Interactive comment on "Detection of potentially hazardous convective clouds with a dual-polarized C-band radar" by A. Adachi et al.

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Response to the first referee

We are grateful to the reviewer for her/his very careful and thorough examination of our manuscript. Detailed responses to the suggestions are given below.

1. In Eq. 2, shouldn't 'f' be the reflectivity-weighted ice fraction?

   Response: The reviewer is correct. We have corrected it in the revised manuscript.

2. Eq. 4: what are errors in this equation? Also, this depends on the accuracy of the attenuation correction schemes so this should be mentioned too.

   Response: We added scatter plot of the data used to determine the equation with statistical results including the bias (0.0 dB) and standard deviation (1.0 dB). We have mentioned that the statistical results depend on the accuracy of the attenuation correction schemes in the revised manuscript.

3. Section 2.2, page 3683: one needs to be somewhat careful when Kdp from Phi_dp range profiles at C-band, since backscatter differential phase may become significant (in the presence of large drops). Ideally, and FIR-based method needs to be employed, e.g. that described by Hubbert and Bringi, JAOT, 1995).

   Response: We have made changes in the revised manuscript based on the suggestions from two reviewers.

   "However, the algorithm presented herein does not use K_{DP} but relies primarily on the Z_{DR}

measurements to estimate the rainfall rate because K_{DP} is computed from estimations of a differential propagation phase, Φ_{DP} in the radial direction, which can be noisy for small-scale convective cells with a low rainfall rate during the developmental stage with which we are concerned. Moreover, estimations of Φ_{DP} from measurements of differential phase, Ψ_{DP} at C-band can be unreliable in the presence of large raindrops because of the effect of the backscatter differential phase (δ_{co}). It may be difficult even for advanced techniques including a FIR-based method (e. g. Hubbert and Bring, 1995) to remove the effect of δ_{co} to analyze small-scale convective cells with a low rainfall rate."

4. In eq. (8), shouldn't ζ□ be ζ□?

Response: This was a typo of ours. We found the same typos in other places and have corrected them. Thank you.

5. Fig. 3: Here, can the authors include the 'ice fraction' determined from the radar measurements (as time series)?

Response: This is a good suggestion. We added a time series of ice fraction in the revised manuscript. (See our response to the reviewer's general comment below.)

6. Page 3687, line 19, sentence beginning 'The horizontal distance...', is not at all clear. Please rewrite. (The next sentence is understandable).

Response: We have removed this sentence in the revised manuscript.

7. Page 3688, line 11, sentence beginning 'A detailed error analysis. . .' Authors can note or refer to the article 'Estimating the Accuracy of Polarimetric Radar–Based Retrievals of Drop-Size Distribution Parameters and Rain Rate: An Application of Error Variance Separation Using Radar-Derived Spatial Correlations' by Thurai et al., Volume 13, Issue 3 (June 2012) pp. 1066-1079.

Response: We have referred this paper in the revised manuscript.

8. Page 3689, line 23, sentence beginning 'Because the number of . . .' – it is not clear why cell B should develop in a very short time. The sentence needs to be rewritten.

Response: We have removed this sentence in the revised manuscript.

9. Fig. 10: are the numbers in this figure in minutes? If so, this should be included in the figure caption.

Response: The reviewer is correct. We have modified figure captions in the revised manuscript as "Black contours with numbers indicate the arrival time of the maximum rainfall in minutes."

10. General: Since the manuscript contains significant discussion on ice fraction, in the analysis of the two cases, it might be helpful to include these values, perhaps as a set of panels corresponding to Fig. 7. This may help identify regions with significant fraction of non-(fully) melted hydrometeors so that further contrast between the cells A and B can be made.

Response: We added a time series of ice fraction along with attenuation corrected (but may include large scatters from ice particles) reflectivity and rainfall rate that corresponding to Fig. 7 in the revised manuscript. As the reviewer expected, the ice fraction in B was much greater than that in A. In this process, we found that a threshold of 20 dBZ (~ 0.6 mm h^{-1}) at the 5^{th} step of our algorithm is not enough to eliminate a bias due to the effect of small spherical raindrops, and set a new threshold of 40 dBZ (~11.5 mm h^{-1}) instead to eliminate the bias. This modification does not effect to the results of heavy rainfall (with high reflectivity) analysis in this study. We thank the reviewer for drawing our attention to this.

11. Related to the above point, a brief discussion can be included in the Appendix on how Parsivel performs for events with such partially melted hydrometeors.

Response: We have added a brief discussion in the revised manuscript on the effect of melted hydrometeors to the Parsivel measurements.