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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Arctic smoke – aerosol characteristics during a record air pollution event in the European Arctic and its radiative impact" *by* R. Treffeisen et al.

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Specific comments Title: I would like suggest a small change; the suggested form is Arctic aerosol characteristics during a record smoke pollution event in the European Arctic and its radiative impact Yes, we can follow the referee here and did change the title as the suggestion is more specific.

Abstract, p 2: add "number": The aerosol number size distribution was characterized as having an accumulation mode centered at 165-185 nm. Yes, we add number.

p 3 and afterwards: it is first said that smoke is from peatland fires, but later mostly it is used the term agricultural fires. Please, be more specific concerning what is burning. We tried to be more specific here.

p 4 and afterwards throughout the text: When the authors are discussing about the mixture state of the aerosol, they should somehow take into account the fact that soot is primary and organic carbon is a mixture of primary and secondary particles; thus, for example in Aitken size range there is most likely minor amount of soot compared with organic carbon. - Although it is hard to believe that this is really the case. The detailed mixture is not known and any attempt to make a calculation based on some size dependent mixing would have to be based on further assumptions. We are convinced that for the objectives of the paper this would not improve anything other then some extra results in between the extremes that we choose to use for our calculations. As we already mention in the text The reality is somewhere in-between these two extremes.

(p. 18), ąÈsoot fraction is best described as an external mixture, p 20: soot is evenly distributed over the entire size spectra This is a simplification that is necessary to reduce the degrees of freedom in the study. This should be understood as following: In the case of external mixture we assume two parallel size distributions. The soot aerosol merely represents a fraction of the total number of aerosols. In the case of internal mixture, the soot fraction is equally large in all the bins. To avoid confusion we have re-written line 22-23, page 2298 as below: We further also assume that the soot is evenly distributed over the entire size spectra.Is rewritten as In the case of internal mixture, we further also assume that the soot is evenly distributed over the entire size spectra. Besides direct emissions, and perhaps through new particle formation considering the smallest particles, all processes in the atmosphere strive to make the aerosol more internally mixed. This includes condensation, coagulation, and liquid chemistry. Given the few sources in the Arctic it is basic understanding that the atmospheric aerosol will gradually change towards a more internal mixture. This is particularly true for the optically active size range.

p 6, chapter 3 first para: what does the following sentence mean: There was no evidence of dry or wet deposition, some dry deposition happens even in the accumulation mode size range; please, clarify that. The sentence ąÈThere was no evidence of dry

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or wet deposition along the path and no precipitation occurred is changed to: Along the path no precipitation occurred and therefore we conclude that there was no wet deposition.

p 11, second para: it may be for reader hard to understand the low DMPS/CPC ratio if you don't explain that the difference is because nucleation event particles are too small to be detected with this DMPS configuration. Please, clarify this paragraph. In order to clear this we added here: deally the integrated number density based on the size distribution should be equal to or less than that observed by the CPC. This comes from the cut-off characteristics of the CPCąÇs used and the size range used for the DMPS system. In the absence of small particles (ca 20 nm) the ratio should be very close to one. With an increasing number density of particles around the cut-off of the CPC (10 nm), this ratio will decrease as the DMPS system will not detect these particles with the same efficiency.

p 13, Absorption measurements: This is a bit confusing, because the authors are speaking about Particle Soot Absorption Photometer, which is commercially available (Radiance Research), and according to my knowledge has much lower uncertainty than mentioned here. I suggest making changes and clarifications according to this fact. We rephrased the sentence and hope this is clear now.

Chemical measurements, line 5: replace The instrument setup with The sampling setupąÉ, because it may refer otherwise to the thermo-optical method. The major concern in this chapter is the positive artifact (collection of organic vapours by the filter). The authors should explain how they manage this issue: how this may affect the results: OC concentrations and contribution of watersoluble OC. Also I would like to recommend to be more careful when speaking about compounds which may be either in the smoke or come from sea salt (nss-sulfate, nss-K, nss-Ca). Yes, it is changed now. We add to be more specific the following sentences. Blank filters stored with the ambient samples are used to subtract a baseline. In the case of the most polluted week the OC baseline represented 2.5 % of the amount analyzed on the ambient sam-

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ple, whereas the EC baseline represented less than 1.5%. In the case of the cleanest week the OC baseline represented almost 60% of the amount analyzed on the ambient sample, whereas the EC baseline represented less than 15%.

Technical corrections are changed. p 4 line 2: should be ąÈone third p 15 second para: should be linear regressionąÉ and ąÈ1 ęÌmąÉ

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 2275, 2007.