We appreciate the careful and timely reviews of our manuscript provided by both referees. Our revised manuscript text and figures include several minor revisions based on their feedback. Both referees drew our attention to a need for improved technical clarity regarding Doppler velocity values. This issue is addressed in lines 478-479 of the revised manuscript. Additionally, we addressed suggestions by Referee #1 to provide some representative synoptic context for our selected storm. We also appreciate the comment by Referee #2 to reiterate the need for consideration of relative changes in Doppler velocity with height owing to potential for measurement biases. In the following text, please find our direct responses to specific comments.

Referee #1 Comments
General Comments:

The authors have done a great job on the manuscript titled "Simulated Particle Evolution within a Winter Storm: Contributions of Riming to Radar Moments and Precipitation Fallout". The manuscript was a pleasure to read as it is well-written, clear, and well-organized. The authors have addressed important scientific questions, have understood well what previous work has been done on their research topic, and have presented work that adds a significant contribution beyond what has been done previously. I have only minor comments that should be easy to address.

Thank you for your careful review and for providing several helpful suggestions which have strengthened, and added clarity to, our revised manuscript.

Scientific questions/issues:

- It is probably good to briefly explain, in a sentence or two, the representativeness of this storm for an East Coast U.S. winter cyclone in Section 2.1. While this storm was a moderate storm with mixed precipitation that was stretched along a long frontal boundary (and was suited well for your study), a number of East Coast U.S. storms, including some on the IMPACTS project, were more intense with regions of elevated convection, strong frontal boundaries/circulations, deep-stratiform comma head clouds, and a variety of snowband patterns that evolved quickly with time. This will help add context for a reader that may not be too familiar with winter cyclones, especially over the East Coast.

As suggested, comments were added in Section 2.1 to provide a brief description of our selected storm's representativeness among northeast US storms based on a recently published IMPACTS paper by Zaremba et al. (2024), particularly their Table 1 and associated discussion. Lines 198-205 of the revised manuscript now read:

"Winter storms that impact the northeast US are commonly described according to the track of the low-pressure center, with implications for their precipitation characteristics. From these tracks, Zaremba et al. (2024) classified twenty-six IMPACTS events in one of six categories, which varied in, for example, rates and regions of cyclogenesis, frontal forcing, and precipitation intensity and distribution. Six of the events were classified as cold fronts and had relatively weak and expansive low-pressure areas which yielded widespread rain and snow along, and extending to the cold side of, the front. As one of these cold front events, the 04 February case had a broad frontal boundary that extended from the Gulf of Mexico to Maine."

Zaremba, T. J., Rauber, R. M., Heimes, K., Yorks, J. E., Finlon, J. A., Nicholls, S. D., Selmer, P., McMurdie, L. A., and McFarquhar, G. M.: Cloud-Top Phase Characterization of Extratropical Cyclones over the Northeast and Midwest United States: Results from IMPACTS. Journal Atmos. Sci., 81, 341-361. https://doi.org/10.1175/JAS-D-23-0123.1, 2024.

Minor comments/technical:

- In Figure 4, I believe the y-axis should be labeled Height (km) not Height (m)

Thank you for catching this error. The y-axis label on Figure 4 has been corrected to now read: *"Height (km MSL)"*.

- I'm not sure this has to be done but I noticed Height km MSL is used in the text. However, on the figures, it's Height (km). Again, may not be totally necessary, but just for consistency, use Height (km MSL) on the y-axis figure labels.

We agree with this suggestion and have revised all relevant figures to now specify height units of: *"(km MSL)"*.

- Lines 471 – 472: You state the V_D increased from -0.72 m s^{-1} to -1.00 m s^{-1}. Technically that's a decrease in value, correct? However, I also realize most readers will know what you mean, that the particles are falling faster. Perhaps adding a little to the sentence like: "V_D increased from -0.72 m s^{-1} to -1.00 m s^{-1}, meaning the particles fell faster" or something like that could help.

