Review of "Influences of an Entrainment-Mixing Parameterization on Numerical Simulations of Cumulus and Stratocumulus Clouds" by Xu et al. (ACP-2021-937)

While I am generally pleased with the addition of the entrainment fraction parameterization and the additional analyses, I still have some major concerns, as outlined below. Thus, I would like the authors to address the following concerns below before I can recommend the publication of this manuscript.

Major Comments

Is the parameterized entrainment fraction suitable for microscale processes? Of course, the fitting seems to be successful (Fig. 8), and I like the idea of parameterizing the entrainment fraction based on the grid-scale relative humidity and cloud water mixing ratio. However, I doubt that this parameterization is suitable for a microscale process, where local shear and buoyancy drive turbulence generation and entrainment. In fact, Xu and Randall (1996) developed the applied parameterization for climate models in the 1990s, i.e., for representing entire subgrid-scale clouds at a resolution of several tens to hundreds of kilometers, while the authors apply it for subgrid-scale processes below 100 m. Finally, I wonder why the data on the x-axis of Fig. 8 is not evenly spaced? The calculated (1 – f) values should have values between 0 and 1 with a spacing of 0.01, which should be visible in the plot. Or is there some post-processing not mentioned in the manuscript?

Extension of the parameterization to account for entrainment fraction. In Luo et al. (2020), the authors showed that the entrainment fraction impacts the subsequent mixing process. Why is the entrainment fraction not considered in their parameterization (6)?

References

Luo, S., Lu, C., Liu, Y., Bian, J., Gao, W., Li, J., ... & Guo, X. (2020). Parameterizations of entrainment-mixing mechanisms and their effects on cloud droplet spectral width based on numerical simulations. *Journal of Geophysical Research: Atmospheres*, *125*(22), e2020JD032972.

Xu, K. M., & Randall, D. A. (1996). A semiempirical cloudiness parameterization for use in climate models. *Journal of the atmospheric sciences*, *53*(21), 3084-3102.