TRAFFIC INTENSITY AND AIR POLLUTION BEFORE AND DURING LOCKDOWN IN NOVI SAD, SERBIA

by

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The aim of the study was to analyse relationship between $PM_{2.5}$ and PM_{10} concentrations, traffic density and meteorological factors during the week with regular traffic regime and first week of COVID-19 lockdown in Novi Sad, Serbia. During the study period, which included working days and weekends, traffic emission contributions to PM were also determined. Obtained results have shown higher PM, pressure and emission contribution values, lower temperature, relative humidity values, and lower traffic counts for all vehicle categories during the COVID-19 week. A positive correlation was detected only during the first week, between $PM_{2.5}$ and passenger vehicles and lightweight trucks, as well as between PM_{10} and all categories of vehicles. Background $PM_{2.5}$ and PM_{10} concentrations were moderately correlated to total traffic during the first week as well. Very strong and moderate positive correlation was detected between $PM_{2.5}$ and PM_{10} concentrations and temperature during COVID-19 week. The PM concentrations increased during COVID-19 week, but total traffic decreased by 31% on workdays and 42% on weekends, proving the impact of lockdown measures on traffic regime and intensity. Since relationship between $PM_{2.5}$ and PM_{10} with different vehicle categories was confirmed only during first week, and PM and emission contribution concentrations were higher during COVID-19 week, a secondary emission source of PM was strongly indicated. Very strong and strong positive correlations of $PM_{2.5}$ and PM_{10} with temperature during COVID-19 week have confirmed lower temperature impact on PM concentrations and, consequently, increased impact of heating, as an emission source, due to lockdown measures and people staying at their homes.

Key words*: fine PM, coarse PM, traffic density, Covid-19 lockdown, meteorological parameters, emission contribution, correlation*

Introduction

Urban air pollution by fine ($PM_{2.5}$) and coarse (PM_{10}) particulate matter (PM) is one of the major and complex issues in the modern world [1]. Human exposure to airborne PM is

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linked to adverse health, including mortality and morbidity from respiratory and cardiovascular diseases [2]. In urban areas, road traffic is recognized as an important source of direct emission of PM into the atmosphere [3]. Special emphasis has been given on traffic-related pollution near roadways, where PM concentrations tend to be most severe [1]. Most of the road vehicles, such as passenger cars, trucks, and buses, can produce significant amounts of PM in urban areas [2]. The $PM_{2.5}$ are mainly emitted from the vehicle exhaust pipes, while road abrasion mainly gives rise to larger wear particles ($PM_{2.5-10}$). The PM emission sources from road traffic are also tire wear, brake wear, and vehicle-induced resuspension of road dust [4]. Particle matter air pollution in Novi Sad is often influenced, depending on the season, by individual boilers and furnaces, intensive traffic in urban areas, and activities in heating thermal power plants [5]. Air quality especially deteriorates during the heating season and unfavorable meteorological conditions such as temperature inversion, high air pressure, and low wind speeds. An immense impact on air quality across the world and a major reduction in traffic demands has been observed during the COVID-19 pandemic, producing noticeable declines in traffic delays, energy consumption, and emissions [6]. Many countries worldwide reported air pollution reduction due to the lockdown [7-9] with $PM_{2.5}$ and PM_{10} concentration reductions of up to 30% [10]. Similar studies have been conducted in Spain [11], Italy [12], India [13], and the USA [14]. All studies have confirmed that there was a significant reduction in air pollutants, and a significant improvement in air quality during lockdown due to COVID-19 [15].

During March 2020, the lockdown has been established in Novi Sad, Serbia, introducing a set of sudden restrictions and changes in people's habits, and consequently traffic volume and regime. In the period March 09-22, 2020, a research study was conducted with the intent to analyze the impact of lockdown measures on traffic and PM pollution in the Novi Sad. As the first step, we have collected the $PM_{2.5}$ and PM_{10}, meteorological parameters, and traffic data available from public services and institutions. The research period was focused on two specific sampling weeks and data were collected from a selected traffic location in Novi Sad with heterogeneous traffic flow.

