Comments to the manuscript with ID “acp-2022-351”

General comments:

This study explored the stratocumulus marine boundary-layer (MBL) and cloud responses to aerosol injections using idealized large-eddy simulations to address the longstanding aerosol-cloud interactions. It shows that “the cloud-top entrainment rate, MBL turbulence, surface fluxes and cloud microphysics differently depending on meteorological conditions.” These findings can contribute to the effort of disentangling aerosol effects on cloud properties from the meteorological effects. In addition, this study developed methods to quantitatively decompose LWP adjustments into contributions by different processes, and the cloud radiative effect to contributions from Nc, LWP, and cloud fraction.

Overall, the manuscript is well written and organized with clear scientific questions being challenged and answered. Therefore, I recommend the publication of this manuscript with minor revision.

Specific comments:

L.5-10: By just reading this sentence, “The key results are that (a) the cloud top entrainment rate increases in all cases, with stronger increases for thicker than thinner clouds”, it is unclear to me what causes “cloud top entrainment rate increases”. Since this is in the abstract, I suggest the author elaborate on the causality to improve the presentation and readability.

L.111-119: What are the parameters for the input aerosol size distribution? Are they from in-situ measurement or arbitrary?

L.125-130: Are the large-scale forcings from ERA5 reanalysis? How did you validate them? By saying “steady forcings”, did you mean the large-scale advective tendencies of thermodynamics and divergence do not vary with time? If so, could this affect the boundary structures and therefore the cloud macrophysics?

L.132-136: Are the aerosols uniformly distributed in the entire domain in the control simulation? Are the injected aerosols instantaneously distributed into the domain after the injection?

L.138-139: Do you apply nudging to large-scale divergence? If so, what is the reference divergence? Does Na, FT varies with time? Why do you need to adjust it? Would such adjusting affect your conclusion on aerosol-cloud interactions?

L.144-149: Why not use the same domain size for all simulations (96*9.6 km)? The convective organization could be different between the 96*9.6 km and 48*9.6 km-sized domain, which may result in different LWP and CF. Could the authors check this at least for one set of simulations to make exclude the effect of domain size difference?

L.537-539: Since the cloud responses to aerosols strongly depends on meteorology conditions, would it be necessary to validate the meteorological conditions in the presented simulations using observational or reanalysis data? Such a validation could strengthen the conclusion.

L.435: Can the authors elaborate more on the “coupling and surface flux responses”?

Technical comments:

L.64: Is the deviation missing after the “-3.7 W/m^2”?
L.193: Is “s_l” defined?
Fig.3 caption: Since the authors labeled the each subplot, why not use labels to improve the readability, e.g., q_t: (a) and (c), … ?
L.213: Does “run-average” mean time average after the spin-up time?
L.569: Can the authors rephrase the sentence? I am confused with the parenthesis and “runs with runs”.