Improvements to harmonize different soot measurement techniques in air quality monitoring networks

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Measurements of soot particles in ambient air are depended on the definition of soot (Andreae and Gelencsér, 2006). While elemental carbon (EC) is analysed with thermal methods, black carbon (BC) is measured via optical methods by analysing the transmitted and reflected signal from a sample filter. So far, there exist intercomparison studies of BC and EC (e.g. Nordmann *et al.*, 2009) and between non-standardized measurement techniques for EC (Hitzenberger *et al.*, 2006). Up to now, intercomparison studies of BC and EC along different size fractions (PM_1, $PM_{2.5}$ and PM_{10}) for a longer time period (more than a year) are missing.

As a precaution to protect the human health and environment and in conjunction with new WHO air quality guidelines, BC and EC are simultaneously measured on certain hot spots within the Saxon air quality network (Dresden-Nord and Dresden-Winckelmannstr.). However, in the European air quality guideline 2008/50/EG neither a target value nor a limit value for EC or BC is included. Within the cross-border EU-project UltraSchwarz, BC is continuously measured and EC is measured every 6th day in Annaberg-Buchholz (Saxony; D) and Ústí nad Labem (Usti region, CZ). For consistency, BC is measured with a MAAP 5012 (Thermo Inc., Waltham, MA, USA) in all named sites downstream of a PM_1 - inlet and a membrane dryer in between. The membrane dryer guarantees that no measurement artefacts of BC on the deposited filter occur due to enhanced aerosol humidity. The relative humidity of the aerosol is monitored continuously and BC values with RH > 40% were disregarded. Sampling of EC occurs on quartz microfiber filters QFH 150 (Albet-Hahnemuehle, Dassel, D) downstream of a $PM_{2.5}$ - inlet for Annaberg-Buchholz and Ústí n. L. and a PM_1 - inlet for Dresden-Nord and Dresden-Winckelmannstr., respectively. EC is characterized by guideline VDI 2465 Part 1 using a carbon analyser (Ströhlein, Cuolomat 702).

Figure 1 shows a comparative measurement of BC (PM_1 – inlet) and EC (PM_1, $PM_{2.5}$ – inlet) at one site. Interestingly, both EC values do not differ significantly. Former measurements revealed that the EC mass fraction from traffic emissions is much smaller than $PM_{2.5}$, while the EC mass fraction originating from tire abrasion is larger than $PM_{2.5}$.

Figure 2 shows an intercomparison of BC and EC for all sites, partially with a different classification (ub = urban background, rs = roadside). All sites expect for Dresden-Winckelmannstr. show significant relation ($R^2 > 0.9$). A reason for the weak correlation for Dresden-Winckelmannstr. could be the less polluted season in summer 2012 with BC and EC values < 2µg/m^3 and a low daily variation. The measurement shall be repeated in the more polluted season.

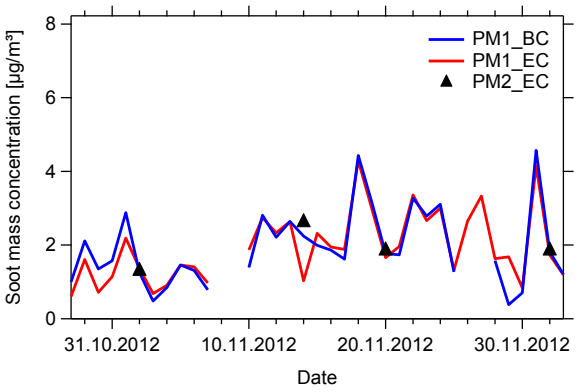

Figure 1: BC and EC time series for different size fractions for the site Annaberg-Buchholz.

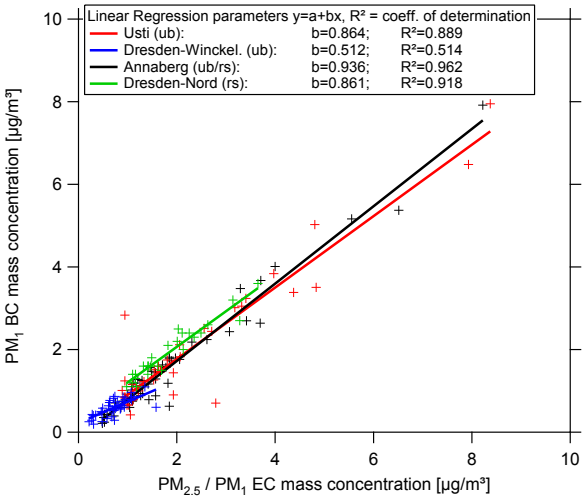

Figure 2: Intercomparison of BC and EC for different sites and classification (data from 1.1.2012 – 31.1.2013). For reasons of clarity the error bars were disregarded.

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