# Responses to Review Comments on ACP-2022-495

Again, we would like to express our sincere thanks to the Handling Editor and anonymous reviewers for their great comments and suggestions. We have further revised the manuscripts based on the reviewers' comments. Detailed responses are provided below.

1. Regarding $Z_{DR}$ calibration, the current U.S. NEXRAD is following the order of: (1) Bragg Scattering, (2) Dry Snow, and (3) Light Rain method with weighting number (3) to be the lowest consider its lowest accuracy and largest standard deviation. Since this is a typhoon case, Bragg scattering is not an option, dry snow method should be the best choice left. I'd agree you want to make sure dry snow is dominated in order to use this method. The idea of using RDQVP (for better coverage at low levels) can significantly improve melting layer top detection and avoid low level non-meteorological noise. A typhoon/hurricane case can be benefited to have quite large areas of stratiform precipitation for a RDQVP profile to be built. Anyway, this is a suggestion but not required for $Z_{DR}$ calibration here.
Response: We truly appreciate this great suggestion. We totally agree with the reviewer that RDQVP built from large areas of stratiform precipitation during a hurricane event could potentially improve melting layer top detection and avoid low level non-meteorological noise. We will consider RDQVP in our future work. Thanks again for the suggestion.

2. Referring Kumjian and Prat (2014) is a nice touch. But some RHIs of Z, $Z_{DR}$, $K_{DP}$, and Rhohv would be more direct evidence to show the stronger break-up processes here.
Response: We thank the reviewer for the kind words. Indeed, Kumjian and Prat (2014) is a best reference we should cite and *compare* in this particular study. We also agree with the reviewer that RHIs would be useful to show the stronger break-up processes here. In Fig. 1 below, an example with simultaneously decreasing $Z_H$, $Z_{DR}$, and $K_{DP}$ toward the surface (highlighted by the rectangular boxes). Nevertheless, as the reviewer may be aware, the stronger break-up processes (i.e., breakup-only processes) might not be always perceived through real RHI measurements since the collision process is usually controlled by the coalescence-breakup balance; some large-sized drops may form due to coalescence, but such an increase will also be balanced by break-up. Another fundamental process is that larger-sized drops fall at a faster speed than small-sized drops, which can be validated through Eq. 3 along with disdrometer measurements. Combining these two processes, $Z_{DR}$ may also increase toward the surface (but might not exceed $\hat{Z}_{DR}$) in situations with coalescence-breakup balance.

Therefore, it might be easier to differentiate the dominant break-up or coalescence through the difference between $Z_{DR}$ and $\hat{Z}_{DR}$, and drop size increase is not enough to make $Z_{DR}$ approximate or exceed $\hat{Z}_{DR}$ (more small-sized drops in DSD dataset) if break-up overwhelms coalescence; conversely, $Z_{DR}$ may be approximate or exceed $\hat{Z}_{DR}$ (due to more large-sized drops) if coalescence overwhelms break-up. In this way, more pixels are found with $Z_{DR}^{C} < \hat{Z}_{DR}$ in the following Fig. 2 (below the ML), particular within the range of 60 km.

3. One last concern and this may be picky, but I would also agree with the other reviewer's opinion that a strong typhoon case is not appropriate for radar QPE comparison considering all the biases from observation side. Admitted it is high impact case, but this also make analysis of individual microphysical process much more complicated.
Response: We thank the reviewer for this very good point. As mentioned in the main manuscript, we meant to select a challenging high-impact event for this study. Motivated by the reviewer's comments, we have added more discussions about the limitations of current research on microphysical process, as well as radar QPE comparison. Just for the reviewer's information, we have been putting significant efforts into the microphysical process and radar QPE in other similar (and challenging) events. Indeed, it is rather difficult to justify all the findings based on polarimetric radar observations, especially when there is a lack of in-situ measurements (which, unfortunately, is another challenge). We hope the reviewer is Okay with such an investigation.

