

“Numerical Case Study of the Aerosol-Cloud-Interactions in Warm Boundary Layer Clouds over the Eastern North Atlantic with an Interactive Chemistry Module” by Lee et al. [Research Article, egusphere-2024-3199]

Responses to the Comments of the Anonymous Referee #1

We appreciate the editing provided by this reviewer. The editing suggestions have been incorporated into the revised manuscript, and we have also outlined our point-by-point responses to the reviewer’s comments below (the reviewer’s comments are indicated in *italics*).

Comments:

This manuscript is overall well written but still needs some minor edits which are enclosed in the PDF.

Line 590: ... is characterized as clean, ...
Modified.

Line 618: remove “the”
Modified.

Line 619: "cloud layer" what? Do you mean to say within the cloud layer?
We modified the sentence to “In the simulation of 20170719_control, most aerosols are concentrated within a height of 1000 m, which corresponds to the cloud layer height”

Lines 733-734: which in turn activates more aerosols as CCN.
Thanks for suggestions and the sentence is modified.

Line 911: case studies
Modified.

Figures 3 and 4: remove minus sign.
Modified.

Figure 5: Be sure to use the correct time format for this journal.
It is followed the time format requested for ACP.

Figure 6: 4 km
Changed in the figure caption.

Figure 12: dashed
Thank you for catching the typo. Modified.

Be sure to remove the minus sign for western longitude in your supplemental figures.
All figure captions in the supplementary are updated.

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Responses to the Comments of the Anonymous Referee #2

We appreciate the constructive comments and suggestions from this reviewer. Our point-by-point responses to the reviewer’s comments are as follows (the reviewer’s comments are marked in *Italic* font).

Comments:

I appreciate the authors’ efforts in addressing my comments. Most of them have been thoroughly resolved. I have only one remaining concern regarding the calculation of LWP susceptibility to CCN concentrations. In this study, the susceptibility is quantified through the logarithmic slope of aggregated grid points from both the control and perturbed simulations. However, such calculated slopes might be statistically insignificant (e.g., likely so in Figure S10c upon visual inspection). To enhance the robustness of the findings, I recommend that the authors include statistical significance information for each calculated susceptibility in Figure 12 (and Figure 11 if applicable). For example, they could use solid dots to indicate cases where $p \leq 0.01$ and circles for $p > 0.01$. This might help reconcile the discrepancy with the results from Hoffmann et al. (2024). In other words, positive LWP susceptibilities observed during periods of no rain or light rain might not be significant.

We appreciate the reviewer’s suggestion and have updated our manuscript accordingly. The p-value for Figure S10c is 8.1×10^{-9} , confirming its strong statistical significance. The data points from the perturbed run have systematically lower LWP than these in the control run.

In response to the reviewer's comments, we have incorporated p-value calculations into Figure 11 and Figure 12. In Figure 12, black circles indicate statistically significant results ($p \leq 0.01$), with more than 70% of the results meeting this criterion. Similarly, Figure 11 highlights statistically significant results with black edges. Our findings support the conclusion that when CCN concentrations are low, LWP is highly sensitive to variations in CCN number, with higher CCN concentrations leading to increased LWP. However, when the mean CCN concentration is relatively high, LWP becomes less sensitive to changes in CCN, resulting in smaller LWP susceptibilities, which include both positive and negative values (most with $p > 0.01$). The negative values are primarily caused by evaporation of small cloud droplets at non-rain grid points near the cloud edges.

We have updated the figures and revised the relevant text to include our response to the reviewer's comments, as reflected in Lines 678-679.

Editing suggestions:

Line 432: “which is to double” to “which doubles”

Modified.

Line 1246: “rages” to “ranges”

Thank you for catching the typo. Modified.