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Comment on acp-2021-710

Anonymous Referee #2

Referee comment on "The diurnal and seasonal variability of ice nucleating particles 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-2021-710-RC2>, 2021

Review of "The diurnal and seasonal variability of ice nucleating particles at the High Altitude Station Jungfraujoch (3580 m a.s.l.), Switzerland" by Brunner et al.

The paper from Brunner et al, reports seasonal variability and diurnal variability of INP concentration at the JFJ site during the year 2020. This is this year the third paper in this series of INP measurements at JFJ. The first technical paper appeared earlier this year in AMT, describing the auto-HINC, a new CFDC device enabling continuous INP measurement at the JFJ. "Continuous online monitoring of ice-nucleating particles: development of the automated Horizontal Ice Nucleation Chamber (HINC-Auto)". A second paper, "The contribution of Saharan dust to the ice nucleating particle concentrations at the High Altitude Station Jungfraujoch (3580 m a.s.l.), Switzerland" currently in ACPD presents one year (2020) data of INP attributed to Saharan dust and measured at JFJ. This current third paper is pushing the analysis further by looking more carefully at the seasonal variation of the INP during the same time, extracting the INP seasonality and diurnal variation by excluding the SDE. The data are first cleaned from local pollution (roughly 25% of the data removed) and then data is classified in 4 different air masses: FT with or without SDE and BLI with/without SDE. This paper is well written and very pleasant to read. It is a nice continuation of the first two papers published/under review this year. It presents an impressive work of high temporal resolution of INP concentration for 1 year of continuous measurement. The fact that the authors could use this high temporal resolution HINC instrument compared to "classical" daily filter measurement allow the authors to remove from the data any short local pollution, which I'm not sure would have been feasible with 24hr filter. For sure, much more of this type of high temporal INP measurement is very appreciated, and hopefully more in the future will be done (also at different locations).

I have only one main comment and a few small comments, and I recommend the paper to be published once these comments are addressed.

Main comment:

PL369: "Based on our observations, it is unlikely that pollen or subpollen particles are responsible for the observed high background INP concentrations in April,"

Looking at the data, I would arrive at a different conclusion (or at least less affirmative about the non-influence of pollens on INP at JFJ).

A) Like Sarahan dust, pollens are known to be a very good candidate to act as INP as the authors explained, and this is why the authors investigated this specific source of INP. However, the authors do not have a direct measurement of pollen directly on site, so they have to speculate. The data presented here show that there is a peak of pollen measured 60 km away from the station (at Bern, 3 km lower in altitude) just a few days (1-3 days, hard to read from the figure FA1.a) before the measured "peak" of the INP at JFJ. Pollens are released first before INP increases, which therefore does not rule out the possibility of Pollen reaching JFJ and increasing INP concentration (the other way round would not work). Similar to SDE, pollen transported to JFJ could have departed days earlier before arriving on this high altitude site?

B) Then there is the estimation of how many pollen particles would reach the station:

P11L261 ". If every pollen grain would be ice-active at 243 K, and the same pollen concentration were present at the JFJ as measured in Bern, i.e., the PBL was perfectly mixed and the JFJ was within the PBL, pollen would only contribute up to 3.6 INP std L-1 (4 INP L-1), 5 times less than the Q95% INP concentration for BLIBG conditions during the same time period. "

However, pollen concentration measured at Bern is an average of 24hrs, whereas INP concentration measured at JFJ is a snapshot of 20 min of measurement. So for me, this will not exclude the possibility of pollens arriving in a batch at JFJ, therefore explaining this higher concentration. Also, pollen concentration measured at Bern may not be the representative concentration of pollens arriving at JFJ as another site (Visp) at a roughly similar distance from JFJ reported half of the concentration around the same day (April 20th ?).

C) Air mass origin. I wonder if an analysis of the air mass origin could help in understanding this spring peak of INP. Where the air mass is coming from during the INP peak? Could this air mass have collected pollen from somewhere in Europe? Could pollen

be transported from further away than Bern or Visp (like SDE)? The authors state that an anti-cyclone was present until April 16th. Could it have influenced the non-transportation of pollen to JFJ at that time (low INP)? Could the peak of INP arriving just after the end of the anti-cyclone be a result of transportation of air mass from mainland Europe (which was full of pollen)?

Small comments:

It would be good to have Brunner et al. accepted 2021 in ACP to use the same notation as in this paper (if it is still possible to edit the manuscript). For example table 1 in both paper show the same results but with different notation.

P3L87-88 "(CPC), TSI 3772, **lower cut-off size: 14 nm**) and size distribution (scanning mobility particle sizer (SMPS); optical particle sizer (OPS)"
What is the size range of the SMPS (which is then used to calculate N90) and the size range of the OPS?

Fig 3: "with the Q10% of PFT of a given day" what is the right axis BLI/FT %? I m a bit confused about how to read this scale. I am assuming that data close to BLI correspond to 0% and close to FT correspond to 100%. is that correct?

Fig 3: What is the meaning of the dash black line around mid-April in panel a) and b).

Reference Schneider, J. et al. 2020 is from ACPD, Schneider et al. 2021 is the final version. Please correct in the text and in the reference list.

Reference Brunner et al. 2021 in ACPD might be available at the time of the publication of this article.

if other references of manuscripts in "preparation" are now available, please add them.