Responses to Reviewer 2 comments.

Original comments in black, our responses and explanation of changes in red.

The authors of this manuscript compared the Eulerian binning method and Lagrangian superdroplet approach in simulating the condensation process of cloud droplet driven by turbulence. They concluded that the Lagrangian superdroplet approach is able to represent fluctuations better, which is consistent with previous works as discussed in this manuscript. This detailed comparison between the two numerical method could help contribute to a better understanding of modelling the condensation process. However, in my opinion, the so called "ill-posedness of the initially monodisperse droplet size distribution for the bin microphysics." described in this manuscript could be avoided by testing different initial droplet-size distributions. I would recommend the publication of this manuscript after the authors carefully address this problem and other few comments listed below.

We appreciate the Reviewer's time and effort to read and provide comments on our manuscript. In the revision, we actually decided to tone down the discussion of the ill-posedness of the initial condition in the Eulerian scheme. This is because, as shown in the revised text, the distribution becomes well-resolved after some time, and bin microphysics matches nicely superdroplet solutions at the end of the simulations once the bin resolution is sufficiently high. We start with a monodisperse distribution because previous studies of Lanotte et al., Sardina et al. and Thomas et al. considered exactly the same monodisperse initial distribution.

Our initial thought was to follow the reviewer's advice and complete some simulations with initial Gaussian-like distribution. We thought about including those results as an appendix. However, after analyzing the spectra (per Reviewer's 1 suggestion), we decided that this is not needed. We include a discussion of those results at the end of this response for the Reviewers' reference. We are open to the suggestion of either including or excluding those results in the revised manuscript.

Specific comments:

L.24: turbulence integral time scale; Added "integral" in the sentence in question.

L.145: Could the authors use mathematical symbols in equations all across the manuscript (e.g. Eq.1 and 2) to improve the readability of the manuscript?

This comment echoes one of the comments of the Reviewer 1. However, we strongly feel that explaining in words details of the two microphysical schemes (with references to previous papers that present the equations) rather than through specific equations should be sufficient for the reader. We will be happy to include the equations if the reviewer insists.

L.280: Kolmogorov slope. Added "Kolmogorov" in the sentence in question.

L.412: What is the equation to calculate C_d? We slightly modified the description, but feel - as explained above - that using words is sufficient.

L.630: What is the difference between the two plots at the lower panels? This is explained in the text that we slightly modified. The point is that because of statistical fluctuations of the number of superdroplets per grid box N (when compared to the expected value of 40), the cloud water strongly fluctuates in the Lagrangian scheme. The magnitude of the fluctuation can be reduced by rescaling the cloud water calculated from the superdroplets present within a grid box by a factor of 40/N. The lower panels show the results before (the left panel) and after (the right panel) such a rescaling.

Technical corrections:

L.13: by applying L.96: based on L.102: point-by-point L.412: due to L.545: High
L.575: . . .show the expected . . . L.585: macro L.613: being present. What is q_c 40/N?
The changes were included in the text as suggested. The last point was addressed by explaining in the revised text that 40 is the mean number of superdroplets expected in each grid volume (see our response to L.630 comment above).

Possible Appendix.

This appendix describes results from additional Eulerian bin and Lagrangian superdroplet low TKE simulations for the case of the total droplet concentration of 130 cm^{-3} with the initial either monodisperse droplet spectrum (i.e., as in the main text) or a wide spectrum that can be well represented by the bin microphysics. For the latter, a truncated Gaussian spectrum is used with the width of 1 μm and truncated to zero for droplet radius outside the 10 to 16 μm range (i.e., three standard deviations). For the bin microphysics, the bin setup is as in the BIN.HR.130 (i.e., high-resolution) simulation, that is, with the bin width of 0.3 μm. With a single bin centered at 13 μm, there are 21 nonzero bins for the truncated Gaussian distribution in the 40-bin Eulerian setup. To simplify the super-droplet setup, we use 42 superdroplets per grid volume (rather than 40 as in main-text simulations), repeating twice the 21 superdroplet radii and multiplicities to exactly match the non-zero 21 bins in the initial bin setup. Motivated by the initial results, we extend ten times the simulation length, that is, up to 200 min, over 60 eddy turnover times. The results are documented in Figs. A1 and A2.

