The contribution of biomass burning to PAH concentrations in Budapest in wintertime

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Polycyclic aromatic hydrocarbons (PAHs) are well-known environmental pollutants related to the incomplete burning of organic material. Due to their carcinogenic and mutagenic effect these compounds have been in the focus of environmental studies for a long time. PAHs have been found in the atmosphere (both in gas phase and aerosol particles), in surface water, sea water, sediment, soil, drinking water, food, etc. Energy production (power plants burning oil, coal or biomass), domestic heating, transport and some industrial processes are the main emission sources of atmospheric PAHs. After being emitted from burning processes these compounds condense primarily on soot particles in the submicron range. As a consequence the atmospheric residence time of PAHs can be as long as a week and thus the pollutants can be transported in the atmosphere from urban and rural sources to remote areas like e.g. the Antarctica.

In cities the concentration of PAHs can reach high values which damages health. In order to assess the health risk posed by PAHs it is necessary to know the contribution of different sources to their atmospheric concentration. However, the source strengths may vary in time following human activity at different periods of the day. This can be traced down only if the sampling frequency is high enough, i.e. the sampling time is comparable to people's daily rhythm.

In this study the concentration of 13 PAHs (3-6 ring compounds) was determined in urban PM10 samples and the correlation among concentrations, meteorological conditions and the dominant emission sources (transport and domestic heating) was investigated.

Results

Six-hour sampling was performed in the outskirts of Budapest on a continuous base from February 10 to March 11 in 2015. The 4 samples per day frequency made the tracking of the diurnal variation of a number of characteristics possible. On the other hand, the sampling campaign was long enough to study the effect of different meteorological situations on the PAH concentrations. Qualitative and quantitative analyses of PAHs were performed by HPLC with programmed fluorescence detection.

In Figure 1 the total concentration of PAHs in different periods of the day is shown for the whole sampling campaign. In the first ten days and the last 8 days of the campaign anticyclonic weather conditions dominated with low windspeed and without precipitation. These circumstances facilitated the accumulation of PAHs in the atmosphere leading to total concentrations above 200 ng m^{-3}. In the middle of the campaign (samples 46-80) wind and precipitation resulted in total concentrations below 50 ng m^{-3} most of the time. During most of the sampling campaign the highest concentrations were observed in the evening hours (17-23 h) while the lowest values in the early afternoon (11-17 h). This can be explained with the change of the mixing height within the day on one hand, and the variation of emission sources on the other hand. In the late afternoon and evening hours the emission from traffic and wood burning (domestic heating) is considerable and it happens concurrently with the decrease of mixing height.

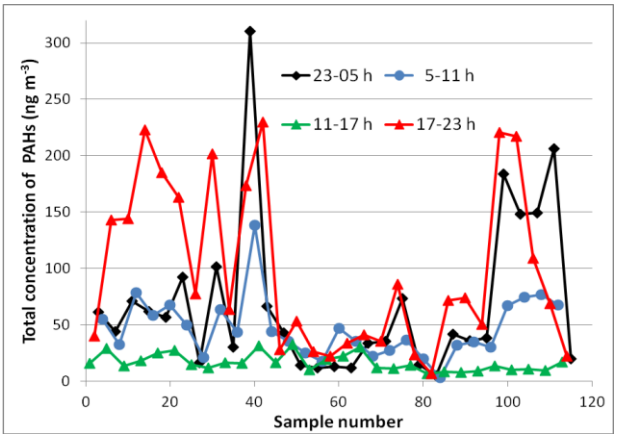

Figure 1. The total concentration of PAHs in different periods of the day during the sampling campaign.

In addition to the total PAH concentrations the variation in the concentration of individual PAHs and their contribution to the total concentration were also studied. Next, the share of PAHs in the total carbon content of the aerosol in different period of the day was examined, too. Finally, the sources of PAHs and carbonaceous aerosol were investigated by using 5 diagnostic pairs of PAHs as well as measuring levoglucosan (a tracer of biomass burning) concentrations in the samples. These results will be discussed in the presentation.

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