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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Long-term volatility measurements of submicron atmospheric aerosol in Hyytiälä, Finland" *by* S. A. K. Häkkinen et al.

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1) Regarding the calculation of black carbon fraction and non-black carbon MFR: if the BC measured by the aethalometer is soot, it is likely that these particles will be highly fractal. Thus, this may impact your calculation of non-BC MFR. Does the analysis change if you convert BC to volume and subtract this from the V(tot,VDMPS)? My guess is that the MFR(non-BC) is over-estimated as a result. This may also improve the summertime correlation in Figure 6. (Andrew May)

By analyzing the aerosol absorption data from aethalometer measured at the wavelength of 880 nm, we can assume that the BC measured is more or less all soot (Weingartner et al., 2003). We also agree that these soot particles are highly fractal which complicates the determination of black carbon aerosol mass fraction and

thus affects the calculations of MFR(non-BC), as you mentioned. That is why the BCF (black carbon fraction) and MFR(non-BC) are rough estimates of the ambient conditions. However, the assumption made in the calculation of BCF that all of the BC mass is in particles below 500 nm in diameter, gives the absolute maximum fraction of BC in these particles (see Sect. 3.2 in the manuscript for details). Due to this, we can argue that, if something, MFR(non-BC) is rather under- than overestimated.

2) Regarding the estimation of parameters of a single component organic aerosol which does not evaporate at 280 °C: why do you select such a low enthalpy of vaporization? The value you have selected will be more similar to that of a compound having saturation concentration on the order of 1e6 μg m-3 [Epstein et al., 2010], which is inconsistent with the saturation concentration you provide in the text. (Andrew May)

We agree that the vaporization enthalpy that we use in the exemplary calculation is far too low to represent a realistic single-component aerosol. However, previous studies have shown that multicomponent organic aerosols (such as probably present in our study) often show a much shallower temperature-dependence than can be represented with a single-component vaporization enthalpy and saturation vapour pressure (e.g. Riipinen et al., 2010). As we do not intend to fit a full volatility distribution of a multicomponent mixture to our data, but rather use the calculation to make the point that the material that is left after 280 °C is indeed of very low volatility, we chose to use this low vaporization enthalpy value that results rather in us overestimating the volatility than underestimating it. If we are invited to submit a revised version of the manuscript, we will make sure to explain this choice better.

3) Regarding the correlations of data: does BCF correlate with the PAH mass fraction? If so, this may allow for a rough source apportionment of a fraction of the ambient data, potentially complementing Figure 10. For example, if the BCF correlates with a high PAH mass fraction, this may be indicative of motor vehicle emissions while a BCF correlating with a low PAH mass fraction, this may indicate biomass burning [Schauer et al., 1996]. (Andrew May)

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Thank you for the comment, this is a good point. We observed that the BCF correlated positively with PAH mass fraction with a correlation coefficient of 0.64 and p-value of 0.03. Thus, this result might indeed suggest that motor vehicle emissions or other anthropogenic emissions, e.g. from residential heating, are the main source of BC in Hyytiälä area.

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