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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Diffusional and accretional growth of water drops in a rising adiabatic parcel: effects of the turbulent collision kernel" *by* W. W. Grabowski and L.-P. Wang

Anonymous Referee #2

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This paper uses adiabatic parcel models to simulate the growth of water drops by diffusion and collision and access the enhancement of collisional droplet growth in a turbulent environment. This study is relevant for the important and long-standing problem of understanding the mechanism of spectral broadening and precipitation formation in clouds. For two turbulent conditions conducted in the study, the enhancement of droplet growth quantified by turbulent speedup factor is in the range of 0.6 - 0.85. This, together with the conclusion that the rain initiation time and droplet spectrum width is sensitive to the number of size bins will be of interest to the community. I recommend the paper to be published provided that the following concerns are addressed.

Comments:

(1)The paper discusses the effect of turbulence on droplet collection and rain initiation. It would be good to see an analogous discussion on turbulent effects on the condensation process.

(2)The authors mentioned briefly that “a lot of time was spent on condensational growth” but nothing more. It would be good to see some numbers on the partition of growth time between condensation and collision-coalescence.

(3)Figures 9 and 10 show the evolution of growth rate which is scaled with a “time-independent factor”. It is not clear however what this time-independent factor is. The interpretation of these figures is not very straightforward and I found the figures very difficult to follow. How is the transition time between autoconversion and accretion obtained based on the figures? There should be a better way to represent the results (e.g. with a time-dependant contour plot) and I recommend a change.

(4)The point that the droplet spectra is sensitive to number of bins is interesting. What aspect of the collection process (or size range) is the bin density most influential on?

(5)Could turbulence generate parcel supersaturation fluctuations? If so, it would also affect growth of droplets and should be discussed in the paper. This is important, since most parcel models predict a very smooth vertical profile of supersaturation, and it would be interesting to discuss the role of stochastic supersaturation variability on collection and growth.

(6)This paper shows the turbulent speedup factor is weakly dependent on number of bins, parcel velocity, and aerosol characteristics. Given that precipitating clouds are generally associated with broad cloud spectra, investigating how sensitive the droplet width is to the turbulent speedup factor is important and should also be discussed.

(7)In the discussion and conclusions sections, a sentence in the first paragraph states that there is a numerical widening of the spectra when number of bins for radii below

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Interactive Comment

20 μm is small. Can authors elaborate upon this point? I would like to see a discussion on the effect of bin resolution on the droplet growth process (driven by a respective sensitivity study).

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 14717, 2008.

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Interactive Comment