This is a very solid and well written paper describing the optimal estimation (OE) algorithm for retrieval of microphysical characteristics of ice using combined polarimetric and dual-frequency radar measurements. The algorithm was tested on the data collected during the ICE-POP 2018 experiment in Korea. Although certain microphysical features of ice / snow are well captured, an overall quality of the algorithm performance is quite modest which might be possibly or partially attributed to the instrumental biases of the radar measurements (and the dual-wavelength ratio DWR in particular).

We thank the reviewer for their helpful comments.

A fundamental question this study raises regards the feasibility of utilizing a very complicated and computationally intense OE methodology to solve multiparameter problems with large uncertainties in the state and observed vectors. I do not exclude that combining more simplistic retrieval methods with careful data quality control might be more efficient under such scenario.
Here is a list of more concrete comments and suggestions,

- The authors avoid using specific differential phase K_{DP} in their formalism and resort to the total differential phase instead. Radial dependencies of Φ_{DP} in Fig. 4 and temporal plots of K_{DP} in Fig. 8 (bottom panels) show that K_{DP} can be quite reliably estimated at both Ku and Ka bands. K_{DP} is very sensitive to a lower end of the particle spectrum and the results of this and similar studies indicate that K_{DP} is strongly correlated with the total concentration of smaller-size ice. In other words, K_{DP} has very strong informative content and is immune to attenuation, resonance scattering effects (even at Ka band), and radar miscalibration.

We agree that K_{dp} is an informative radar observable that does provide constraints on the smaller particle sizes and total particle number concentration, and is less prone to calibration error than the other measurements. One reason we avoid using K_{dp} is the uncertainty in estimating the quantity from profiles of differential phase. This uncertainty comes from the variety of methods to calculate K_{dp} as well as the noise in the PhiDP field. Our method accounts for the propagation effects (both attenuation and accumulation of differential phase from non-zero K_{dp}) directly, so the information content provided by the differential phase shift is utilized without having to take the additional step of estimating the K_{dp} field and its associated uncertainties (which are likely to be non-Gaussian, violating the OE formalism) . In other words, it is more difficult to constrain the independent K_{dp} values at each range gate than the total phase shift, since errors in K_{dp} will accumulate down range if there are systematic errors in PSD and orientation parameters.

- Since the D3R radar was able to do genuine RHIs during the ICE-POP experiment, would it be possible to display composite RHIs of Z, Z_{DR}, and K_{DP} and generate vertical profiles of the radar variables (at Ku and Ka bands) over the PIP location in a height vs time format? This would give a better idea about the vertical microphysical structure of the storm and possible problems in the radar – PIP comparison which are mentioned in the manuscript such as enhanced vertical gradients of Z likely responsible for underestimation of snow rate and size.

This is a good suggestion and we have generated these plots. The strong near-surface vertical gradient in Z_H is clearly evident in the 9 January case, suggesting low-level ice particle growth may be one reason retrievals produce lower snowfall rates and particle sizes than those found from the PIP. The strong peak in DWR (without similar patterns in the other variables) is also evident in the 28 February case. We have added these plots to the revised manuscript.

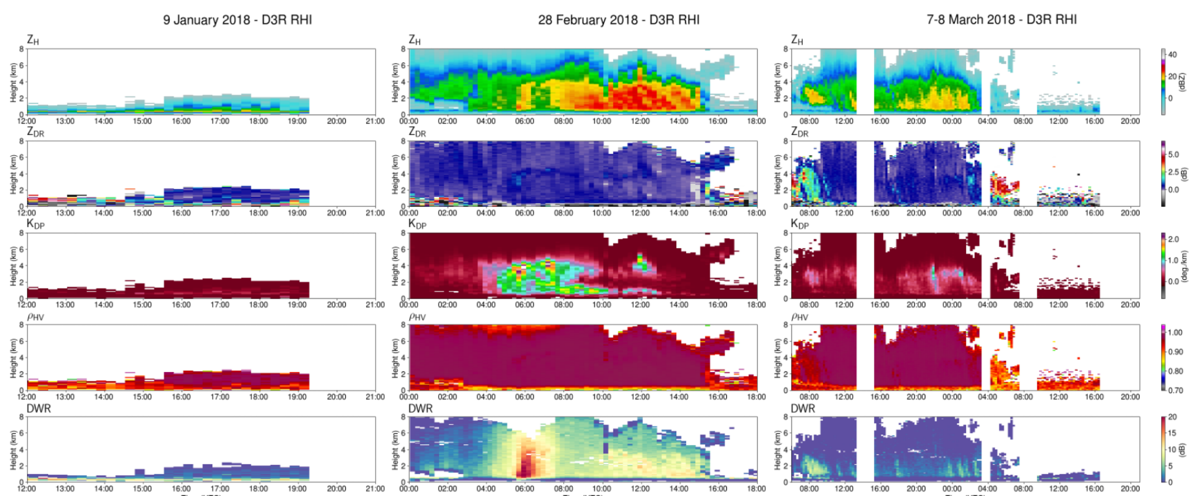

Figure R1: Time-height cross-sections of RHI profiles of the 9 January 2018 (left column), 28 February 2018 (middle column), and 7-8 March 2018 (right column) cases. The profiles correspond to 10 km downradial of the D3R radar, approximately 8 km downradial of the PIP. We use the 10-km range so that the elevation angles are low enough for the polarimetric variables to be meaningful. From top to bottom, row 1 is the Ku-band Z_H, row 2 is the Ku-band Z_{DR}, row 3 is the Ku-band K_{dp}, row 4 is the Ku-band ρ_{hv}, and row 5 is the Ku-Ka Dual-wavelength ratio.

Captions to Figs. 4 and 5 are the same. Thank you for noticing this oversight, we have fixed the caption to Figure 5.

Correct the reference the Ryzhkov et al. (2016) paper. It is not in press.

Thank you for noticing this error, we have fixed the reference.