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Comment

Interactive comment on “Aerosol particle number size distributions and particulate light absorption at the ZOTTO tall tower (Siberia), 2006–2009” by J. Heintzenberg et al.

Anonymous Referee #1

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General comments: This paper presents a unique three-year dataset from aerosol measurements in Siberia, concentrating on the intra-annual variations of particle modal characteristics and particle sources, thereby forming a nice continuation for the article by Heintzenberg et al. 2008. The impressive experimental setup and successful measurements in extreme conditions of Siberia receive my compliments. The paper manages to depict a clear picture of the general annual features of Siberian aerosols, although the source analysis remains slightly facile, and even partially confused. The paper is in scope with the ACP and I recommend it being published after the authors have addressed my detailed points given below.

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Specific comments:

p. 1155 line 3: Why the authors only mention aerosol formation observed “over other boreal forests”? There are references reporting these observations also from Siberia. Generally, the introduction discusses very little on the previous observations made in Siberia.

Could the authors add to section 2: What was the upper size-cut in DMPS and PSAP measurements? What was(were) the CO sampling height(s)?

p. 1162 line 3: Is May already a summer month in Siberia? Any reference to meteorological data?

Lines 8-9 (and in conclusions): This is most probably true but natural (biogenic) aerosol sources might as well explain a part of the higher concentrations. Which types of sites are referred with “pristine”?

Lines 12-13: The sentence “This suggests that. . .” is a very general statement and I’m not sure what its meaning is.

Line 14: It might be relevant to mention that the aerosol volume here includes only the volume of smaller than 835 nm particles. While it’s well known that boreal forests are an important source of particles, also in mass-wise (e.g. Tunved et al., 2006; Koutsenogii et al., 1997), the DMPS-derived volume might differ from the total aerosol volume significantly, especially in summer.

p. 1163 line 5: What here means “evens out”?

line 14: Is the measured aerosol particle diameter range the same both for the absorption coefficient and for the volume?

p. 1165 line 11: I don’t see a clear late winter maximum in mode 3.

p. 1166 line 22-23: Were the trajectories, computed for the different heights, generally consistent with each others?

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p. 1170: When discussing the clusters authors might (whenever possible) refer to the air mass types instead of referring to the cluster numbers (which seem to be in arbitrary order, devoid of any information on the air mass origin or type).

Line 20: The particle mass concentrations are presented here for the first time. How these were derived?

p. 1171 lines 4-7: This is confusing to me. I don't find real proofs for claiming that biomass burning and new particle formation do not greatly influence the mean concentrations, even though their effect is undetectable in back-trajectory analysis. First of all, what then influenced the concentrations, anthropogenic sources? Second of all, I think these issues should be inspected more carefully by separate papers (as the authors have promised to do in conclusions) using the available modelling and satellite tools. On the other hand, if the purpose of these sentences is to say that the concentrations remained relatively low at all clusters (except for those two anthropogenically influenced from south) it seems slightly contradictory to: 1) first say that the mean concentrations were higher than those at truly pristine sites indicating anthropogenic influences, and 2) then to say that biomass burning or particle formation didn't increase the mean concentrations because they were so low. Also in sections 3.1.1 and 3.1.2 forest fires and particle formation are suggested to explain many of the observed seasonal characteristics of concentrations and modal parameters. In the end, I find it difficult to figure out what the authors suggest the relative contribution of different sources (anthropogenic vs. natural) is, even though there is a considerable discussion on the possible sources in this paper.

In addition, I miss some more discussion on the observed similarities and/or differences between the results of this study and those reporting previous findings from Siberia (which though are not so many). At least the findings of those articles cited (Paris et al., Koutsenogii et al., Vartiainen et al., Kozlov et al.) could be touched. Now comparison is made only with number concentrations found in Vartiainen et al.

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Comments on Tables and Figures:

Table 2: Average total concentrations here (between hours 14 and 20) are much lower than those medians given in Table 1. Is this truly explained by the diurnal variation? Could the authors comment/present how pronounced the observed diurnal variation was? The boundary layer diurnal evolution and structure are broadly discussed in the paper so it might also be convenient to discuss a bit on its effects on the observed concentrations in different seasons (and heights).

Fig 3: Instead of “sap” I would use “sigma_ap” also in axis and figure legend. What was the diameter range for volume and absorption?

Fig 4: Same as for Fig. 3, I might use “sigma_ap” instead of “sap”.

Fig 5: I don't understand how the probability lines can be continuous?

Figs 8 and 9: It's difficult to separate between some of the darkest colours. The numbering should follow some logic, e.g. numbers from one to ten could follow from unstable to stable profile, respectively. This would also help in reading the text.

In addition, for month axis (Figs. 2-4, 7) a scale from 1 to 13 would be clearer to me.

Some minor technical corrections I picked up:

p. 1154 line 14: considerably

p. 1156 line 3: The scientific leaders of the ZOTTO facility are. . . , or rephrase and name only one leader .. together with ..

p. 1157 line 2: Check the given diameter range (12-835 nm). In next page, a bin range from 15 to 835 nm is mentioned.

p. 1162 line 14: “in summer” is repeated

line 15: than

p. 1164 line 18: four (?) summer months

line 21: “in summer” repeated

lines 22-24: a bit complex sentence, consider rephrasing

p. 1165 line 1: considerably

p. 1166 line 8: In the presence..

p. 1167 line 17: could the cluster number “k” be marked with a different symbol to separate between it and the distance factor k_i

p. 1170 line 12: I assume this should be “Figure 10”, which is missing

p. 1171 line 10: “ZOTTO... exhibits only a limited intensity of aerosol sources on its own.” Could this be simplified?

p. 1172 line 10: considerably

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