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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Anthropogenic and forest fire pollution aerosol transported to the Arctic: observations from the POLARCAT-France spring campaign" *by* B. Quennehen et al.

Anonymous Referee #2

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This study presents airborne observations of aerosol properties in different air masses encountered over northern Scandinavia. European, Asian, Anthropogenic, and natural aerosol plumes are contrasted. The authors use model tools to try to explain observed differences in the aerosol characteristic.

There is yet a shortage of information about aerosol properties aloft and how these properties evolve during transport. As such there is always room for an observational study such as this. The strong section of this study is the relation between the model estimated "age" of the air and the observed properties. This has a great potential for exploring new, but also perhaps older data. Linking in-situ observations with numerical

models like this will be very useful. Weak points are speculations used to try to explain the data. Revisiting the same plume is not a Lagranian study, and the authors actually contradict themselves in the interpretation of the data.

Abstract contains a listing of observations, but no scientific punch line. No statement of what implications data might have or how the observations might be useful. Introduction P4543, L25- It is not clear if the authors describe the phenomenon Arctic Haze (that only occurs a certain time of the year) or sources of pollutants to the Arctic in general. In the latter case non-land emissions is of interest as well.

P4544, L5 True, but a broad distribution can make be effective in scavenging the smallest particles.

P4544, L15 Dilution would rather be mixing. The air that is used to "dilute" also has a characteristic aerosol.

Instrumentation P4546, L5- Which inlet was used, the backward facing inlet (estimated upper cut-off?), or the CVI as aerosol inlet? Are data from both inlets used, if so how might the results be affected by the different inlets (SPMPS, OPC)?

P4546, L15- How was the size distribution treated in the overlap region (with respect to size), or more precisely was the SMPS data dependent on the OPC size distribution for the inversion?

P4547, L19 . . .running average over 180 (units?). . .

Some PSAP instruments are very sensitive to rather fast variations in the relative humidity that is sometimes experiences in aircraft measurements (in and out of clouds or vertical stratification etc). Was this observed, or any special precautions taken with respect to this issue? Bond et al., 1999 is give as reference, does that also mean that the PSAP data was corrected for light scattering aerosols?

P4548, L8 What is really meant by "function" here? I suspect that ON/OFF was decided on while making the measurements given current ambient conditions, or was this a post

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flight selection routine?

P4548, L21 How was this random procedure performed?

P4550, L15 The “typical polar background” distribution, how did you arrive to this? In what way is this typical, for this time of year, at this altitude, or this latitude?

P4550, L22 “This evolution is explained. . .” Is not supported in anyway at this part of the document and should be removed. With diurnal variability, a semi-Lagranian approach such as this would at least have to compare distribution at equivalent times the different days.

P4551, L8- In what way is Aitken and Accumulation mode defined in this study? Simple estimates based on the data given do not support the statement that coagulation is a key player for the reduction of accumulation mode particles. The 11th April have fewer but larger particles, which show a tendency of nearly 20 % more volume presumably acquired over the last 2 days. The reduction in number density is about 400 particles per cc. Perhaps 25% of that reduction can be explained by coagulation (assuming a coagulation constant of 1e-9 1/s). In Figure 3 around 0930, there is a feature which I would interpret as cloud processed air. If the authors disagree (based on the statement that no clouds occurred during the transport), I suggest adding some comment in the paper with respect to this feature in the data.

P4551, L20- Did you consider that particles heated, may end up just below the 20 nm detection limit?

P4552, L13- The conclusion that the plume was sampled at different conditions and that dilution is an important process for the interpretation of these data, feels as a contradiction to several other statements in this manuscript.

P4552, L20- The speculative statement about gravitational settling is one of several in this manuscript that is ill founded. The terminal velocity of an accumulation mode particle (assuming BC is mainly associated with this mode) is on the order 1 micrometer

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per second.

P4553, L15- I'm a little confused with the numbers in the text and the references to figure 8 and table 2 (and Table 1?). But more interesting is that I find the coagulation calculation results surprising. First a large drop in simulated accumulation mode number density, which is not captured in the observations. Then the opposite occurs for the following day. As stated by the authors on the previous page, sampling is done in the plume with different characteristics (not Lagranian) so this type of exercise have limited use. My impression from the simulated coagulation is that the mass is not conserved and that some dilution must be assumed.

P4556, L17 "These assumptions. . .." I don't follow this sentence.

P4557, L1 The hypothesis listed needs more explanation. The bottom line is to suggest reasons for why there are more Aitken mode particles in the European Plume vs the Asian plume.

1) This implies that there were a lot of Aitken mode particles in the Asian plume, but they grew to become accumulation mode particles in 5 days. Asian particles are larger, but they are also fewer. Would a case with a strong surplus of condensable vapors not also make more particles? 2) More gives less? It needs rather exotic size distribution to arrive at less by starting with more, through coagulation. 3) Plausible, as a large condensational sink would suppress secondary nucleation. 4) What is meant with large scale here? Time, space, number of particles?

P4557, L17 "Concentrated" As you are to discuss chemistry, this word may be ambiguous in this context.

P4558, L1-L25 Perhaps this section can be shortened to highlight some particular aspects, but refer to tables for all the numbers.

Conclusions This section must be split in one summary and one conclusions section with perhaps a couple of bullet points. I'm not convinced about the interpretation with

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respect to coagulation vs condensation.

Figure 2 The small numbers in the figures are hard to see. I suggest replace with fewer but larger or only keep the ones with arrows.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 4541, 2012.