Urban and Suburban Intermodal Fraction of Atmospheric Aerosol in Winter 2014

Kozáková, Jana
2014

URBAN AND SUBURBAN INTERMODAL FRACTION OF ATMOSPHERIC AEROSOL IN WINTER 2014

Jana KOZÁKOVÁ[1, 2], Jan HOVORKA[1], Jaroslav SCHWARZ[2]

[1] Institute for Environmental Studies, Faculty of Science, Charles University in Prague
Benátská 2, 128 01, Praha 2, Czech Republic
[2] Laboratory of Aerosols Chemistry and Physics, Institutute of Chemical Process Fundamentals of the ASCR, v. v. i. Rozvojová 1/135, 165 02, Praha 6-Suchdol
kozakova@icpf.cas.cz

Keywords: Intermodal fraction, $PM_{2.5-1}$, Sioutas impactor

INTRODUCTION

Fine (PM_1) and coarse ($PM_{10-2.5}$) aerosols differ not only in size but also in the chemical composition, health effects, type of sources, and others. A dividing line between fine and coarse aerosol is not clearly defined. These fractions overlap in the aerodynamic particle size range 1-2.5 μm, also called the intermodal fraction. Sources of both coarse and fine aerosols contribute to the intermodal fraction to a different extent relating to different meteorological conditions and types of locations. According to several studies, the intermodal fraction highly correlated with coarse aerosol in dry areas during high wind speed episodes (Kegler et al., 2001, Claiborn et al., 2011). In contrast, other studies have shown higher or comparable correlation with fine aerosol (Geller et al., 2012, Jalava et al., 2006).

The aim of this study is to characterize the intermodal fraction in urban and suburban localities and estimate to what extent fine/coarse aerosol sources contribute to this fraction.

EXPERIMENTAL SETUP

The measuring campaign took place from 5.2.-7.3.2014 at an urban site (Ostrava Radvanice) and a suburban site (Plesná), Czech Republic. The urban site Radvanice is the residential area near a large industrial zone (southwest of the site) and traffic roads. The suburban site Plesná is the residential area situated on the northwestern outskirts of the Ostrava city. At both sites, we measured with various online and offline instruments. The results obtained daily using Personal Cascade Impactor Sampler (PCIS) are presented in this abstract.

RESULTS AND CONCLUSIONS

The results from PCIS showed that the intermodal fraction represented 3 - 26% of the total PM_{10} in both sites. In contrast, PM_1 represented 64 - 93% and $PM_{10-2.5}$ 3 - 29% of the total PM_{10}. The Table 1 summarizes the statistic characterization of 24 - hours concentrations from PCIS.

Table 1. The statistic characterization of 24 h - concentrations from PCIS.

	Radvanic			Plesná		
	PM_1	**$PM_{2.5-1}$**	**$PM_{10-2.5}$**	**PM_1**	**$PM_{2.5-1}$**	**$PM_{10-2.5}$**
Average (μg/m³)	40.4	3.5	5.1	31.9	2.9	2.4
Median (μg/m³)	38.5	3.0	4.1	27.7	2.7	2.1
Min (μg/m³)	14.3	1.7	2.2	9.1	0.7	0.6
Max (μg/m³)	89.6	10.8	12.2	61.1	7.2	11.3
Standard deviation	16.6	2.1	2.7	15.8	1.9	2.2

24 h – concentrations of all three fractions, daily average wind speed and prevailing wind direction during the whole campaign in Radvanice and Plesná is shown in the Figures 1 and 2.

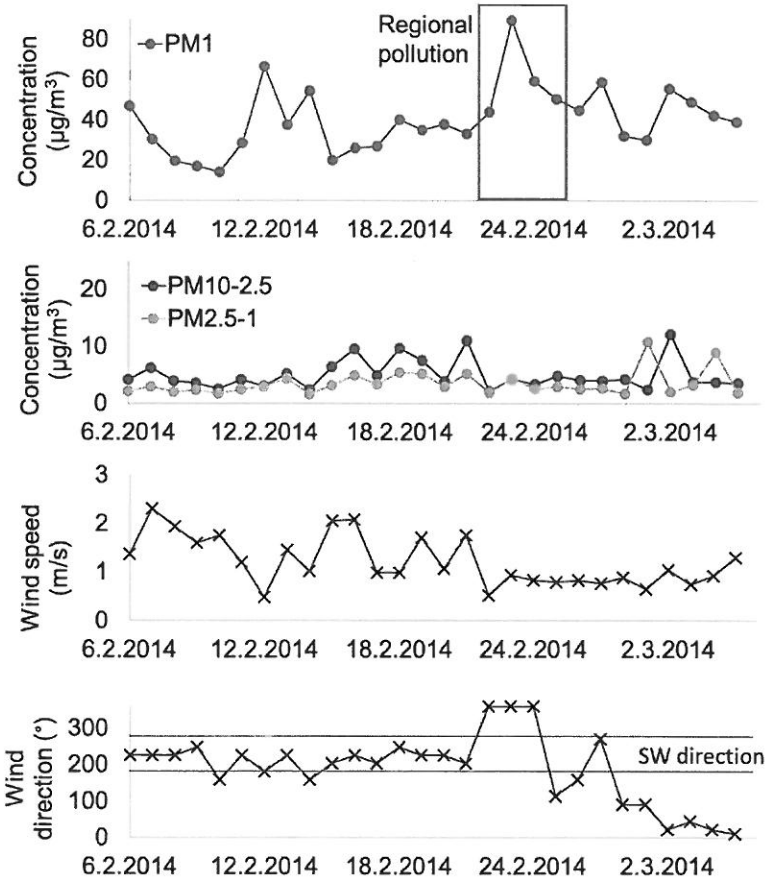

Figure 1. 24-h concentrations of PM_1, $PM_{2.5-1}$ and $PM_{10-2.5}$, daily average wind speed and prevailing wind direction in Radvanice during the whole measuring campaign.

