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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Cloud droplet diffusional growth in homogeneous isotropic turbulence: bin microphysics versus Lagrangian superdroplet simulations" *by* Wojciech W. Grabowski and Lois Thomas

Anonymous Referee #1

Received and published: 4 December 2020

General comments:

The present paper compares two different mathematical descriptions (Lagrangian and Eulerian frameworks) to address the cloud droplet diffusional growth in homogeneous isotropic turbulence. The manuscript shows interesting results with potential interest for Atmospheric Chemistry and Physics community. Nevertheless, the Reviewer has several comments/questions/suggestions that could make this paper even more useful for the community.

Specific comments:

-In order to have a more detailed (and useful) analysis, the Authors should report the final square radius distributions for all the Eulerian and Lagrangian cases. The theory shows that the pdf(R^2) is Gaussian. Are they Gaussian or not in these cases? The referee expects a departure from the Gaussian distribution in high TKE SDS.26

-It is better to plot in the same graph the statistics from the bin and Lagrangian simulations for every single case so that we can directly compare one by one.

-The Reviewer is not convinced that the results of the bin simulations differ so much due to the difficulty to describe the monodisperse delta distribution as an initial condition. The Authors can easily run the Lagrangian simulations for some iterations, extract the radius distribution pdf and use as an initial condition for the bin simulations (together with the same flow, temperature and humidity fields). Then they should be able to reduce the errors induced by wrong initial conditions and maybe to analyse better the effects of the bin resolutions or the effects of numerical diffusion.

-Why the high TKE simulations are run just for few minutes compared with the low TKE cases? What happens for long times? Since the resolution and number of superdroplets/bins are the same, the computational efforts are precisely the same, so there are no problems to extend these cases in principle.

-The Authors should describe with more equations and details the Lagrangian and the bin approaches, so far, everything is referred to previous papers.

-For the bin simulations, a diffusion coefficient for the droplet distribution function should be given, how much is this value in the present results?

-Sedimentation and inertial terms are neglected in the Lagrangian simulations, what about in the Eulerian cases?

-Why does the term r_0 appear in equation (9)? It is needed to avoid some singularities when r is small? Is r_0 appearing also in the Lagrangian radius equation evolution? Why has r_0 that specific value?

-The value of the dissipation in Lanotte et al. (2009) is 10^{-3} not 10^{-4} m^2/s^3

-It is better to introduce a new Table with the case description

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