The aim of the study was to analyze the relationship between PM fraction concentrations ($PM_{2.5}$ and PM_{10}) and traffic density, meteorological factors (temperature, T, pressure, P, relative humidity, RH), during working days and weekends, and traffic emission contributions to PM, during the week with regular traffic regime (W1) and the following week when COVID-19 lockdown began (W2).

Methodology

Study area

Novi Sad is the capital of Autonomous Province of Vojvodina and, as an urban-industrial agglomeration, with about 350000 inhabitants, fig. 1. The city experiences a regional climate from moderately continental to continental and is situated at about 80 m above the sea level [16]. Air quality in urban areas in Vojvodina is affected by several factors, most commonly coming in the form of combination of the following items: individual boilers and furnaces, intensive traffic in urban areas, low energy efficiency of plants in the energy sector and industry, diffuse pollution from agriculture and others.

In the city of Novi Sad, there are three main groups of monitoring stations: stations that belong to national networks running under Serbian Environmental Protection Agency (SEPA), stations in the regional network running under Provincial Secretariat for Urban Planning and Environmental Protection, while stations in the local monitoring networks were established by the City Administration for Environmental Protection:

- National Network, website http://www.amskv.sepa.gov.rs/pregledstanica.php.
- Novi Sad, Rumenačka, Lat/Long: 45.26263°, 19.81902°.
- Liman, Lat/Long: 45.23864°, 19.83570°.
- Regional Network, website http://www.amskv.sepa.gov.rs/pregledstanica.php.
- Novi Sad, Šangaj, Lat/Long: 45.27237°, 19.87333°.
- Local network, website https://environovisad.rs/vazduh.
- Novi Sad, Intersection of Rumenačka and Bulevar Jaše Tomića, type of station: urban/traffic, Lat/Long: 45.26348°, 19.81903°.
- Kać, Kralj Petar I, Lat/Long: 45.29980°, 19.93926°.
- Novi Sad, Sunčani kej 41, Lat/Long: 45.24000°, 19.85139°.
- Sremska Kamenica, Kamenički park 1-14 (Lat/Long: 45.22931°, 19.84898°)

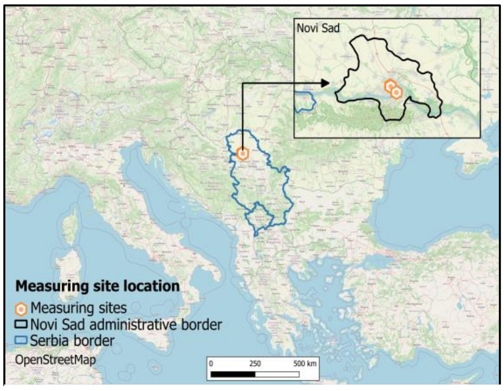

Figure 1. Location of measurement

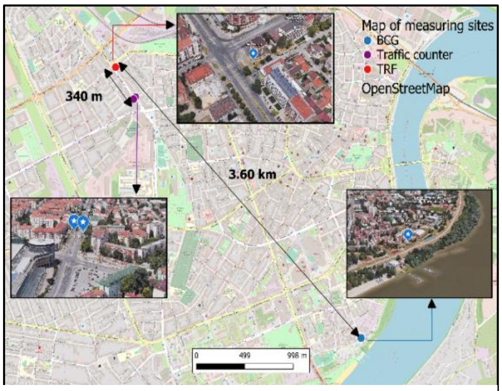

Figure 2. Map of measuring sites

Data description

All data sets used for our research were collected from public services. One of the air quality measuring stations established by the SEPA, which measures both PM fractions of interest, is placed in Rumenačka street (Lat/Long: 45.2627, 19.81916) and is set for assessing the influence of traffic in an urban area with residential/commercial characteristics [16]. Data on PM concentrations and meteorologic parameters were collected from the aforementioned SEPA station, denoted as TRF in further text since it is classified as a traffic location, fig. 2, red point. The PM concentration data at TRF were collected by the monitor GRIMM Aerosol EDM 180 [17] measuring device, regular kept in check by additional gravimetric measurements. Traffic count data were collected from two traffic counters under the jurisdiction of the Public Company *Urbanism* Novi Sad which are also placed in Rumenačka street (Lat/Long: 45.26019, 19.8217, and 45.26001, 19.82146), in the vicinity of SEPA station (distance of 340 m), fig. 2, purple point.

