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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Diffusional growth of cloud droplets in homogeneous isotropic turbulence: DNS, scaled-up DNS, and stochastic model" *by* Lois Thomas et al.

Anonymous Referee #1

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Comments to the manuscript with ID number "acp-2020-159"

General comments:

My understanding of the "scaled-DNS" presented in this manuscript is that one can simulate a large domain size by artificially increasing the kinetic viscosity of the airflow. The Reynolds number is kept unchanged in such simulations so that the computational cost is still feasible. Therefore, one can study how the supersaturation fluctuations can be affected by the large eddies. This is plausible as the small scales do not matter for the supersaturation fluctuations. The authors further tested the application of the superdroplet approach in such a setup to tackle the condensation process.

I would recommend the publication of this manuscript after the authors carefully discuss the following comments.

The author addressed both in the abstract and in the conclusion that this is a "novel methodology". This statement should be treated carefully for the following reasons: 1. The method presented in this manuscript is DNS with large artificial kinetic viscosity, which is not a new method. 2. Mellado et al also used the same treatment (section 3 of Mellado et al).

Specific comments:

1. The paper by Mellado et al applied the same idea. Can the authors compare their work with the one of Mellado et al? 2. Can the authors check Eq.3 again? If dR/dt=KrS/R, then Rˆ2/2=KrS, together with Eq.2, you will get a pre-factor of 2 instead of 4/3 in Eq.3, right? 3. L.125: Should the intensity of turbulence determined by the single parameter, Reynolds number? The energy dissipate rate is a small-scale quantity which describes how fast energy dissipates in the dissipation range of turbulence. In other words, it characterizes how vigorous the small eddies of turbulence are. It is calculated from the trace of the strain tensor. This aspect is also discussed by the authors in the paragraph just below Eq.10. Did you mean the energy transfer rate here, which is the rate energy transfers from large to small eddies in 3-D turbulence? 4. Can the authors normalize the energy spectrum in the same way as the one of Fig.1 of Li et al. (2019)? If the Reynolds number is the same, the normalized spectrum should collapse on top of each other; 5. Why is there an initial spike in Fig.6? I don't understand why it is different for different domain sizes. The water mass loading is the same for all the simulations, right? 6. As the integral time scale is different for simulations with different domain size, could it be an idea that the authors normalize the time axis by the integral time scale?

Technical corrections: 1. Fig.4, caption: standard deviation of supersaturation fluctuations? 2. L248: When "the" multiplicity. . .

References: Mellado, J.P., Bretherton, C.S., Stevens, B. and Wyant, M.C., 2018. DNS and LES for simulating stratocumulus: better together. Journal of Advances in Modeling Earth Systems, 10(7), pp.1421-1438.

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