

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2022-171

Anonymous Referee #2

Referee comment on "Seasonal updraft speeds change cloud droplet number concentrations in low-level clouds over the western North Atlantic" by Simon Kirschler et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-171-RC2>, 2022

This manuscript investigates the influences of vertical updraft speeds and CCN concentration of cloud droplet number concentrations using air craft measurements. The conducted measurements and analytical methods (while not fully explained, see my comment below) appear scientifically sound. The paper is not particularly original, but can still be considered as a useful contribution to the scientific community. There are a few issues that need to be addressed better before I can recommend accepting this paper for publication.

Major comments

The authors define three pollution levels, or regimes, based on measured CCN concentrations. There are a few issues related to this approach requiring better justifications, or some revisions. First, although it makes sense to use CCN as a measure of pollutions for the purposes of this paper, this wording is problematic considering that for air quality community pollution levels are usually defined based on concentrations of a selected chemical compounds, or simply PM mass concentration. This causes also confusing statements, such as that on lines 398-400: for air quality people it sound strange to claim that the mass concentrations of the most typical particulate air pollutants increased only moderately as the pollution levels increased in winter. I would encourage the authors to reconsider what to call the different CCN regimes used in this paper. Second, what is bases for the grouping of the different CCN regimes? The borders between the different groups given on lines 214-215 seem rather arbitrary to me. Third, if strict limits for different CCN groups are given (lines 215-215) how is it then possible that CCN concentration in different groups can overlap each other (Figure 4a and text on lines 278-380)? Finally, do the authors have any idea on why the medium CCN regime was absent during the winter?

The description of the methodology used to determine w and S_{max} needs to be expanded (lines 218-223). How is S_{max} determined in practice? It is unclear whether w or w_{eff} is really used later in the paper, as w_{eff} appear only in equation 2. If this methodology has been described in more detail in earlier literature, the relevant studies should, at the very least, cited here properly.

I have a hard time to understand how the values of S_{max} given on lines 350-351 have been obtained, and how they are related to the lines in figure 6c. This problem is, at least partly, related to the lack description how S_{max} has been determined in this study.

I would appreciate if the authors had listed concrete scientific goals for this paper. Written like it is now (lines 59-61), a reader might get an impression that the purpose of this paper is solely to produce data for other researchers for e.g model evaluation.

Minor/technical comments

line 255: ... between 208 and 1367 ...

line 293: please separate N_{gt85} from the rest of the text using commas (i.e. ..., N_{gt85} , ...).

lines 305 and 315: the term altering processes sounds odd to me. I suppose the authors mean a combination of chemical and physical (aerosol) processes that convert sub-CCN size (nucleation and Aitken mode particles) into largest ones that then contribute to the CCN population.

lines 338-341: while I agree on that the HP regime shows the strongest increases with increasing w at $w < 1.6 \text{ m s}^{-1}$ and at $w > 3 \text{ m s}^{-1}$, it is hard to see from figure 6 that there would be such border for LP or MP, or that they would clearly saturate at high values of w .

The units of quantities are usually written using normal text, not in italics. Furthermore, different parts of the units should be separated from each other using spaces (i.e. m s^{-1} , not ms^{-1}).

The title of Section 4 should be reconsidered (Summary and Conclusions), as most of this section is simply summary of the results with only few conclusions provided.