously in panel (a), the hydrometeor types as before in a panel (c) and add a panel (b), where you only display the LWC. This might help to better distinguish the different classes. In addition, the colorbars/labels still overlap.

We follow your suggestion to create three panels now, and we move the LWC colorbar to the 2nd panel so the bottom panel is not too crowded that creates overlapping of characters. Figure caption has been modified accordingly.

Fig. 10, 11, 12: Please add x axis labels, even though it is just pixel number. But this information is currently not given and helps the reader to interpret the plots.

“# pixel” added on the x label. Thank you for the kind suggestion.

Technical corrections:

l. 174: a comma is missing between “unrimed aggregates” and “graupel”

A comma is added. Thanks for spotting that.

Fig. 9: Please include the regression line and R value into the figure caption.

Now a sentence is added in Fig. 9 caption: “Linear regression results for (a) are added as the blue line and equation/R-value written in the bottom right corner of panel (a).”

Fig. 10 caption: “see” -> “See”

Corrected.

l. 392: “yet” -> “Yet”

Corrected.

l. 396: “figure shown by Fig.”

“figure” is crossed out now.

l. 459: “While” -> “while”

Corrected.