Comment on acp-2022-98

Anonymous Referee #2

Referee comment on "Snowfall in Northern Finland derives mostly from ice clouds" by Claudia Mignani et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-98-RC2, 2022

The authors use several months of radiosonde soundings and coincident, ground-based hydrometeor imagery at a high-latitude station in northern Finland to infer ice formation pathways during snow events. Relative humidity (RH) profiles (both with respect to water and ice) from radiosonde data are used to develop a simplistic snow event predictor. For snow events, the authors show how imagery-based ice particle habits change as a function of RHw. Using cloud-top temperature the authors conclude that primary ice formation was the main pathway to form snow.

The study is well written and contains many useful plots. I recommend publication after resolving a few major issues.

Major points

The "Results" section includes a few elements of a discussion. However, I feel the study would benefit from a broader discussion that is also placed into its own section. Following points should be relevant to the reader:

- The authors start their study by mentioning the Arctic surface budget. Do the authors think the site in Finland is representative of the Artic? Or could the continental character and the influence from boreal forests (e.g., Schneider et al., 2021) mislead?
- Would other (frequently used) INP parameterization lead to the same conclusions?
- Could the high-RHw group (Fig. 8) be useful as a proxy of snow events in a warmer climate?
- Is a 15 min window appropriate? How long would it take for a particle to fall from ~2.7 km?

Please review the order of the figures. Figure 7 is mentioned earlier (l. 89) than Figure 2 (l. 150). The same review should be applied for supplementary figures.

Minor points

l. 1 This sentence sticks out. Either specify "properties" and their "role" or write it more general as "clouds" (instead of "cloud properties").

ll. 198-199 Perhaps show examples of unclassifiable particles.

l. 208 This sentence is redundant as the information was provided in l. 206.

l. 225 How is cloud-top temperature obtained?

ll. 226-228 This description needs improvement and perhaps an illustration of the concept. What is meant by "gaps" and how do you determine them?

ll. 244-247 This seems highly relevant and should be shown as its own plot.