

SEASONAL VARIATION OF PAHS CONCENTRATION IN ROME METROPOLITAN AREA AND SOURCE ATTRIBUTION THROUGH DIAGNOSTIC RATIOS ANALYSIS

S. Finardi (1), A. Cecinato (2), C. Gariazzo (3), M. Gherardi (3), P. Romagnoli (2)

(1) ARIANET S.r.l., Milano, Italy; (2) CNR-IIA, Montelibretti (RM), Italy; (3) INAIL Research Center, Monteporzio Catone (RM), Italy

Presenting author email: s.finardi@aria-net.it

Summary

Atmospheric concentrations of polycyclic aromatic hydrocarbons (PAH) have been measured in different locations in Rome metropolitan area during EXPAH LIFE+ project (www.ispesl.it/expah) field campaigns. The large number of samples gathered from November 2011 to July 2012 allowed to quantify a seasonal variation of more than one order of magnitude for heavy PAH congeners concentration, with B[a]P varying between min/max values of 0.01-3.0 ng/m³ recorded during summer and winter months. The comparison of PAHs diagnostic ratios with emission profiles suggests the concurrent contribution of different sources on a yearly basis, with prevalence of traffic during the summer and heating emissions during the winter.

Introduction

The population exposure to PAHs in urbanised areas is of great concern for the possible health impact of these carcinogenic substances. The routinely available measurements performed to fulfil the EC Air Quality Directives requirements are limited to B[a]P and do not allow a clear insight of space and time variability of concentrations over the whole Rome conurbation. The extensive measurement campaigns realised by EXPAH project allowed to analyse the seasonal concentration variability, investigate the possible sources contribution and verify sources profiles included in emission inventories.

Data Analysis and Results

EXPAH field campaigns have been carried out from November 2011 to July 2012 in both indoor and outdoor environments. The monitoring involved 17 locations (nine houses, six schools and two offices), together with three stations of the urban air quality network. All outdoor measured PAH congeners show a large time variation spanning more than one order of magnitude from winter maximum to summer minimum values. Figure 1 shows B[a]P, B[b]F, B[k]F and IP average concentrations for each sampling period. The time variation of PAHs concentration is much larger than that of PM_{2.5} mass concentration of the corresponding samples indicating the possible contribution of different sources along the year. A large variation of concentrations is observed even for contiguous winter sampling periods, when B[a]P average concentrations ranges between 2-3 ng/m³ during polluted periods, and 0.5 ng/m³ during “clean” periods. The space variability of PAHs concentrations, evaluated by the ratio of the standard deviation to the mean for each sampling period, is larger during summer than in winter, with average values of 0.4 and 0.2 for B[a]P.

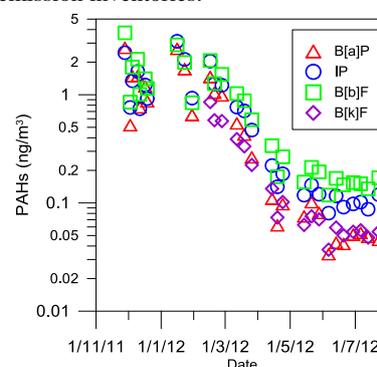
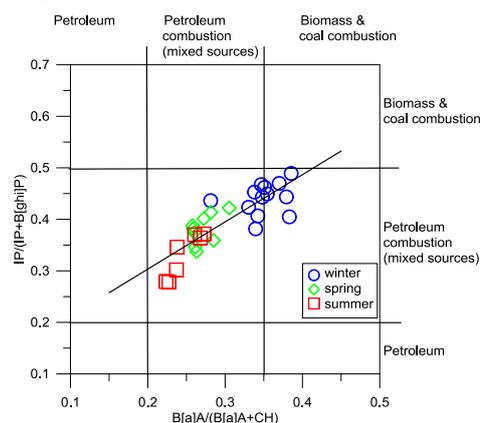


Fig. 1. PAHs average concentrations

The identification of specific sources footprint has been attempted by analysing the ratios of individual PAH concentrations with the approach indicated by Ravindra et al. (2008). In particular, we analysed the seasonal variation of B[a]P/B[ghi]P, IP/(IP+B[ghi]P), B[b]F/B[k]F, B[a]P/(B[a]P+CH) and B[a]A/(B[a]A+CH). All the diagnostic ratios show a continuous variation from winter to summer with values indicating the presence of multiple sources influencing the Rome area, with different relative contributions during the year. The sources contribution variation is synthesised in Figure 2 by the cross plot B[a]A/(B[a]A+CH) vs. IP/(IP+B[ghi]P), which indicates the relevance of biomass burning connected to house heating during winter and the prevailing contribution of petroleum combustion and road traffic during summer. The mentioned sources influence is confirmed by the comparison of diagnostic ratios with emission profiles measured during the latest years in Italy by CNR/IIA for mobile and industrial sources, and by some of the emission profiles available in literature (see e.g. Ravindra et al., 2008).



Conclusions

EXPAH field campaigns allowed to quantify PAHs concentration variability in Rome. The seasonal behavior of PAH diagnostic ratios permitted to identify different sources contributions better than long term average values, highlighting the influence of winter house heating and, in particular, of biomass burning in determining high values measured in wintertime.

Acknowledgement

The LIFE+ EU financial program is acknowledged for the provision of funding for EXPAH project (LIFE09 ENV/IT/082).

References

Ravindra K., Sokhi R.S., Van Grieken R., 2008. Atmospheric polycyclic aromatic hydrocarbons: Source attribution, emission factors and regulation. Atmos. Environ. 42, 2895-2921.