Review of: "Enhanced Simulation of Supercooled Liquid Water for In-Flight Icing Using an Aerosol-Aware Microphysics Scheme with CAMS Reanalysis" by Yuan et al.

Overall impression and rating

The manuscript describes three model simulations of supercooled liquid clouds with different aerosol schemes as input. The results are compared with each other and with aircraft observations. Overall, the manuscript is very easy to understand, well structured, and clearly written. Although the actual results do not necessarily provide novel scientific findings, they nevertheless show a robust comparison of three aerosol schemes and their effects on the results with regard to supercooled liquid clouds. This comparison may be particularly useful for the modeling community in terms of further optimizing models. I therefore recommend the manuscript for publication in ACP after my more technical comments have been taken into account.

Specific comments/questions:

- Title: I suggest changing the title of the manuscript so that it better reflects the actual comparisons of a model with three different aerosol input datasets.
- line 39: I would recommend pointing out the major differences between INPs and CCNs here. In particular, INPs are always solid, insoluble particles, while CCNs are always water-containing liquid aerosols (e.g., Belosi et al. 2017 or Krämer et al. 2016). Therefore, I would recommend writing the following in line 39: ...insoluble aerosol act as...
- Section 2.5: How were the in situ measurements compared exactly with the model output? Section 2.2 states that only out-cloud sections of the measurements were used. Was this (only out cloud) also done with the model results? Otherwise, the concentrations (inside and outside clouds) are not necessarily comparable. This is particularly important with regard to the section in lines 387-391 and should also be taken into account in the discussion.
- Section: 3.1: Intercomparison to ERA5 data. First, the ERA5 data should be introduced in Section 2 because you used it in the end to compare the other simulations to ERA5. And you can't assume that everyone knows the details of ERA5 relevant for this comparison.

- Line 368: I would perhaps simply add that the models lack in reproducing a bimodal SLW distribution.

Technical comments/questions:

- line 62: "simply" to "simple"
- line 87: "climatic" to "climatological"
- line 108: "is" to "were"
- Figure 1: The arrow of the flight path is hardly visible. Maybe place it better directly next to flight path or enlarge it a bit. In addition, it would be nice, if you could also plot the innermost nest in panel b. Then it is easier to compare.
- Figure 2: The orange line looks more reddish. May name it red instead of orange.
- Figure 4: I would recommend collecting the explanation of the isolines in one place in the caption. Explain the part: cloud water: g kg-1, rain: 10-3 g kg-1, cloud ice: 10-7 g kg-1, snow: 10-3 g kg-1, temperature: °C together with the shading.
- Table 2: Please avoid line breaks in the units (row 1 and 5).
- Figure 5: Please provide information in the caption, what QCten is. All other classes can be inferred by the name itself.
- line 361: Please exchange "confirm" with "show" or similar. Because you cannot confirm the same thing with the same data. Both plots show this feature in MVD from the same CDP data.
- Line 397: Which blue dot are you referring to in Figure 10c. I just see only multiple blue plots from simulation, but not a specific one.

References:

- Belosi, F., Rinaldi, M., DeCesari, S., Tarozzi, A., Nicosia, A. and Santachiara, G. (2017) Ground Level Ice Nuclei Particle Measurements Including Saharan Dust Events at a Po Valley Rural Site (San Pietro Capofiume, Italy). Atmospheric Research, 186, 116-126. https://doi.org/10.1016/j.atmosres.2016.11.012
- Krämer, M., Rolf, C., Luebke, A., Afchine, A., Spelten, N., Costa, A., Meyer, J., Zöger, M., Smith, J., Herman, R. L., Buchholz, B., Ebert, V., Baumgardner, D., Borrmann, S., Klingebiel, M., and Avallone, L.: A microphysics guide to cirrus clouds – Part 1: Cirrus types, Atmos. Chem. Phys., 16, 3463–3483, https://doi.org/10.5194/acp-16-3463-2016, 2016.