Data on $PM_{2.5}$ and PM_{10} concentrations on the urban background location for Novi Sad were collected from the measuring station situated at Lat/Long: 45.24, 19.85138, denoted as BCG in further text, since it is classified as a background location, fig. 2, blue point. The distance between TRF and BCG is 3.60 km. The background site BCG is placed in the vicinity of the Danube in Jirečekova street at a distance of 120 m from the river, with low traffic density, and is surrounded by residential buildings connected to the central heating system and with small parking.

Basic vehicle categorization types used for the research were, passenger cars (A1), vans (A2), lightweight trucks (B1), trucks (B2), and buses (C1).

Results and discussion

Particulate matter data

The PM concentration data at TRF had 1 hour resolution and were analyzed during both research weeks, on weekdays and weekends. Obtained data are averaged on 24 hour concentrations and results of their descriptive analysis during W1 and W2 on weekdays and weekends for $PM_{2.5}$ and PM_{10}, are presented in tabs. 1 and 2.

Table 1. The TRF $PM_{2.5}$ concentrations on weekdays (WD) and weekend days in W1/W2

TRF $PM_{2.5}$	WD_{W1}	$Saturday_{W1}$	$Sunday_{W1}$	WD_{W2}	$Saturday_{W2}$	$Sunday_{W2}$
Mean	28.0	12.3	11.5	38.1	24.8	10.0
MED	27.4	10.6	9.15	27.4	22.3	9.83
STD	15.5	5.53	4.43	22.3	30.8	1.47
Min	6.00	5.74	7.59	11.2	4.98	7.85
Max	70.8	24.6	20.1	90.6	92.0	14.3

Table 2. The TRF PM_{10} concentrations on weekdays (WD) and weekend days in W1/W2

TRF PM_{10}	WD_{W1}	$Saturday_{W1}$	$Sunday_{W1}$	WD_{W2}	$Saturday_{W2}$	$Sunday_{W2}$
Mean	54.8	24.1	16.4	72.1	63.3	16.0
MED	42.7	21.1	15.2	59.5	48.8	15.7
STD	35.8	11.9	4.89	46.9	45.3	3.57
Min	13.3	11.6	9.43	12.7	8.83	9.86
Max	188	57.6	24.7	336	168	23.7

During the week before the lockdown (W1), $PM_{2.5}$ concentrations were in the range from 6.00-70.8 μg/m^3 on weekdays, and in the range from 5.74-24.6 μg/m^3 on weekend. Concentrations of $PM_{2.5}$ during W2 were higher and ranged from 11.2-90.6 μg/m^3 on weekdays and 4.98-92.0 μg/m^3 during weekend. Concentrations of PM_{10} were lower during W1 for all days as well. The concentration range of PM_{10} on weekdays during the W1 was from 13.3-188 μg/m^3 and during weekend was from 9.43-57.6 μg/m^3. During the W2 concentrations ranged from 12.7-336 μg/m^3 on weekdays and between 8.83-168 μg/m^3 during weekend. Results are further averaged to six hour concentrations in order to examine concentration variations and differences during different parts of day. Average six hours concentration variations of $PM_{2.5}$ and PM_{10} (μg/m^3) during W1 and W2 are shown in fig 3. Before lockdown (W1), higher $PM_{2.5}$ concentrations were detected between 6-12 PM, during whole week. During W2, $PM_{2.5}$ concentrations were higher from 0-6 AM and from 6-12 PM on weekdays and Saturday, with the highest concentration of 48.6 μg/m^3 on weekdays and 85.3 μg/m^3 during weekend, respectively. The PM_{10} average concentrations tended towards increasing throughout four daily averaging periods during the W1. This pattern however did not repeat during lockdown (W2). Additionally, PM_{10} average concentrations were mostly higher compared to the week before, with the highest value of 125 μg/m^3 6-hour average on Saturday morning.