Figure A1 shows evolution of the radius squared standard deviation in the format of Figs. 6 and 8 of the main text for simulations with monodisperse and with truncated Gaussian initial conditions. Extending ten times the length of simulations from the main text shows that the Lagrangian simulation continues on the expected $t^{1/2}$ scaling, and the bin simulation continues to approach that scaling. The truncated Gaussian initial droplet distribution simulations are close to each other, and they start to approach the expected scaling only after the initial 10 min.

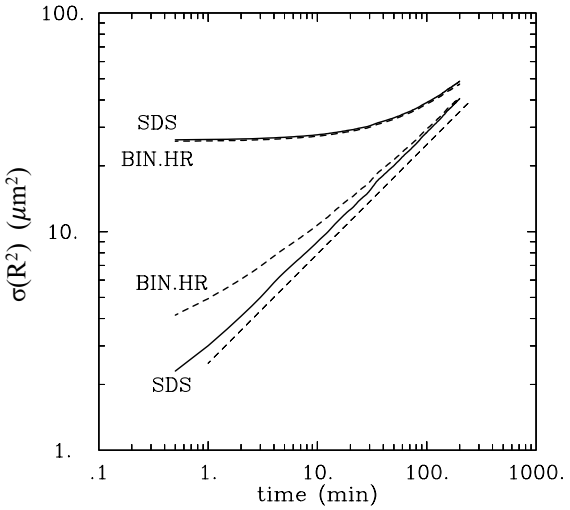

Figure A1. Evolution of the radius squared standard deviation for extended superdroplet (solid lines) and bin (dashed lines) simulations with 130 cm^{-3} droplet concentration and low TKE. The lower lines are for initially-monodisperse simulations as in Figs. 6 (SDS) and 8 (BIN.HR) but extended from 20 to 200 minutes. The upper two lines are for simulations with truncated Gaussian initial droplet size distribution. Thin dashed line shows expected $t^{1/2}$ scaling.

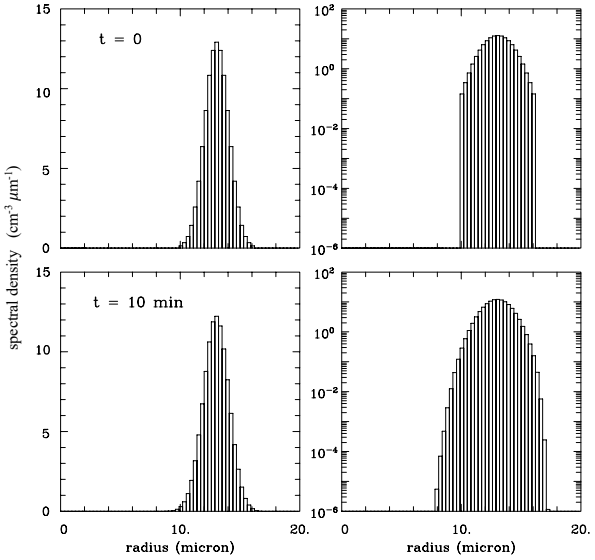

Figure A2. Initial droplet spectra (upper row) and spectra at time of 10 minutes (lower row) for bin simulations. Left and right panels show spectra using linear and logarithmic vertical scale, respectively.

To understand the results of the truncated Gaussian simulations, we show in Fig A2 the droplet distributions at the onset of the simulations and after 10 minutes from the bin simulations. (Results from Lagrangian simulations are practically the same and thus they are not shown). When applying the linear vertical scale (left panels), the spectra look the same. However, panels with the logarithmic vertical scale show that the key change during the initial 10 minutes of the simulations is an expansion of the spectra into tails that are barely visible on the left panels. Note that formation of the tails insignificantly affects the spectral width which explains the evolutions

shown in Fig. A1. The key point is that formation of the spectral tails beyond the truncated Gaussian initial distribution and transition to the increasing spectral width proceeds gradually and in virtually the same way in both Eulerian and Lagrangian simulations.