

***Interactive comment on* “Seasonal cycle, size dependencies, and source analyses of aerosol optical properties at the SMEAR II measurement station in Hyytiälä, Finland” by A. Virkkula et al.**

Anonymous Referee #1

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This is an extensive and high quality data set that is of interest and value to the atmospheric sciences community.

Abstract and Page 29999. Spell out acronyms, eg., GAW, SMEAR, CCN. Consider Light Absorbing Carbon as a better term for BC (Bergstrom and Bond, 2006).

P. 30001. Was there an annual cycle in the nephelometer RH? RH greater in Summer?

P. 30002. Was the WCCAP a field audit? Spell out EUSAAR acronym.

Given the number-size distribution data from the site, a much more accurate illumination correction could be calculated than from the empirical algorithm by Anderson and

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Ogren which has large uncertainties when including the coarse particle mode.

P. 30004. ...good agreement..... Be more quantitative about comparison of SMEAR cf. standard SMPS.

P. 30006, line 17 A sentence of additional explanation about the forcing efficiency would help. Also the sentence is too long and not clear.

Mention specifically the other parameters, surface or cloud albedo, from Haywood and Shine.

Define “soot” in context of BC or LAC above and Aethalometer[®] data and use consistently throughout manuscript.

P. 30007. Even at 800% magnification it is hard to make sense of the time series and especially the “error” bars in figs 2 and 3 over the years and log scales. A running mean would be better. The “error” bars are really representative of atmospheric variability over a day and not instrumental or computational uncertainty and would be better termed as such.

P. 30008. “also” not needed. Now use GAW if acronym explained earlier Four other sites? I count five plus Beijing. ...treeless, barren hill.....

P. 30010, line 1. The topic was more mentioned above than discussed. “Now that...” Replace with Because. The possible explanation is weak speculation since diurnal variance is small cf. synoptic variance. Simply describe the observation.

30011. Symbol V not defined yet. ..results also as a good... ..results in a good... Provide a reference for the density value.

The high correlation of Charlson et al is really only for scattering and sub-um particulate [mass].

Given that V was determined from the size distributions the size range integration could be for PM1 or PM2.5 or PM10.

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Since the mass scattering efficiency is presented in the text, the figures could just as well be scattering vs. mass using the assumed density.

P. 30012. Given the values for SSA it would be reasonable to include at least a nominal value for complex refractive index even if the iterative more accurate value is not calculated.

P. 30013.roughly...? A more scientific term and description should be employed.

P. 30014. An assumption of Junge size distribution is not needed or appropriate unless the empirical relation between the Junge straight line concentration and Ångström exponent is used. The relative relationship between lower and higher Ångström still apply without assumptions to mono-modal or bimodal distributions and to your comparison of measured optical with number-size distribution derived parameters.

Line 12. Strictly speaking, you are retrievingaerosol optical properties....

P 30015, line 7. Lognormal.... Single mode? Some added explanation or discussion is needed regarding the single mode model and the bimodal observed size distributions in fig 10. Fig 10 series A implies that the coarse mode had little effect on the integral (over size) of scattering even though volume was much more bimodal. Is that the justification for a single mode model?

P. 30016 The relationships in Fig 14 and the discussions are not clear. First there is little other than a wide area in which the data pairs are located. Second, there is massive over plotting of points such that possible relationships are hard to determine. A set of frequency of occurrence contours rather than 10,000 point would be more informative. Are there localized patterns in the parameter space that are hidden by the solid black?

Were other diameter parameters besides CMD investigated? In figure 13 CMD has the weakest and least understandable relation.

P. 30017. Better phrasing would be: On 30 March the wind was from the SW..... It is not clear that comparing the forest canopy wind direction at 8.4 m with the 74 meter

wind says anything about the Eckman spiral or transport direction in the lowest levels of the boundary layer other than on the smallest of local scales or that the 20 degree shift is significant.

“...advected from Eastern Europe and was a relatively highly polluted air mass with...”

“...VMD...” Of the accumulation or coarse mode?

P. 30018. “...wind direction veered so that it was first from the west.....”

“The number-size distribution changed markedly. The accumulation mode.....”

“CMD decreased markedly and V decreased at the same time to”

“... so that asp decreased to -.6 to 0.9. “ What does this imply about the aerosol?

“On 31 March an obvious new particle event...” The new particles don’t affect the optical properties very much. Be clear that the optical properties change due to the change in air mass that accompanies a change in size distribution and concentration in the optical sub-range and this is concurrent with a new particle formation event.

“... decreased significantly..” Quantify the percent decrease.

P 30019. First paragraph has a lot of speculation and not much in the way of solid results and conclusions.

Page 30020. Line 5. Replace visible with obvious.

Line 14. Delete “Fortunately”. “The low winds represent.... “When the wind was greater than 1 m/s....

“In addition to the case studies the trajectory date was analysed statistically.”

Line 22. “The result....

Line 28. It is better to use 15 to 30% and to avoid the arithmetic minus sign.

Make it clear that this is a frequency of occurrence plot for the motion of trajectory

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air parcels across geographical regions. It is not a source relationship plot since not emission inventory is involved.

P. 30021 I don't think the discussion of trajectory vs. local winds is valid. Transport winds within the boundary layer are not necessarily the same as local surface winds. Are there wind profiles at the site to support this?

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 29997, 2010.

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