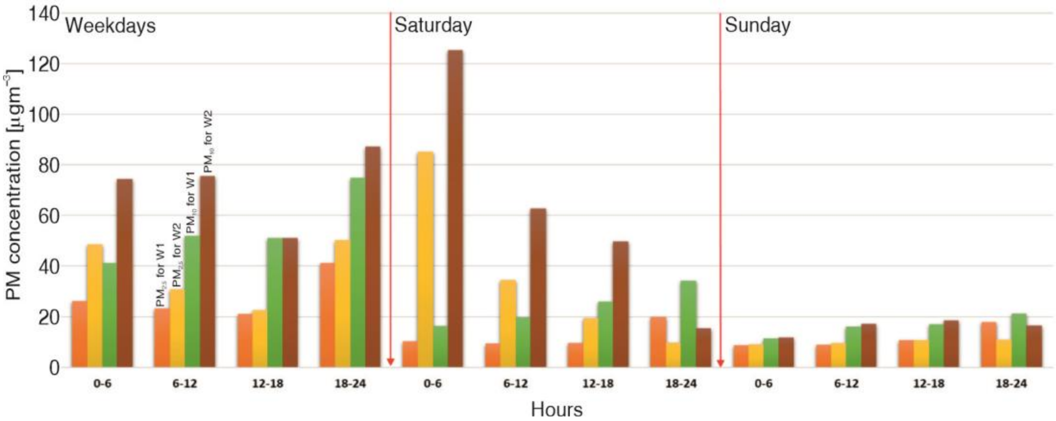

Figure 3. Six hours $PM_{2.5}$ concentrations

In order to analyze changes and effects of lockdown on particle pollution variations in ambient air throughout the day, 1 hour $PM_{2.5}$ and PM_{10} concentrations during weekdays and weekend for both weeks are presented in figs. 4(a), 4(b), 5(a), 5(b), 6(a), 6(b), 7(a), and 7(b).

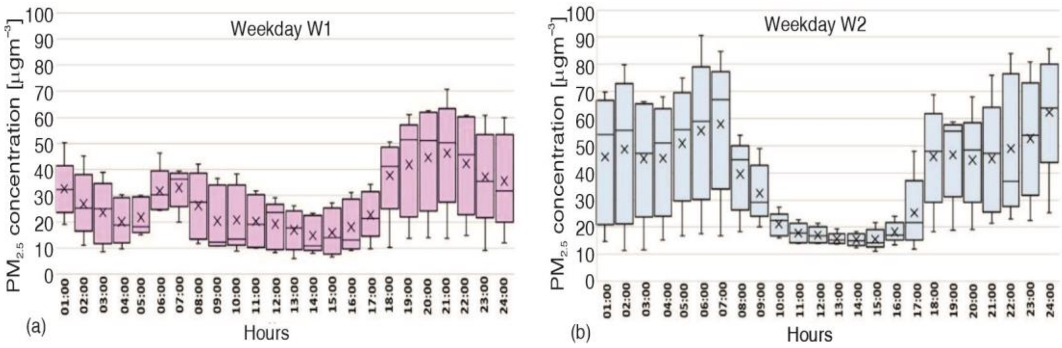

Figure 4. The $PM_{2.5}$ 1 hours concentration during the day on weekdays;
(a) before lockdown – W1 and (b) during lockdown – W2

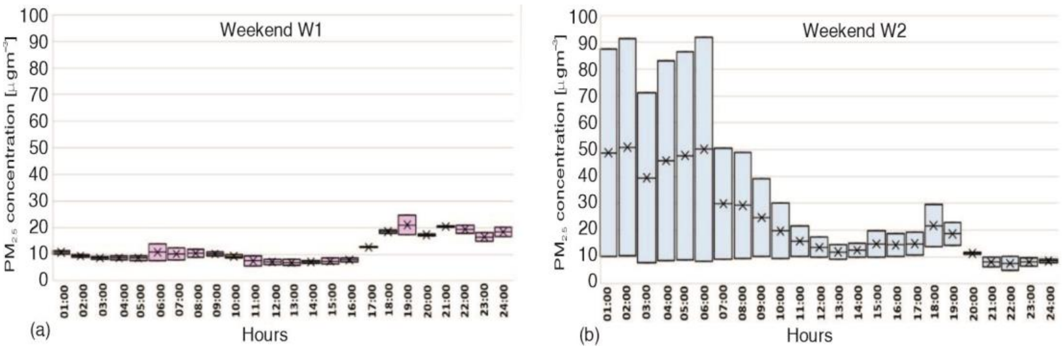

Figure 5. The $PM_{2.5}$ 1 hours concentration during the day on weekends;
(a) before lockdown – W1 and (b) during lockdown – W2

