Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2022-605

Anonymous Referee #2

Referee comment on "Influence of air mass origin on microphysical properties of low-level clouds in a subarctic environment" by Konstantinos Matthaios Doulgeris et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-605-RC2, 2022

In their study Doulgeris et al combine a long-term dataset of in-situ observed cloud microphysical properties at a sub-arctic location with simulations of air mass transport. While the general methodology, uniqueness of the dataset and presentation are reasonable for publication, I do share the concerns of the first referee regarding scientific relevance and quality. In my opinion the manuscript should be reconsidered after major revisions.

General comments

- The authors should point out more clearly where their work extends the current level of scientific knowledge. As the authors describe in the literature overview, the Twomey effect is well confirmed and no significant additions are provided in the manuscript. It should be considered to change the manuscript type and focus to a measurement report instead of a research article.
- It does not become clear how including the cloud base height information in Sec. 3.4 supports the manuscript. A distance of 4km of the ceilometer for cloud-base height retrieval seems quite far away. Also, it does not become clear if and how only stratiform cases are selected. The resulting Fig 10 looks more like a 'point cloud' without the chance to identify any physical relationship.
- The airmass source analysis raises some questions as well. The regions seem rather inconsistent. E.g., why is the Kola peninsula 'Eastern' and not 'Arctic' or why is Scotland an Ireland 'Western' while England is 'Southern'. The simulation duration of 4 days is quite short. Was there any sensitivity analysis performed with 7 or 10 day simulations? How were contributions from outside the area of Fig. 3 treated?

Specific comments

- L31: The statement on larger droplets in warm clouds in the current form is not supported by the presented data. Fig 8 b, d shows a decrease of particle size for the 'Arctic' subsample in the FSSP data.
- L44: The issue of varying meteorological conditions is raised, but throughout the manuscript is does not become clear how different temperature and humidity within an airmass origin category are treated (or if they are uniform enough to be disregarded).
- L49-51: Consider rephrasing this sentence, it is hard to grasp what is reason of the limited knowledge and what is the consequence.
- L79-83: The sudden appearance of ice particle sizes confuses the reader. As the manuscript focuses only on cloud droplets, consider removing it.
- Fig 1: The information content of this map has to be increased. Include the elevation, ideally as shading or contour line, as you later argue based on the orography. A legend and lat-lon grid are lacking. Does the darker green color indicate forest? The labels are too small.
- L147 and 180: Please provide a histogram of wind direction/wind strength. Are certain airmass origin categories subsampled due to filtering periods when FSSP and CAPS did not look into the same direction.
- L152-157: At which of the sites were the meteorological observations conducted? Sammaltunturi? Given the amount of detail on hardware in this paragraph, it would be nice to have that the reader would not be forced to consult Doulgeris 2020/2022 for this piece of information.
- Fig 6 b: Please distinguish the years. Make clearer what data is from CAS and what from FSSP
- L304: Please provide the duration of the >80% periods also as fraction of the total in-cloud duration
- Fig 7: Without indicating the variability, the yearly averages are of limited use for the reader. How may hours of observations are available for each year and each cluster? Also, given the typical duration of the campaigns, shown is an autumn average.
- L350-352: The statement on shorter lifetime of warm Arctic clouds not well supported by the data presented. Please either extend the argumentation or omit that senstence.
- Fig 8: Please include the no of samples per bin, instead the vague statement in L354.
- L367: How did you account for different temperatures in different air masses for this conclusion?
- Fig 9 a: similarly to Fig 6b, please indicate the single years and make CAPS and FSSP more distinguishable
- L431-434: The conclusions on number concentration and diameter with respect to the height are not backed by the analysis presented in Sec 3.4 at all. Either remove this aspect or expand on the reasoning, including descriptive figures.