Review of "Impact of hygroscopic CCN and turbulence on cloud droplet growth: A parcel-DNS approach" by Chen et al. (acp-2019-886)

The revised study considers many of my previous concerns, and I feel much more comfortable with the results after the numerical issues have been resolved. However, there are still some issues that need to be addressed before publication. In particular, I feel that the aspect of "cloud seeding" requires some attention, as detailed below.

Major Comments

Cloud seeding and ultra-giant nuclei

First, I feel that the presumably overarching subject of "cloud seeding" is not well motivated. Cloud seeding is mentioned in the title and four times in the abstract, but it is only mentioned once at the end of the introduction (l. 79). Accordingly, the article lacks general background information on cloud seeding, e.g., how cloud seeding might be used to enhance precipitation in arid environments. Accordingly, I cannot find a continuous storyline that guides the reader through the manuscript, and the erratically occurring discussion of cloud seeding feels like a distraction. The authors owe their interesting results a more concise story. One leading idea for this study, which is discernable at some places already, might be the separation of the *artificial* influence of cloud seeding on the initiation of rain in comparison to *natural* cloud processes such as turbulence and the effect of aerosol hygroscopicity. In other words, one could simply ask: Does cloud seeding make sense?

Second, the initialization of giant aerosols ($R_d > 1$ µm) with their equilibrium radius (ll. 131 – 132) needs to be commented on. In subsaturated environments, these aerosols need several hours to days to reach their equilibrium radius (e.g., Mordy 1959), which indicates that these particles might have wet radii significantly smaller than their equilibrium radius when entering a cloud. Accordingly, these aerosols will not trigger the precipitation process as suspected by the authors (ll. 5 – 6). I was initially not too concerned with this shortcoming since the authors find that the contribution of these particles is insignificant (ll. 6 – 7). However, in the case of cloud seeding, the *natural* giant aerosols compete with the *artificially* added particles. For these cases, it might matter how large the largest natural particles are at the beginning of the simulation. And I suspect that smaller-than-equilibrium particles might increase the importance of seeded particles in the precipitation process, which will certainly affect statements such as ll. 282 – 283.

Minor Comments

Ll. 89 – 91: It feels redundant to mention twice that there is no more activation above the cloud base.

Ll. 89 – 91: It might be the case that there is no activation in the cloud core or your parcel model. However, activation of laterally entrained aerosols might occur in "more complete" cumulus clouds (Slawinska et al. 2012; Hoffmann et al. 2015).

Fig. 1: The supersaturation below cloud base increases approximately linear (see Fig. 2a). Please change this in your sketch.

Ll. 100 and 112 – 113: It feels redundant to mention twice that most droplets are smaller than 10 µm.

Ll. 166 – 167: Is there a significant effect of the fallen-out droplets on the LWC? Figure 7 a does not show a (significant) change in the increase of LWC once droplets reach 50 µm in radius. Similarly, the mean radius seems not to be affected by the fallen-out droplets. Could you please state the LWC of the fallen-out particles? This will give the reader a sense of how much water is lost due to precipitation.

Tab. 2, Figs. 3, 4, 5, 6, 7, and several places in the manuscript: When I previously suggested using more meaningful abbreviations for the individual model runs, I intended to use these abbreviations throughout the manuscript: Run NoTurb instead of Run B, Run NoSolu instead of Run C, …

Ll. 180 – 185: State explicitly that the seeded particles do not exhibit any variability in their initial radius, i.e., they are seeded using a delta distribution function.

L. 185: In addition to increasing the dry radius by a factor of 10, the wet radius in Run D3 is also doubled, according to Tab. 2.

L. 236: For clarity, add “non-turbulent” before “gravitational collection process” if appropriate.

Fig. 4: Panel “(b) Run C (cond+coll)” needs to be labeled “(c) Run C (cond+coll)”.

Fig. 5: Change units on ordinate to “cm^{-3} s^{-1}”

L. 259: Consider moving the definition of the autoconversion rate from the caption of Fig. 7 to the main text.

L. 289: What is meant by “the inhibition effect”? I know that you are refereeing to the last sentence, but it is not obvious that the previous sentence describes the “inhibition effect”.

Ll. 321 – 327: Since and the amount of water lost due to precipitation is presumably negligible (see also comment for ll. 166 – 167 above), and the range of tested aerosol concentrations and droplet sizes is rather small, it should not surprise that parcel-mean values “are not sensitive to turbulence level and aerosol conditions”. It is expected that these quantities are approximately adiabatic. It might be interesting to add some lines to Fig. 7 showing the adiabatic LWC or the adiabatic mean radius, which will allow one to quantify the degree of non-adiabaticity in the conducted simulations.

Technical Comments

L. 13: “On the other hand” not “on the other hand”

L. 40 ff.: It is awkward to cite “Chen et al. 2018b” before “Chen et al. 2018a”.

L. 85 ff.: Units should be displayed with upright characters, not italics.

L. 89: The SI symbol for seconds is “s” not “sec”.

L. 111: There is a space missing between “flow.” and “Studies”.

L. 232 and other places: I suggest to abbreviate “minute” here because it is part of an equation (T = 6 min).

References

Hoffmann, F., Raasch, S., & Noh, Y. (2015). Entrainment of aerosols and their activation in a shallow cumulus cloud studied with a coupled LCM–LES approach. *Atmospheric Research*, *156*, 43-57.

Mordy, W. (1959). Computations of the growth by condensation of a population of cloud droplets. *Tellus*, *11*(1), 16-44.

Slawinska, J., Grabowski, W. W., Pawlowska, H., & Morrison, H. (2012). Droplet activation and mixing in large-eddy simulation of a shallow cumulus field. *Journal of the atmospheric sciences*, *69*(2), 444-462.