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Comment on acp-2021-710

Anonymous Referee #1

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-RC1, 2021

General comments

The manuscript investigates the seasonal and diurnal variability in ice nucleating particle concentration (INP) measured over a year at the High Altitude Research Station Jungfraujoch. It represents the longest continuous measurement of INPs to date with a high time resolution of 20 minutes. A seasonal trend in INPs is observed with highest concentrations occurring in Spring and lowest concentrations occurring in Winter. A diurnal trend in INPs is also identified for air masses with boundary layer intrusions. The study identifies long term trends in INP concentrations and is a valuable contribution to the field of INP research. However, I believe that the discussion of the data represented in the figures could be clearer and further links between potential INP sources and with previous literature studies could be made. I therefore recommend the manuscript for publication in ACP following appropriate response to the following comments.

Specific comments

1. The results section contains very detailed analysis and lots of information is contained within each figure. It would be clearer and easier for the reader to follow the discussion if the panel or the section of the figure that is being discussed is regularly referred to in the text.

e.g. for Figure 2:

- page 8, line 204: 'Dividing BG periods into FT_{BG} and BLI_{BG}…' Please refer to panel c).
- Page 8, line 216: '…is apparent in April for the total particle concentration.' Please refer to panel f).
- Page 8, line 217: '…total particle number concentrations remained at summer levels also in September' Please refer to panel d).

This comment applies to **all** figures but especially to figures 2, 5 and 6.

Additionally it would also help the reader if colours were referred to in the text when discussing the data, e.g. in Figure 5, page 14, line 322-323: '…shows a weak diurnal cycle, with a maximum of 629 std cm^{-3} at 13 h UTC and a …' Please add (black line in panel a)).

2. Pages 9-11 contains a detailed discussion of pollen as the potential INP source for the high INP concentrations measured in April. Whilst this discussion is interesting, I believe it could be reduced as the overall conclusion is that it is unlikely that pollen is responsible for the high INP concentrations in April (without further pollen measurements at JFJ). Why do you not comment on any other potential sources for the high INP concentration in April? Was any back trajectory analysis of air masses performed that could inform on potential INP sources? Were any samples collected (gas or filters) and analysed for chemical composition?

3. The introduction discusses trends in seasonal and diurnal variability in INP measurements in the literature from various studies using mostly offline analysis. It would be good to make links back to the findings of these studies during the results section for comparison i.e. similar seasonal dependences were observed.

4. The introduction states that knowledge of seasonal and diurnal variability will help to understand the sources and sinks of INPs. The conclusion only briefly mentions that the observed seasonal variation of INP concentrations could be linked to partitioning of particles in different seasons. As this appears to be the main motivation for the measurements, this discussion should be expanded in either the results or conclusion section. Can any further information on sources and sinks of INPs at JFJ be obtained from this study?

5. Comment: The only other study to have observed diurnal variation in INPs over a longer time period is mentioned on page 3, lines 65-69 (Wieder et al., 2021 in prep.). It would be useful to make further comparisons between this study (data in Figure 5) and that of Wieder et al., however, as the manuscript is in prep this is not possible.

Technical corrections

Page 7, line 196-7: the text states that 'June had the most active SDE of the investigated period with a duration of **116 h**' whereas in Figure 2 it appears that the SDE in June lasts for 123 hours. Please correct.

Page 16, line 352: the text states 'The large particle concentrations continue to decrease between **9-12 h UTC**…' which I think should be 21-24 h UTC from the data presented in Figure 6, panel f). Please correct.

Figure A3 is not mentioned in any part of the paper. Is this needed?

Typing errors/grammar:

Page 1, line 13: '…is with a factor of…' should be changed to 'is with**in** a factor of'.

Page 3, line 81: 'Furthermore, the remote location allows to study…' should be 'Furthermore, the remote location allows **the** study **of**…'

Page 4, line 98: unites should be units.

Page 6, line 181: 'There were two exceptionally dry period in the end…' should be 'There were two exceptionally dry period**s at** the end…'

Page 11, line 291: '…uncertainty can alter the frequency distributing…' should be '…uncertainty can alter the frequency distribut**ion**…'