Review of "Model-based insights into aerosol perturbation on pristine continental convective precipitation"
Anonymous Referee #3

Referee comment on "Model-based insights into aerosol perturbation on pristine continental convective precipitation" by Mengjiao Jiang et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-715-RC2, 2022

The authors have used model simulations driven by reanalysis to examine aerosol effects on convection over the Tibetan Plateau, an area with very low concentrations of aerosols normally. Their findings are consistent with other works, showing that generally with increased aerosols they see delayed warm rain production and then enhanced cold rain processes with some convective invigoration. I see no major flaws with the work, I just have some suggestions below for clarification and better readability.

Overall:

Throughout there are some typos and small language/grammatical issues that require some copy-editing.

I would suggest adding subtitles to figures, it's easier to follow that way.

Specific:

Abstract is a bit confusing, what does this sentence mean? "With the increase in the aerosol number concentration, the conversion of cloud water to rain in clouds is first enhanced." First according to what?

Line 127: The sentence starting with 'The aerosol impact in..' was confusing to read. I
think you are just trying to state that impacts on convection can then effect teleconnections through the heat pump? Also, the reference is the 2007 paper, not 2016.

Line 146: 'This methodology could then be applied in other regions of the world with similar background environments.' I'm not sure which methodology you mean - just using model simulations driven by reanalysis? I'm certain this has been done numerous times in various regions of the globe.

Line 236: Do you not have observations of convection and/or precipitation? Why do you need to compare the soundings to 'suggest' that convection developed in this time period?

Line 253: 1km and 60s are a bit coarse. (especially the 60s, was that truly used for the 1km grid?)

Is there a reason this particular date/case was chosen?

What is the default value from the model and where does it come from? Why not perturb the observed aerosol value instead?

Line 299: You mention radar here, but why is this not shown anywhere? How do the simulated storms compared to what was observed?

Fig 5: I'm not sure how to interpret a cloud field that's averaged over 12 hours. Physically this doesn't make a lot of sense, as over this period of time advection, microphysics, and precipitation are all occurring.

Line 302: You say 'indicating that the warm cloud process was dominant', but these are model simulations, and you should be able to easily check to see what processes are dominant.

Line 340: You are repeating yourself from the previous paragraph when you describe the figure here.

Line 356: I'm not sure I follow this argument. Might it just be the case that the extremely pristine environment is aerosol-limited?
Figure 9: It might be easier to see differences if this was just one plot.

Line 401: These w averages are over a large domain, over 5 hours. There are different cloud/storm amounts in each simulation. It’s not clear that you can interpret anything real from this plot, it would just be averaging over anything interesting. I would suggest looking only at updrafts, or use a condensate threshold, to be more sure this is actual invigoration.

The conclusion feels kind of sudden and a bit non sequitur. There is talk of uncertainties in measurement, but not really in context of the study. It just seems kind of incomplete.