"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 greatly appreciate the editing and feedback provided by this reviewer. In addition to the editing suggestions, which have been incorporated into the revised manuscript, we have outlined our point-by-point responses to the reviewer's questions and comments below (the reviewer's comments are indicated in italics).

Comments:

Lines 263-265: There should be a more clear reason for your adjustment for sea salt emissions. Is this due to wind speed, observed emission data, etc?

We revised the sentences to "Sea salt emissions are driven by surface wind speed. The simulated surface wind speed aligns closely with ERA-5 data; however, the sea salt concentration is only one-third of the value found in the MERRA-2 analysis. To improve the alignment with the sea salt aerosol concentration observed in the MERRA-2 reanalysis, we adjust the parameter factor for sea salt emissions to three times the original estimate (further comparison can be found in Section 3)." Lines 267-272 in the revised manuscript.

Line 282: what is the cloud type?

We clarify it is stratocumulus clouds in the manuscript.

Lines 379-381: Is this part of the reasoning the authors chose to adjust sea salt concentration by three times?

Yes. We also adjust the sentence to "Although the simulated surface wind speed matches well with ERA-5 (Fig. S7), the underestimation of sea salt concentrations may be attributed to limitations in the emission parameterization, which is overly reliant on surface wind speed (Gong, 2003)." Lines 391-394 in the revised manuscript.

Line 392: is this a correct domain resolution complete with units?

The resolution of domain 4 is 190 m, meaning that the aggregation of 20 grids results in a total distance of 3.8 km, which is approximately equivalent to a resolution of 4 km in the text.

Line 472: below is a better word choice, revise for all instances.

Modified "under" to "below".

Line 519: Within a 1000 height layer? At 1000 m in altitude? What does this mean?

We changed the sentence to “the CCN number concentration is averaged from the surface up to the height of 1000 m”.

Lines 641-644: These sentences seem to contradict one another. An increase in CCN has a large impact on LWP as shown by AIE. However, if the concentration exceeds 100 cm-3 (an increase) then there is a smaller sensitivity? Please revise.

We thank the reviewer pointed it out. We modified the sentences to “However, when the mean CCN concentration exceeds 100 cm^{-3}, the relationship between LWP and CCN becomes more complex, with both positive and negative susceptibilities observed. This suggests that the change in LWP is influenced by other factors, such as environmental conditions and cloud precipitation status. (as shown in Fig. 11a).” Lines 676-679 in the revised manuscript.

Line 672: NCCN?

We changed it to CCN number.

Figure 10: What specifically is this the ratio of? This sentence is awkward.

The caption is changed to “The time series of the ratio of the number concentration of CCN at a supersaturation of 0.2% in the perturbed runs to that in the control runs, normalized by the corresponding accumulation mode aerosol concentration, defined as $(CCN_{0.2\%}/Accu.aerosols)_{perturbed} \Big/ (CCN_{0.2\%}/Accu.aerosols)_{control}$. The black dashed line indicates the value of unity.”

Figure 11: The cases are not labeled. There are no titles on the plots.

The title is added to each plot. The LWP susceptibility plots include 6 simulations (both control and perturbed simulations of three cases).

Figure 12: See previous comments for Figure 11.

The title is added to each plot.