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Comment on acp-2021-540

Anonymous Referee #1

Referee comment on "North Atlantic Ocean SST-gradient-driven variations in aerosol and cloud evolution along Lagrangian cold-air outbreak trajectories" by Kevin J. Sanchez et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-540-RC1, 2021

Review of North Atlantic Ocean–Atmosphere Driven Variations in Aerosol Evolution along Lagrangian Cold-Air Outbreak Trajectories by K. Sanchez et al.

This manuscript presents an interesting case study which provides new insights on aerosol-cloud interactions in cold-air outbreaks. The data presented in this manuscript and the derived conclusions may be useful both for the modelling and experimental aerosol-cloud interactions research communities. The manuscript is well organized and clearly written. I recommend publications after the following (minor) comments are addressed.

Further considerations on the data robustness and uncertainty would be necessary in the manuscript, to allow a more sound interpretation of the results. If we take Table 3, which is a keystone of the manuscript, as an example, and consider the data displayed in Figure 4, we can conclude that not all the numbers reported in the Table are characterized by the same level of robustness. Clearly AMS concentrations are derived from few and quite scattered data, which make them more uncertain than other data presented contextually. I understand the scientific value of these data and the technical efforts necessary to obtain them and believe they are worth of publication. Nevertheless, at least, in the Table it should be reported the number of observations (n1, n2) used to derive the delta values so that the reader can judge about the robustness of the provided information. In alternative, the authors might evidence (e.g., with a *) which of the delta values are based on poorer statistics than the others, based on appropriate criteria.

The results reported in Table 3 are likely depending on the selection of the representative 10-minute periods of measurements used to calculate the deltas. Figure 2 suggests that a different choice, even by few minutes, may result in significantly different results. The authors should explain better how they selected the reference periods and show that their choice does not affect the results in a significant way (i.e., they should present the sensitivity of the results to the selection of the reference periods).

Specific comments

L270. I would invite the authors to indicate in brackets at what time the transition occurred, to help the reader in interpreting Figure 2.

L313-314. Please refer to my comments on Fig. 1 and Fig. 3.

L388-390. A more robust statistic approach would make this assumption stronger. I invite the authors to apply a statistic test on the datasets to evidence which difference are statistically significant for a given confidence interval.

L402. The authors may want to double check this sentence: "… resulted in the decreased the overall rate in aerosol particle".

Table 1. Please correct the units of measurement in the caption (superscripts are missing). I have not clear the concept of "updraft-weighted updraft velocity", maybe some explanations are needed here..

Table 2. Please correct the units of measurement in the caption (superscripts are missing).

Figure 1. I believe that the manuscript would be more immediately comprehensible by a wider audience if more information were provided in Figure 1. I would invite the authors to mark the borders of the open cell, closed cell and clear sky regions object of their investigation on the satellite images of Figure 1. In alternative, they could provide the required information adding an extra Figure in the supporting information.

Figure 3. The Figure could be improve by showing which data points refer to which of the considered regimes: closed cell, open cell, clear sky… This could be done by adding a horizontal bar at the bottom of the plot, marking the respective regimes.

Figure 8. In panel d), it would be interesting to discriminate between statistically significant and not significant correlations (according to a chosen confidence interval). It can be done easily by using two different colours for significant and not significant R values data points.

According to the Journal guidelines, the Data availability statement should be separated from the Acknowledgement Section.