

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2021-643

Anonymous Referee #2

Referee comment on "The contribution of Saharan dust to the ice nucleating particle concentrations at the High Altitude Station Jungfraujoch (3580 m a.s.l.), Switzerland" by Cyril Brunner et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-643-RC2>, 2021

The authors conduct measurements of INP from February 2020 to December 2020 at JFJ. The INP measurements are constrained to a temperature of 243K and a saturation ratio of 1.04. They classify the INP according to whether or not Saharan dust events were present. The classification is based on four criteria: single scattering albedo; satellite retrievals of dust mass concentration; modelled tropospheric residence times; the backscatter signal from a ceilometer. 14 dust events of high confidence (hcSDEs) were classified where each of the four criteria for Saharan dust were met and 12 events of lower confidence (lcSDEs) were classified where at least one of the four criteria were met. The authors show that INP concentrations increase by generally one to two orders of magnitude during the periods of dust events. They also find some evidence for dust influence in the absence of an identified event. I find the main aspects of the work to be sound and useful. I think the interpretation of the results, initially sound, is carried a bit farther than warranted, reflected in my comments 12-17 below. Overall, I feel the paper could be suitable for publication subject to some revisions.

Comments:

- 1) Abstract – lines 3-4 – These two sentences might be better reversed in order, as I find the second seems to contradict the first.
- 2) Lines 33-35 – Again, slightly contradictory statements: Mixed phase exist between 273K and 235K, yet most clouds warmer than 253-258K are ice free.

3) Line 41 – I suggest mentioning the importance of mineral dust as INP before discussing the sources and transport of dust.

4) Line 73 – Remove “Besides”

5) Line 250 – What metric of particulate matter is recorded?

6) Line 256 – Please clarify what you mean by “and involved microphysics of dust”.

7) Lines 264-270 – Perhaps clarify that the median of all single events is the median of the individual event medians, and that the collective refers to the median of all INP concentrations during the SDEs.

8) Lines 277-279 - They clearly differ based on the stated uncertainties, yet you say the difference is not significant. Please explain.

9) Lines 297-298 – With only 12 IcSDE cases, the statistics for these events cannot be strong, unless one criterion was dominant.

10) Lines 310-311 - Maybe, you can't say this is true, or even implied, without some sort of chemical ID.

11) Figure 6b – You mention having normalized the area under each curve. I suggest adding that this does not allow the “SDE” plus “no SDE” curves to equate to “all”.

12) Lines 334-339 – This a simple back-of-the-envelope calculation. The inclusion of uncertainties of 0.1% and 0.2% suggests otherwise and I think is inappropriate. I suggest reducing this discussion to something like "With our assumptions, we estimate that about 23% of the INPs measured during non-SDE periods were dust-related."

13) Lines 351-363 - The potential for correlation of INP with dustcams is based on Figure 6 showing consistency between the INP and dustcams distribution. However, the dustcams distribution for the SDE cases does not exhibit a log normal, which suggests that the sizes of dust particles vary, perhaps substantially. One consequence of that is the number concentrations of dust particles will not necessarily scale with dust mass. The authors note that INP scales with r^2 , but that is largely related to the process of ice

nucleation. Actual INP concentrations likely also scale with simply r or just the number of viable dust particles. Significant improvement of this discussion is needed.

14) Line 378 and Figure 9 – The " R^2 " in Figure 9c looks to be 0.826. Is that correct?

15) Lines 393-394 - Please explain the evidence for a connection between the dust and the virga, which to me looks tenuous at best. Are you suggesting that the dust is responsible for the virga or that the dust may be modifying it?

16) Line 415 – Where are the dust particles between 10200 m and 11200 m? It looks like noise above 8 km.

17) Lines 420-442 and Figure 12 - I don't see any evidence for lifting of the dust above 7 km at best. Why can't the "connection" be simply the virga settling until it hits the drier air containing the dust? The virga does not correlate with the dust, which suggests that, if the dust is involved, it may only modify the virga. One might expect more and smaller ice crystals associated with more INP, which might result in a shorter fall streak. However, the shortest fall streaks appear to be farther from the dust and completely unconnected.