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Interactive comment on "A ubiquitous ice size bias in simulations of tropical deep convection" *by* McKenna W. Stanford et al.

Anonymous Referee #2

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This manuscript compares the hydrometeor sizes as functions of total water content and vertical velocity from simulations using two bulk and one bin schemes with observations from a mature to decaying tropical mesoscale convective system on Feb. 18 2014 during the HAIC-HIWC field campaign to investigate how and why models overestimate the radar reflectivity and underestimate the high total water content in higher portion of tropical convective storms. This study shows that all scheme overestimate the mean mass diameter of hydrometeors by producing too much mass at large particle diameters due to the assumed PSD function, the mass-size relationship, the species partitioning and the parameterized microphysical processes.

In general, the approach to compare model results and observations by constraining environmental condition is somewhat novel and effective and the findings are interesting that justifies its publication in ACP. However, the organization of the texts and the

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figures should be improved and the following points should be addressed before it is accepted for publication.

Major points:

1. A table showing the density and mass-size relationships of all hydrometeor species should be provided for FSBM. I would also suggest putting terminal velocity and mass relationships to all three tables. As mentioned in the manuscript, sedimentation process also causes the different behaviors of the overestimated hydrometeor size. Some related studies (terminal velocity impact on cloud and precipitation structure) should be cited too.

2. The upper limit of the Deq of hydrometeors in FSBM is less than 10 mm due to its relatively fewer bin numbers (33 vs. 36 from many other bin schemes). How come the PSD, MSD and ZSD in Fig. 17 showing sizes reaching 10 mm for FSBM?

3. Is the C-POL reflectivity data gridded? It will be tricky to show plan view just at 2.5 km of the C-POL reflectivity in Fig. 3(a) if the data is not gridded. What is the data sample size of the observed reflectivity for each level shown on Fig. 5? The unevenness of the sample size above and away from the radar can cause bias in the observed profile. How was the reflectivity calculated for each simulation? What wavelength was assumed in the model reflectivity calculation? Were mass-size relationships associated with particular schemes or the water equivalent diameter used to calculate the model reflectivity? How are the partially melted particles coated with water are treated in the calculation? Different ways of calculating the reflectivity will provide very different results. Some discussions about the uncertainties of the model reflectivity should be provided.

4. Figure 4 is the same as Fig. 3 and Fig. 9 is the same as Fig. 8. It is hard to follow the discussions about these figures.

5. It will be good to plot PSD of liquid and ice particles separately in Figs. 11 and 12.

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6. The last sentence in the abstract is too strong. It is hard to imagine current microphysics schemes will uniformly produce a high bias in reflectivity.

Minor points:

1. It will be good to also mention the lower size limit of the OAPs in page 4 line 15.

2. 2. The threshold for simulated condensation mass mixing ratio is too small at 10-12 kg kg-1. Using this threshold may introduce grid points with unrealistic results. 10-6 kg kg-1 should be a good threshold for the analysis.

3. You probably referred to Fig. 6b in line 14 on page 12.

4. Page 1, line 16: using "different" microphysics. . .

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