This suggestion is consistent with a comment from Referee #2, indicating a need for improved clarity. In lines 478-479 of the revised manuscript, the referenced sentence now reads:

"Within the subsequent 1 km (5.5 km to 4.5 km MSL), V_D becomes increasingly negative (-0.72 m s^{-1} to -1.00 m s^{-1}) as particle fall speeds increase (Fig. 7b)."

Referee #2 Comments
General Comments

Overall, the manuscript is well-structured, with an in-depth introduction laying the foundation for the goals and methods of the paper. The paper falls within the scope of ACP, while utilizing novel methods presented from past literature and unique in situ data to answer these questions. The experimental design is explained in a clear manner, and limitations arising from the methods are sufficiently addressed. I only have a few minor comments, as listed below:

We appreciate your careful review of our manuscript and for providing insightful feedback regarding the clarity and consistently of the language in the text pertaining to the Doppler velocity measurement uncertainty.

Specific Comments

One of the key findings from this paper is demonstrating the usefulness of using V_D to discriminate regions of significant riming from regions of aggregation or other microphysical processes. However, as the authors also acknowledge the uncertainty range of V_D measured by the HIWRAP Ku-band (lines 502-503), it may be helpful to reiterate the importance of the relative change of V_D with height, rather than the magnitude of V_D, in the conclusions. In particular, given that all of the simulations shown in Figures 9 and 10 fall within the ±1 m s^{-1} range, a brief discussion of the robustness of the differences in the vertical derivative of V_D may reduce any possible misinterpretation of the results presented in the paper.

Because of the potential bias in the V_D measurements, we intended to emphasize relative, as opposed to absolute, changes throughout the manuscript. As suggested, some additional discussion to reiterate this point was added to the referenced discussion at the end of Section 3.3, in lines 512-515 (added text italicized):

"Despite the confidence in Z aloft, we find that V_D is underestimated by about 0.5 to 1 m s^{-1} in the control simulation but within an uncertainty range of ± 1 m s^{-1} (Matthew McLinden, personal communication, 25 April 2024) for the HIWRAP Ku-band V_D measurements. *Some of the uncertainty in the V_D measurements is due to corrections necessary for the aircraft motion, which, although unlikely to significantly affect the relative evolution of V_D with height, may yield an absolute magnitude bias.* This bias between the observed and simulated V_D is consistent throughout the column, suggesting that this consistent bias may be explained, to a large extent, by *those* uncertaint*ies* in the observations. More importantly for this analysis, the relative changes in V_D with height, which have process-based implications, are similar between the observed and simulated profiles."

The following complementary comments were added in lines 587-590:

"As discussed in Section 3.3, remote sensing measurements of V_D, including those from the HIWRAP radar used throughout this study, are subject to magnitude biases. Nonetheless, as with Z, the relative magnitude changes in V_D with height demonstrate a sensitivity to the riming process."

Additional relative context was added in lines 593-595:

"As a result of rime accumulation in the control simulation, V_D immediately above the melting level (3.6 km MSL) increased by about 68% relative to the no_riming simulation. Similarly, Z increased by about 44%."

Finally, we have revised our third bullet point of the conclusions (lines 724-726) to now state relative changes resulting from effects of riming and now reads:

"Riming cumulatively increased radar reflectivity above the melting level by an estimated 44% and Doppler velocity by 68% and demonstrated significant sensitivity to small perturbations in supercooled liquid water concentrations."

This similar change to relative changes expressed in percentages has also been made in the Abstract.

Technical Corrections

Lines 471-472: consider rewording the phrase "V_D increases from -0.72 m s^{-1} to -1.00 m s^{-1}" to clarify that the speed is increasing, although the numerical value is becoming more negative.

We appreciate this suggestion, which is consistent with a suggestion from Referee #1. In lines 478-479 of the revised manuscript, the referenced sentence now reads:

"Within the subsequent 1 km (5.5 km to 4.5 km MSL), V_D becomes increasingly negative (-0.72 m s^{-1} to -1.00 m s^{-1}) as particle fall speeds increase (Fig. 7b)."