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Comment on acp-2021-491

Anonymous Referee #1

Referee comment on "Controls on surface aerosol particle number concentrations and aerosol-limited cloud regimes over the central Greenland Ice Sheet" by Heather Guy et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-491-RC1, 2021

Review of "Controls on surface aerosol number concentrations and aerosol-limited cloud regimes over the central Greenland Ice Sheet" by Heather Guy et al.

This is a very well written manuscript that presents a year's worth of surface aerosol concentrations at Summit Station Greenland along with in-depth analysis of the processes that control the surface aerosol concentration. I have only a few minor comments:

- My biggest comment is simply that this paper is long. I felt that the Discussion section was largely repetitive (though certainly not entirely) to discussion that had already occurred in the Results section.
- Lines 8 and 290: Be sure to state "anomalous" cyclonic circulation.
- Lines 59-62: The implication here is that the WBF process will be active whenever ice crystals and cloud droplets are co-located. This is not the case since air can be either supersaturated or subsaturated with respect to both liquid and ice simultaneously. Please just modify the sentence to avoid the implication.
- Lines 265-266 and 436-437: The authors note that it is not possible to determine if blowing snow and fog (presumably supercooled liquid fog since that is the kind of fog that the authors have discussed) occur simultaneously. That may be true based on the instrumentation. But if fog were present at the start of a blowing snow event, wouldn't we expect the blowing snow to rime the supercooled liquid or potentially eliminate it through the WBF process? It seems unlikely to me that we would have both fog and blowing snow for very long.
- The authors present three case studies of low N20 and show that in all three cases there is "near-zero" liquid water when N20 is < 10 cm^{-3}. Is there ever non-near-zero liquid when N20 < 10 cm^{-3}? Or maybe there simply aren't enough events for the answer to this question to be meaningful.