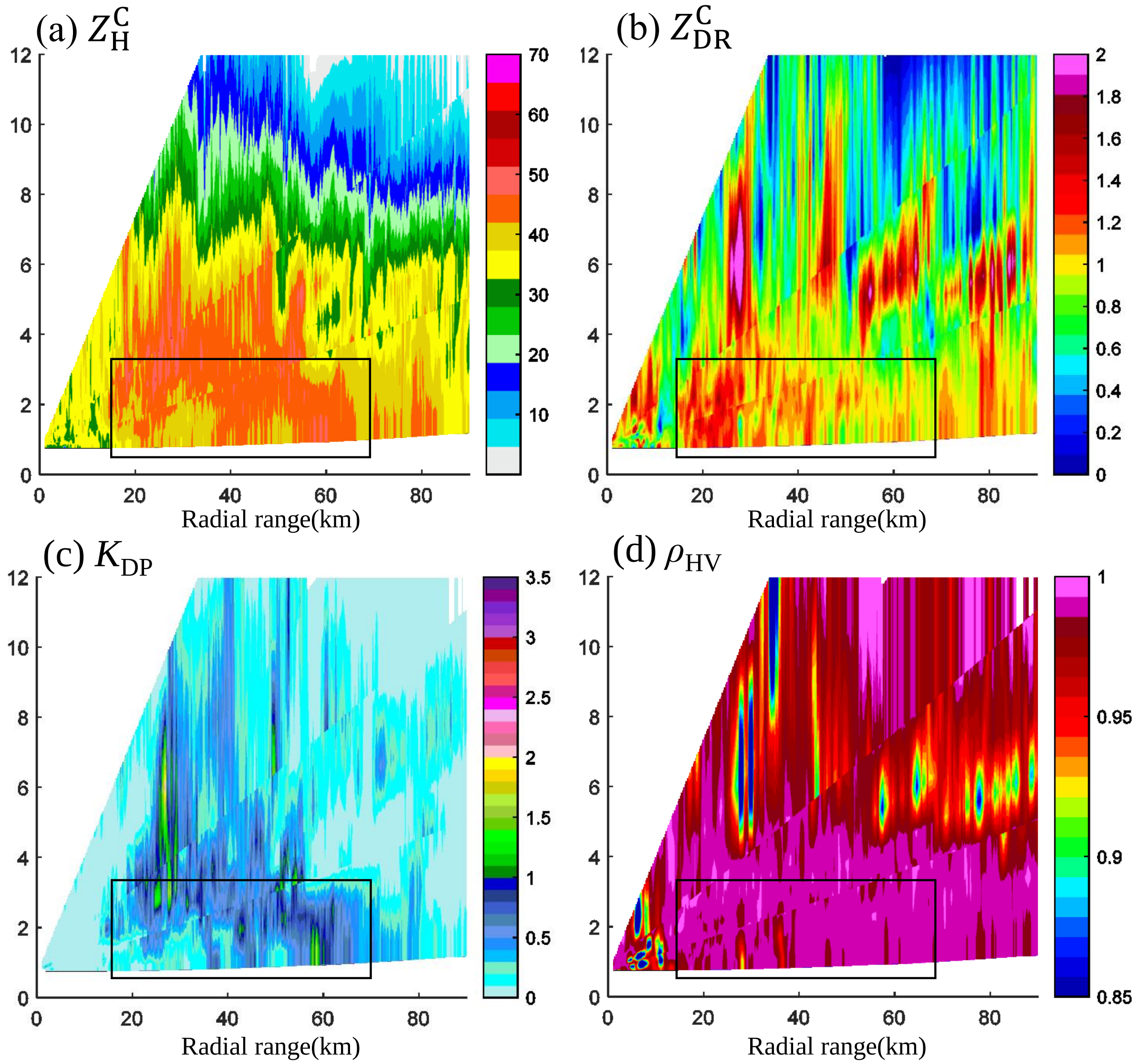


Fig. 1. RHIs of WZ-SPOL radar observations pointing to the DT station at 1759 UTC, 09 August 2019: (a) $Z_H^C$ (dBZ), (b) $Z_{DR}^C$ (dB),(c) $K_{DP}$ (deg/km), (d) $\rho_{HV}$.

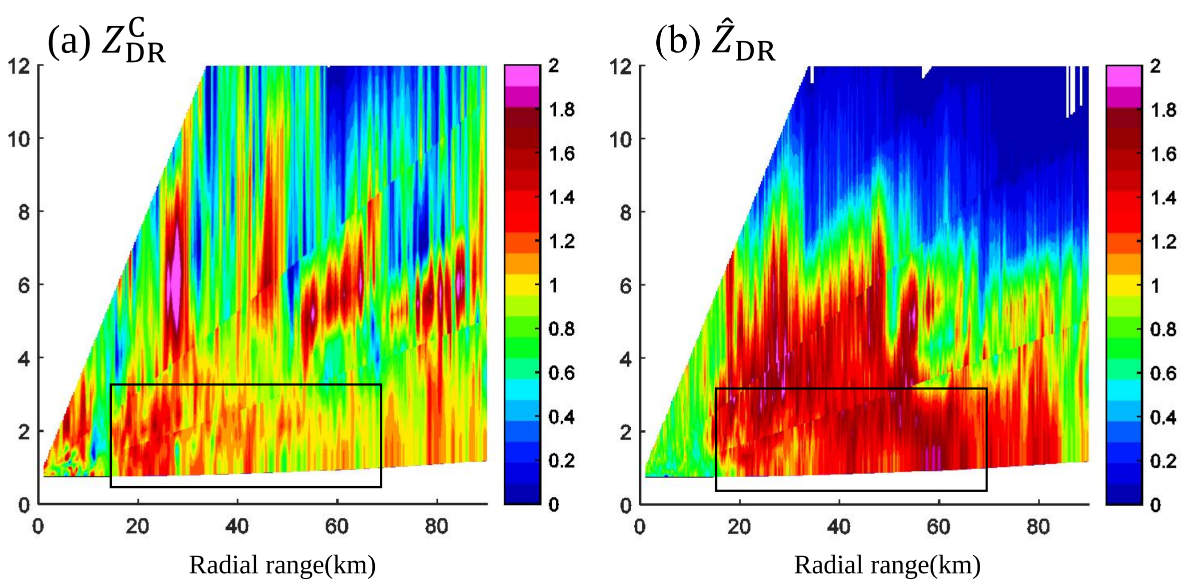


Fig. 2. RHIs of WZ-SPOL radar observations pointing to the DT station at 1759 UTC, 2019 (a) $Z_{DR}^C$ (dB), (b) $\hat{Z}_{DR}$ (dB).