

Second review of “**Influence of cloud microphysics schemes on weather model predictions of heavy precipitation**”, by Kocher et al., submitted to *ACP*.

General comments. The paper is improved from the previous version. The authors have well addressed my main concerns with the previous version, particularly consistency of CR-SIM with the microphysics scheme assumptions and consistency of the ice analysis with how P3 represents ice particle properties. I have several additional comments and suggestions below to mainly improve the presentation; all are minor. Once these are addressed I recommend accepting the paper.

NOTE: line numbers refer to track changed version.

Overall recommendation: *Minor revision*

Minor science and editorial comments.

1. General (incl. abstract and main text): terminology of “model” versus “scheme”. There seems to be a mix and match of this (e.g., lines 7 and 10 in abstract says “scheme”, but then lines 12, 13, 14 say “model”). Usually “model” refers to the main model system or driver model, like WRF or ICON. I suggest using consistent terminology throughout the paper where “scheme” refers to the microphysics parameterization and “model” refers to the main driver model or modeling system.
2. Which version of P3 was used (there are multiple versions available in WRF)? Was it the two-moment, single category version (MP option 50)? It would be good to clarify this somewhere in the paper. Perhaps even give the MP option #'s for all the schemes used here, to make it clear to readers for all the schemes tested.
3. Lines 86-87. (1) and (2) are not approaches per se; they are questions covering specific science problems. Thus I suggest rewording by not calling (1) and (2) “approaches” or clarifying these are approaches to address questions (1) and (2).
4. Line 110. “particle property prediction” should be “Predicted Particle Properties” (and it is typically capitalized).
5. p. 4-5, this paragraph is very long. It might help to improve the structure by starting a new paragraph beginning with the sentence “A forward radar operator (CR-SIM; Oue et al., 2020)...” Also, I’d start another new paragraph beginning with the sentence “The horizontal model grid spacing is at 400 m.” since this is covering a different topic than CR-SIM discussed in previous sentences.
6. Lines 117-120. Here you refer to different ice types in P3 (e.g. small ice, graupel, unrimed and partially rimed ice). Do this mean the different ice types distributed across the particle size distribution (PSD) as in Fig. 1 of Morrison and Milbrandt (2015)? If so, I’d clarify this and

perhaps cite Fig. 1 in Morrison and Milbrandt (2015). Is CR-SIM coupled in a consistent way with these different regions of the PSD?

7. Line 135. Suggest replacing “Both, radar and model, require...” with “Both the radar and model require...”.

8. Line 160. Would “quantities” be better than “moments”? Are these quantities formally moments of a distribution? (I don’t think so).

9. Line 184-185. Confusing wording here. Suggest replacing “and P3, the simulations are for the most part even able to...” with “and P3 are for the most part even able to...”.

10. Line 190. “relevant over a larger statistic” is confusing. Maybe replace with “relevant statistically over a longer period”.

11. Lines 195-200. Same comment as #3 above referring to (1) and (2) as approaches. Can this be reworded?

12. Line 202. Typo: “cays” should be “days”.

13. Line 231-237. There are several places here that report rain rates in units of $1/m^2$. I don’t understand this. Is it a typo or error? Same comment in the Fig. 3 caption as well. If the units are indeed $1/m^2$ can you explain where that comes from?

14. Line 238, I don’t follow this sentence. Can it be reworded or clarified?

15. Line 275. In my previous review I had suggested that the authors clarify that the D^3 and D^6 relations for mass and reflectivity apply to liquid drops. However, whether this requires isometric particles depends on how diameter is actually defined. For larger liquid drops which of course are not isometric (since their aspect ratio changes with size), this problem is resolved by defining the diameter as that of a volume-equivalent sphere. All this to say, I’d simply remove “(isometric)” from this sentence as that might be confusing.

16. Line 300. Maybe “behaviors” instead of “behavior”?

17. Line 314. “is” should be “was” for consistency of tense.

18. Line 333. Suggest replacing “is undergoing” with “undergoes”.

19. Line 335. Add “rate” after “evaporation”.

20. Line 336. Replace “in” with “at”.

21. Line 337. Add “and” before “all schemes”.

22. Line 340. Replace the comma after “thresholds” with a semi-colon.
23. Line 342. “indicate” should be “indicates” for subject-verb agreement.
24. 346-347. Suggest rewording this to “However, hail events also have damage potential and therefore are of interest.”
25. Line 353. Suggest a small rewording to “The P3 scheme does not have a separate hail or graupel class.”
26. Line 354. Suggest replacing “into” with “in”
27. Line 356. “anyways” should be “anyway”.
28. Line 360. Suggest replacing “the microphysics schemes” with “microphysics scheme”.
29. Line 365. I’d reword this sentence. SBM not producing a single instance of ice at 35 dBZ or higher is one of two possibilities of a binary situation (either this occurs, or not), so it’s awkwardly worded in this sentence to say the same is true for the Morrison scheme but to a lesser extent.
30. Line 374. Remove the first comma. Also, remove “when”.
31. Line 376. I think you mean “too large” not “too small”.
32. Lines 377-378. This may be true with the way the schemes are configured here, but the Morrison scheme in WRF does have an option to use properties of hail (with a high density of 900 kg m^{-3}) rather than graupel for the rimed ice category. This could be mentioned here (perhaps in a footnote?).
33. Lines 381-386. A newer version of P3 actually *does* include partially melted ice (Cholette et al. 2019). This is not yet implemented in WRF, but could be mentioned here.

Cholette, M., H. Morrison, J. A. Milbrandt, and J. M. Theriault, 2019: Parameterization of the bulk liquid fraction in the Predicted Particle Properties (P3) scheme: Description and idealized tests. *J. Atmos. Sci.*, 76, 561-582.

FYI there is a paper also just accepted in JAMES that applies this newer version of P3 to simulations of a squall line, and discusses the impact of wet ice on the reflectivity calculation:

Cholette, M., J. A. Milbrandt, H. Morrison, D. Paquin-Ricard, and D. Jacques, 2022: Combining triple-moment ice with prognostic liquid fraction in the P3 microphysics scheme: Impacts on a simulated squall line. *J. Adv. Mod. Earth Sys.* (accepted)

34. Line 393. Suggest replacing "The P3" with "P3".
35. Line 394. See comment #32 above regarding the graupel/hail switch in the Morrison scheme, which is relevant here as well. Also relevant to the sentence on line 399.
36. Line 395. For consistent tense with the rest of this paragraph, I'd replace "were" with "are".
37. Line 397. "reason" should be "reasons".
38. Line 405. Suggest adding "but" before "this time".
39. Line 407. Since you've generally referred to the spectral bin scheme as SBM in the rest of the paper, my suggest is to replace "the spectral bin simulations" with "the SBM simulations".
40. Line 408. Remove "the".
41. Line 415. Suggest replacing "is melting" with "melts".
42. Line 431. I would replace "indicates" with "suggests" because in principle other processes could be responsible for more rapid decrease of ice toward the surface, like changes in fallspeed leading to divergence. Although I agree that greater melting is the most likely explanation.
43. Line 437. Suggest replacing "the Morrison and SDM" with "Morrison and SDM".
44. Line 472. Replace "summerly" with "summer".
45. Line 479. Add "model" before "resolution".
46. Line 480. Not sure what "Tt" is supposed to be. Maybe "For"?
47. Lines 500-502. This sentence is very long. You might consider breaking it into 2 sentences.