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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Secondary new particle formation in Northern Finland Pallas site between the years 2000 and 2010" *by* E. Asmi et al.

Anonymous Referee #1

Received and published: 4 November 2011

General comments:

This manuscript presents an analysis of 10 years of new particle formation (NPF) measurements at the Finnish station of Pallas, a station situated within the Arctic circle. The analysed data is mainly particle size distributions measured with a DMPS (7-500 nm), but the authors also use diverse meteorological measurements and airmass trajectories as well as proxies to cover for missing measurements. They seek for seasonal trends, as well as long term trends in their dataset. Their analysis is complete and includes many parameters thought to be relevant to NPF. The authors also look into the consequences of these Polar NPF events on the climate by calculating the contribution of these events to the number of CCN at the station to be around 211 %. They observe small average formation rates at 7 nm (0.1-0.2 $cm^{-3}s^{-1}$) and average growth

rates ranging from 2 to 4 $\mathrm{nm\,h^{-1}}$. Most events happened on days where the airmass came from the Arctic zone where the air is clean. These features are also be seen in other airmass origins: NPF events generally happened on days with high radiation and visibility with low relative humidity.

I think that this manuscript is well written and the structure is clear, but the title could include a word mentioning that the NPF probability is studied, as it is an important part of the paper. The paper presents new and complete data about NPF and the variables that influence it. The authors are aware of important measurements that they are missing and work their way around it in a satisfying way, using proxies or other estimation methods. The conclusions are well supported by thorough explanations and descriptive figures. I think, however, that the figures could be modified to improve the manuscript (see comments below). Overall, I think this paper presents new and important data as well as analysis. Its subject and importance are well suited for ACP. I thus recommend that this paper be accepted provided a few minor modifications are made.

Specific comments

P. 25711, lines 21-22. The phrase “estimates of aerosol cloud forming potential and associated climate effects" should be revised.

P. 25711, line 25. One cannot solve a mechanism. Replace “unsolved" with poorly understood or any more appropriate word.

P. 25712, line 5. Add Vehkamäki et al. (2004) to the list and any other relevant paper from Northern Europe. A paper by Kristensson et al. (2008) also seems to be relevant.

Kristensson et al., Characterization of new particle formation events at a background site in Southern Sweden: relation to air mass history. Tellus 60B (2008), 3. DOI: 10.1111/j.1600-0889.2008.00345.x

P. 25712, lines 26-27. This is a missed opportunity to promote the Pallas dataset. I

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would also like to see an explanation of the type of environment and why Pallas is different from other stations where long term datasets exist also in Northern Europe (e.g. Hyytiälä).

P. 25713, line 6. The measurements, plural.

P. 25715, line 1. Is there any particular reason why the weight decreased from 1 to 0.0769 during the 120 h? Is it common to do so? If so add a reference.

P. 25715, line 15. Which stations are included in the “southern Nordic stations" is not clear.

P. 25715, lines 22-23. A rephrasing like “highest value ($> 0.5\,\mathrm{cm}^{-3}\mathrm{s}^{-1}$) were" might help the reader and the word “months" at the end of the sentence should be removed, as well as the word “overall" in the next sentence.

P. 25715, lines 24-25. The word “undiscovered" may lead the readers to think that there must have been a seasonal trend but it was not discovered. Depending on what the authors mean, perhaps replacing undiscovered by “lack of" or mentioning that the trend was not observed. Nevertheless, The authors should mention why we expect to see a trend: previous studies or logical argument. The word “used" could also be removed.

P. 25716, 2nd paragraph. In Fig. 3, there are NPF events occurring during the polar night, so in these cases, an error on the growth rate does not explain that the event takes place before sunrise. Please acknowledge the presence of those events in the text.

P. 25717, line 11. “[...] along with the corresponding values for the NPF starting times trajectories". This should be rephrased, it is difficult to know if the authors are talking about the starting time of the NPF or the that of the trajectories and what is what.

P. 25722, lines 14-17: “Connection of NPF frequency with GR might suggest that in the lack of sufficient vapour concentrations events are both rare and weak (i.e. GR is low), and do not thereby inflict significant climatic effects." This is only for class I events. Is

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there any chance that class I events are biased in a way that class II events would perhaps yield more CCN?

P. 25723, line 22: typo: events “where" (not were) no new CCN

P. 25724, line 7: The authors could easily remove “part of the year".

P. 25724, line 26: through, not trough.

P. 25725, line 29: “defined"? Did the authors mean “found"?

P. 25726, line 2: “unsolved"? Did the authors mean “solved" or “resolved"?

P. 25726: Can the authors use this study to say something about what happens above the boundary layer in such environments?

References:

P. 25727, line 17. The paper can be found under the name Buenrostro Mazon, which seems to be the author’s last name.

P. 25728, line 25. The accent is missing on Kurtén.

Aalto P. is sometimes P. and sometimes P.P. Are these two different persons?

P. 25730, lines 31-32: Two names are missing letters.

P. 25731, line 21: It should be Prevot, A. S. H.

P. 25731, line 25: Dal Maso in two words.

P. 25731, line 32: O’Dowd (with an apostrophe)

P. 25732, line 2: O’Dowd, C., Monahan, C., (apostrophe, and first and last name inverted for the 2nd author)

P. 25732, line 5: Plass-Dülmer

P. 25732, line 29: atmospheric should not be plural

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P. 25733, line 8: Kivekäs does not have an initial.

P. 25733, line 27-28: From Merikanto to Salminen, the initials go with the wrong name.

Tables & Figures

Table 1. Caption: The GR units are missing their closing bracket.

Table 2. Caption: Please mention that the frequencies are percentages, either in the caption or the table itself.
Table: Even though this is against the ACP general guidelines, it may be easier for the reader to read the table if there were vertical lines in between the seasons. Table: I recommend that the authors add the number of cases in parentheses also for the "All" column. This way, the readers can calculate the number of days in summer where the air mass was of marine origin, for example.

Figure 2. I think it would be nicer to see the observed starting time of class I events as well, to allow comparison with the class II events' starting times.

Figure 5. The NPF-proxy is said to be divided by 1000 in the caption, yet we can see that numbers on the x-axis are between $0 - 5e10^4$. If so, why not divide by another 10000? Should there be units for the proxy?

Figure 9. Caption: Please precise that the lines are the CS for all days (event, non-event and undefined days).

Figure 10. The equation should be described explained. What is BE (I assume Biogenic Emissions)? Moreover, in Table 2, the authors use the limit of 70% of the time spent over a marine origin for the air mass. In the caption, we learn that for this figure, they use 50%. Why did the standard change between Table 2 and Figure 10?

Figure 11. I did not find very clear the meaning of the “trend" bars in this figure. Try to be clear about it in the caption. And please replace “replaiced" with “replaced".

Figure 12. Please explain how to interpret these boxes in the caption. What is the

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meaning of the red line, the boxes, and the whiskers?

Figure 13. Caption: Please insert “NPF start" and “NPF end" into quotation marks to increase the readability. Figure: Are the units of the y-axis okay? Also, I did not fully understand this figure. Please explain what each bar means in more detail in the caption. For example, the readers may wonder why NPF end is not the sum of NPF start and the CCN contribution of the NPF event.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 25709, 2011.

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Interactive Comment