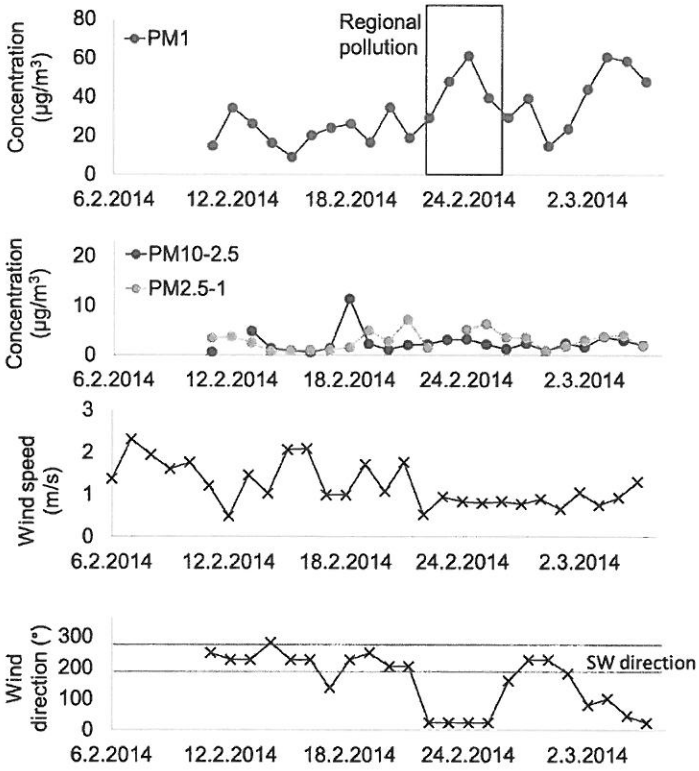

Figure 2. 24-h concentrations of PM_1, $PM_{2.5-1}$ and $PM_{10-2.5}$, daily average wind speed and prevailing wind direction in Plesná during the whole measuring campaign (wind speed data used from Radvanice).

Statistical dependence between the intermodal fraction and other monitored variables can be determined with Spearman correlation coefficients (Fig. 3.).

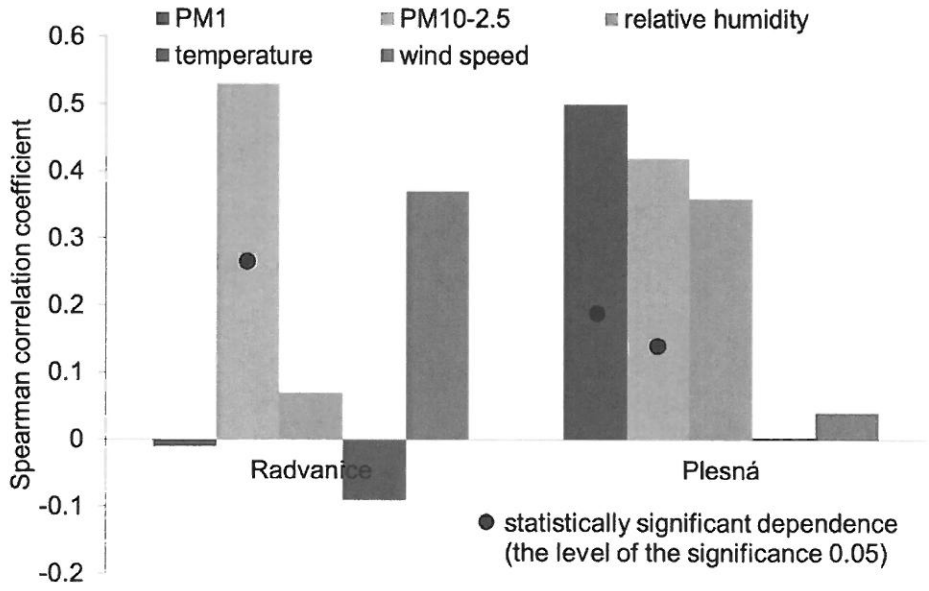

Figure 3. Spearman correlation coefficients between $PM_{2.5-1}$ and other monitored variables.

The higher average concentrations of all three fractions were observed in Radvanice how we expected due to the large industrial source. $PM_{2.5-1}$ was associated with the coarse fraction in Radvanice and with fine and coarse fractions in Plesná.

A certain positive association was observed between $PM_{2.5-1}$ and wind speed in Radvanice despite of the result of the test – not statistically significant dependence (p-value 0.06). During days with SW prevailing wind direction (from the industrial source) in Radvanice we observed higher wind speed (1.7 times) and lower PM_1 concentrations (1.6 times) than for days with other prevailing wind direction. It did not apply to the intermodal and coarse fraction (SW prevailing wind direction and higher wind speed – higher concentrations).

In-depth aerosol source identification of the intermodal fraction will be conducted with the help of ion chromatography (IC), inductively coupled plasma mass spectrometry (ICP-MS) and transmission electron microscopy (TEM) applied to aerosol samples.

ACKNOWLEDGEMENT

The project is supported by the Czech Grant Agency (P503/12/G147) and the Charles University Grant Agency (274213).

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