

Responses to the Reviewer 2 comments.

The authors appreciate thoughtful comments from the Reviewer 2. Below we reply to those comments and list revisions that will be included in the revised manuscript. The original comment text is in black, our responses are in red.

This manuscript combined theoretical and modeling analysis to investigate the factors that influence the buoyancy of convective updrafts including the in-cloud supersaturation, condensate and precipitation loading and entrainment. The authors leverage an ensemble of idealized simulations of varying complexity they have performed during previously published work but provide additional detailed analysis to quantify the relative contributions to buoyancy generation and loss. While the work is motivated by the continuing debate centered around aerosol invigoration of deep convection, to which the authors have made significant contributions, the analysis and results have broader implications to our general understanding of deep convective core dynamics. Compliments to the authors on a very clearly written manuscript. In my opinion, the manuscript is nearly ready for publication in ACP, but would benefit from some minor changes for clarity in a few places.

Opportunities for clarification:

Last paragraph of Introduction – This paragraph is mostly a listing of the different model ensemble members that are incorporated in the analysis. These differences are important for the reader to understand, but I found it quite difficult to parse what they all were. I think a table, or even a bulleted or numbered list might help to present these more clearly.

We think the reviewer means the last paragraph of section 2.1. We added a table listing all ensembles and describing aspects discussed in this section.

Line 225 – While Figure 1 shows equivalent potential temperature, the text refers to moist static energy. While these are similar measures, consistency in terms will help the reader. The similarity of equivalent potential temperature and moist static energy is explained in line 251-252.

We modified the Fig. 1 caption to clearly explain the link between the equivalent potential temperature and the moist static energy.

Figure 5 and 6 would benefit greatly from including a grid such that the reader can more easily identify the features of the comparison that are discussed in the text.

We modified the Figs. 5 and 6 per this suggestion.

Line 480 – Make it clear that the right and left panels of Fig. 8 and 9, that are being referred to, are the pristine and polluted cases, respectively.

We modified the text to stress that.

Minor comments:

Line 130 – "...have to come from different reasons..." I think I know what is intended here, but this phrase does not quite make sense. Would something like, "...require different explanations.."?

Line 197 – "rimes" should be "rimed"

Line 225 – "the cloud cover in left panels" should be "the cloud cover in the left panels"

Line 235 – It would be helpful to add "ice crystal" before sizes. At least I think that is the sizes that are being referred to.

Line 257 – Add "the" between "obtain" and "buoyancy"

Line 619 – Add "a" before "more"

Line 647 – "set" should be "sets"

Line 655 – "it" should be "its"

**All the above suggestions and typos were corrected.**