Review on “Seasonal cycle and source analyses of aerosol optical properties in a semiurban environment at Puijo station in Eastern Finland” by A. Leskinen

The authors wish to thank the Anonymous Referee #2 for her/his valuable comments.

General comments:

The authors give an overview and statistical analysis of in-situ measured optical properties at Puijo, Finland. Optical properties were related to local sources of pollution and to long range transport using trajectory analysis. The measurement site at Pujio seems to be a good place for such a study.

At some points it is difficult to follow the discussion and the conclusions of the authors. E.g., it is hard to follow the discussion on the source analyses without having a map. The reviewer thinks, that the authors should show a map with the location of the measurement sites, the surroundings, and the sectors for aerosol classification. A map should be part of this manuscript, although it is given in the cited literature (Leskinen et al., 2009).

We added a map as Figure 1.

The case study on cloud effects on aerosol optical properties is interesting. The question arises, why only two of in total 260 cloud events were investigated. It seems that this part of the study is in an early stage.

In this paper only two cloud events were investigated as a case study. The analysis of all cloud events does not fit into this paper, and a separate paper is under preparation. We restructured the Section 3.6 so that this will be clearer to the reader.

Specific comments:

Page 4720, lines 20-23: It should be noted that this results is based on a case study of only two cloud events.

We added this information into the text.

Page 4720, lines 23 to 27: The abstract is not the right place for an outlook for further investigations.

We deleted the sentences referring to future work.

Page 4721 line 12-13: The reference Althausen et al. (2009) is a description of the PollyXT instrument; which is not used in the present study. The authors should give a reference with a more general overview on the retrieval of optical properties from LIDAR.

We changed the Althausen et al. reference to Klett (1981) and Ansmann et al. (1990).

Page 4721 lines 23-26: The authors should be careful, since he value of the scattering Angström exponent also depends on the refractive index. For example, when absorption increases, the scattering Angström exponent is not a good measure of size. (see Bond et al. ,2009, page 869, section “2. The correction may. . .”)

We added this notification with the citation to Bond et al. (2009) to the introduction.

Page 4723 section instrumentation: The authors should give a discussion on uncertainties and detection limits of MAAP and nephelometer. Values for instrumental uncertainties are used later in the manuscript (page 4732).

We included the relative uncertainties to the instrumentation section, and the calculation for the relative uncertainty of SSA in the data processing section.

Page 4724 line 21. In Mueller et al. (2011) the wavelength of MAAP was determined to be 637 nm. The calibration of MAAP was referenced (c.f. Petzold et al 2004) to a wavelength of 670 nm. Therefore in Müller et al., section 4.2 a further correction factor of 1.05 was suggested when reporting absorption coefficients at the true wavelength of 637 nm.

We corrected the MAAP data according to Müller et al (2011).

Page 4726 lines 5-6: The correction given by Anderson and Ogren (1998) is often misunderstood. The choice between the two sets of corrections (no-cut and submicrometer cut) does not depend on the inlet configuration. If the aerosol mass is prevailing in the fine mode and a PM10 inlet is used, then the submicrometer correction should be used. In Fig. 5 in Mueller et al. (2011) a plot with correction factors for both corrections versus the Angstroem exponent is shwon. That plot indicates that the Angström exponent can be used to decide which set of corrections is the proper one.

Also Referee #1 commented this and pointed out that the choice between the two correction sets does not depend on the inlet configuration but on the size distribution. With the TSI3563 one can determine the Ångström exponent and use that for determining the best possible size-dependent correction factor. Müller et al (2009) show that the sub-micrometer correction set gives more accurate results than the no-cut correction set. Therefore, we decided to use the sub-micrometer correction set and the correction factors of the form C = a + bÅ, where Å is the Ångström exponent and the constants a and b have been defined by Anderson and Ogren for all the data.

Page 4726 line 21: Why the negative Angström exponents are ruled out?

We decided to include all values to the analysis.

Page 4726 line 26: What is the reason for using the Angström exponent calculated from wavelengths 700 and 450 nm and not from wavelengths 700 and 550 nm?

We recalculated the results using the Ångström exponent calculated from wavelengths of 700 and 550 nm.

Page 4728: Is the classification according to trajectories taken from Leskinen et al. (2009). If yes, then it should be stated.

Yes. We added the reference to Leskinen et al. (2009) into the text.

Page 4730 line 10: ". . .of 0.13±14 at 550." without brackets

Corrected.

Page 4730 lines 25-28: Can the authors give values for the period with forest fires. Is the scattering significantly higher compared to periods without forest fires?

We included the deeper analysis carried out by Portin et al. (2012), which shows that the daily average values of both scattering and absorption during the smoke episodes increased to 23.5-fold and 12.5-fold, respectively. We also extracted the maximum hourly averages during the episodes and included them into the text.

Page 4731 line1 11-12: What does it mean ‘similar effect’. You are comparing intensive (Angström) and extensive (sca. and abs. coefficients) properties. I would expect a higher scattering Angström exponent and lower scattering coefficients.

We could not observe a decrease in the scattering coefficient but only in the scattering Ångström exponent. We deleted the unclear sentence.

Page 4734 lines 4-7: “A similar behaviour. . ..” is misleading. The trajectory distributions for sectors 0-45, 45-155, and 155-215 are very different from the northwesterly sector (245-360).

We rewrote the section in order to clarify it.

Page 4734 line 10-13: I can not follow that conclusion. The trajectory distribution for sector 0-45 is “distributed more evenly” compared to other sectors, but the influence from Artic/Kola air masses is still very high.

We rewrote the section in order to clarify it.

Page 4734 line 18: typing error “..low-level. . .” ?

Corrected.

Page 4734 lines 20-21: A statistical analysis of a larger number of cloud events would be interesting. Why are not more events discussed?

In this paper only two cloud events were investigated as a case study. The analysis of all cloud events will be done in a separate paper, which is under preparation.

Page 4735 line 7: The authors should give values. How large are the differences?

We added the values from Berkowitz et al. (2011), who observed a drop in SSA from ~1 to 0.8 in a foggy situation. This means a 20 % drop, which is similar to our finding at Puijo.

Figures 1 and 2: The authors should think about improving the presentation style of the figures. The use of up and down triangles for the extreme cases is perturbing.

We changed the means to medians and left out the minima and maxima (for other than temperature) in order to make the Figures more readable. We renumbered the Figures to Fig. 2 and 3.

Figure 4: unit for scattering coefficient is missing

We added the unit for scattering coefficient. We renumbered the Figure to Fig. 5.

Figure 7a: unit for absorption coefficient is missing

We added the unit for absorption coefficient. We renumbered the Figure to Fig. 8a.