Contribution of biomass burning to fine aerosol in urban, suburban and regional background atmospheric environments over 1 year

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Keywords: levoglucosan, organic carbon, elemental carbon, molecular marker method, source apportionment.
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Methods

To study the importance, environmental and health effects of biomass burning (BB) in the Carpathian Basin, we collected daily $PM_{2.5}$ size-fraction aerosol samples by identical high-volume samplers on quartz fibre filters in parallel in city centre, suburban area and regional background of Budapest for 2 weeks (except for the city centre, where it was 1 week) in each season over 1 year. The samples were analysed by gravimetry for particulate mass, by TOT carbon analyser for elemental carbon (EC) and organic carbon (OC), by GC-MS for derivatised levoglucosan (LVG), mannosan (MAN) and galactosan (GAN), and by atomic absorption spectrometry with electrothermal atomization for K (Blumberger *et al.*, 2019). Corresponding basic meteorological data (air temperature *T*, relative humidity RH and wind speed WS) and atmospheric concentrations of criteria air pollutants (SO_2, NO, NO_x, CO, O_3 and PM_{10} mass) were obtained from the Hungarian Meteorological Service and measurement stations of the National Air Quality Network, respectively.

Results and conclusions

Median atmospheric concentrations in the various environments and seasons are summarised in Table 1. The data show considerable variability in space and time, and reveal important tendencies. Elemental carbon made up 1–3% of the $PM_{2.5}$ mass, while the OC contributed by ca. 30% to it. The EC concentration and contribution showed a growing tendency from the rural background through the suburban site to the city centre. This can be explained by the vehicular road traffic. Contribution of OC showed no significant tendency for the environments and seasons. Contribution of BB to OC estimated as 5.59×LVG/OC reached 67%, 74% and 72% for the centre, suburb and region, respectively in winter, and decreased in the order of autumn, spring and summer down to 2–3%. As far as the different environments are concerned, the maximum BB contribution was reached at the suburban location in each season. It can be explained by the temporal and spatial occurrence and properties of BB. Since its contributions exhibit a maximum in winter, when most daily PM_{10} health limit exceedances occur, it offers a considerable potential for refining the air quality by improvements in technological specifications for various household appliances that burn biomass together with efficient training of their users.

The study is to be completed by radiocarbon analysis and apportionment of carbonaceous chemical species to fossil fuel combustion, biomass burning and biogenic emissions by a coupled radiocarbon-LVG marker method (Salma *et al.*, 2017).

Table 1. Median atmospheric concentration of $PM_{2.5}$ mass, EC, OC, LVG and K in city centre, suburban area and regional background of Budapest in different seasons.

Variable	Autumn	Winter	Spring	Summer
$PM_{2.5}$ mass (μg m^{-3})				
Centre	28	24	13.3	8.1
Suburb	25	27	9.7	11.7
Region	12.5	15.4	7.9	10.7
EC (μg m^{-3})				
Centre	1.00	0.77	0.79	0.37
Suburb	0.42	0.68	0.51	0.35
Region	0.41	0.36	0.20	0.12
OC (μg m^{-3})				
Centre	6.6	4.6	2.8	2.6
Suburb	4.0	5.4	2.4	2.7
Region	2.3	3.2	2.0	2.2
LVG (ng m^{-3})				
Centre	384	483	36	10.3
Suburb	436	706	40	12.4
Region	172	396	18.0	8.1
K (μg m^{-3})				
Centre	0.26	0.27	0.106	0.057
Suburb	0.22	0.25	0.097	0.075
Region	0.182	0.23	0.088	0.081

Financial support of National Research, Development and Innovation Office, Hungary (contract K116788) is appreciated. The authors thank J. D. Varga of the Eötvös University for her help in the sample preparation for the GC-MS analysis.

Blumberger, Z. I., Vasanits-Zsigrai, A., Farkas, G., Salma, I. (2019). *Atmos. Res.*, in print.

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