Review

This study examines the effect of particle inertia in forward modelling vertically pointing cloud radar Doppler spectrum. The authors have carried out theoretical analysis and validated their method with field observations. The logic of this manuscript is clear, and the research question is sound. Different approaches are clearly compared in good-quality figures. Relevant references have been cited.

However, there is one major flaw regarding the validation. Please see my comments below. In addition, the description of the new simulator is difficult to follow. Therefore, my recommendation is major revision.

Major comments

1. Description of the new spectrum simulator is not clear to me. Since it is a new method, a detailed and explicit explanation is needed. I am wondering where is the term quantifying the turbulence. Also, Eq.12. looks the same as eq.9.
2. The validation part is questionable to me. The broadening effect seems to be exaggerated.
   If I understood correctly, the authors assume no horizontal and shear winds. Then, eq 5 in Borque 2016 changes to $\sigma^2 = {\sigma_d}^2 + {\sigma_t}^2$. σ^2 can be estimated from the observed spectrum, and the magnitude of ${\sigma_t}^2$ depends on ${\sigma_d}^2$. If ${\sigma_d}^2$ as retrieved from the surface DSD is underestimated, ${\sigma_t}^2$ will be overestimated. Then, the broadening effect will be unrealistically large. In a word, the accuracy of ${\sigma_t}^2$ depends on how well the raindrop spectrum was constructed from surface observations. As far as I could image, the fitting process may lead to the underestimation of ${\sigma_d}^2$. I believe the authors should carefully quantify the uncertainty of ${\sigma_d}^2$ in the revised manuscript.

   In addition, in Figure 5, what is the height of the observed spectrum? How well the DSD observed at surface can be used to simulate the spectrum aloft observed by a W band radar? In other applications, these two issues do not significantly contribute to retrieval errors. Given the change of DSD can significantly affect the evaluation results, I am afraid they should be well discussed in this study.

Technical issues

I have some suggestions for technical corrections, but I am not a native speaker.

1. Either using positive or negative to indicate downward is fine, but it is appreciated to make a statement in each figure's caption.
2. L22. consistent with
3. L27. applications for cloud/precipitation
4. L28. microphysical and dynamical
5. L34. For a vertical
6. L35. Provide
7. L53. and many other places. Spectral broadening is contributed by a list of factors such as turbulence, horizontal wind, spectral window etc. In some cases, turbulence dominates this broadening effect.
8. L162. This work is published on a journal with which not many cloud radar people familiar, please detail this method.
9. L164-166. This sentence is confusing. Spectrum width is affected by hydrometeor size distribution,

how can it be a constant value?

10. L188. close.
11. Eq.13. where is n in S_t?
12. L292. L306, and many other places. Turbulent environment
13. L306. echo?
14. L307. of
15. L338. spectra from two approaches are consistent with each other.
16. L340. add a comma before but
17. L343. approaches
18. L344. The black line
19. Figure4. dB($10\log_{10}$ (mm^6 m^{-3}))
20. Figure4 and many other places. Simulated approach looks strange to me. I would call it physics-based approach.
21. L4225. Can be employed in more studies