Comment on “Long-resident droplets at the stratocumulus top” by Alberto de Lozar and Lukas Muessle

The authors quantified the time that droplets stay at the top of a cloudy mixed layer using direct numerical simulations (DNS). Lagrangian particle tracking method has been applied in the large eddy simulation (LES) results during the recent years. One of their purpose is to complement past Lagrangian studies by LES. The advantages of using DNS are (1) resolving the turbulent dynamics explicitly by DNS (2) tracking more cloud droplets and getting better statistics. They found that about 15% cloud droplets can escape the stratocumulus large-scale convective motions, and reside at the cloud top region for a time longer than the convective eddy time. They argued that those long-resident droplets might broaden the droplet size distribution, thus speed up the rain formation in stratocumulus with middle scale turbulence.

This paper is clear and easy to follow. However, I have one concern about their Lagrangian tracking method. If I understand correctly (Line 144), their model does not include the droplet sedimentation. But I think it might be important, especially for large droplets. Even for small cloud droplet, I think, sedimentation might affect its trajectory after a long resident time. Please justify it clearly that why this study neglected the gravitational settling on the droplet movement. Otherwise, I think, sedimentation should be considered in the method.

Overall, this manuscript is well written and the results are interesting. It is worth to publish on ACP, if my concern above and minor comments below are addressed properly.

Comments:

1. Line 83: “Todays” should be “Today’s”?

2. Line 92: There are two papers from de Lozar and Mellado in 2015, should be cited clearly a) or b).

3. Line 100: The author only consider one-way coupling in this study. However, I think the latent heat release duo to evaporation of huge amount of cloud droplets might be significant. Is it because the authors already consider the condensation/evaporation process in the DNS, e.g., Eq. 1?

4. Eq. 1: reference is Lozar and Mellado JAS 2015 or GRL 2015? I think it is JAS.

5. Eq.A5: I derive s_{eva} as an interest, but get a different result:

$$s_{eva} = \kappa_T \left(\frac{df}{d\xi}\right) \nabla^2 \xi$$

I might make some mistakes somewhere, but I can’t figure it out. Please put the derivation in the response file. Thanks.

6. Line 160: “…with changing height” should be “…with changing size”? I think the whole paragraph is talking about the assumption that the growth of droplets are almost independent of their sizes. And I don’t understand this sentence “because this term is identically zero in a mixed layer with constant pressure.” What does “this term” mean?

7. Figure 4: Results here are for one specific time? End of the simulation? Please add more description for this figure.

8. Line360-364: Results here show that long-resident droplets prefer the downdraft regions which is contrary to my feeling. I thought droplets in the downdraft region might be quickly moved out, while in the updraft region might be suspended. Is it because you neglect the inertial and sedimentation for the droplet’s movement in this study?