Concentrations of $PM_{2.5}$ during the W2, fig. 4(b), had more change in median throughout the different periods of the day, and more change in variability (as indicated by larger interquartile range during non-working hours) compared to W1, fig. 4(a), with the lowest levels in the period of working hours from 8 a. m. to 5 p. m., when the concentration had much lower variability in W2 compared to W1. In W1, somewhat higher concentrations can be seen from 6-9 a. m. and 6-10 p. m. During the weekend, concentrations of $PM_{2.5}$ in W2, fig. 5(b), were highest in the period from 1-6 a. m. and generally higher compared to W1, fig. 5(a), when concentrations were at quite low levels, with highest concentrations from 6-9 a. m. and 6-12 p. m.

One hour concentration variations of PM_{10} during W1 and W2 are somewhat similar to $PM_{2.5}$. During weekdays, the highest PM_{10} concentrations during the W1 were from 6-9 a. m. and 6-10 p. m., fig. 6(a), but during the W2 from 1-9 a. m. and 6-12 p. m., fig. 6(b). During weekend concentrations were the highest from 6-10 a. m. and 6-12 p. m. during the W1, fig. 7(a), and the W2 from 1-8 a. m., fig. 7(b).

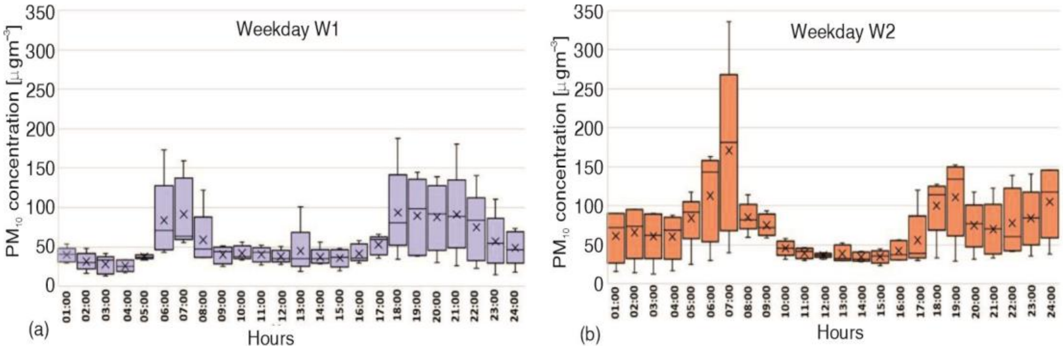

Figure 6. The PM_{10} 1 hours concentration during the day on weekdays; (a) before lockdown – W1 and (b) during lockdown – W2

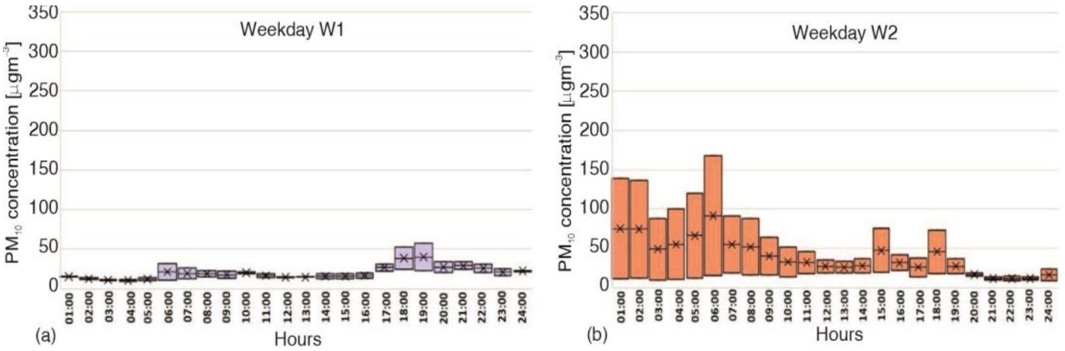

Figure 7. The PM_{10} 1 hours concentration during the day on weekends; (a) before lockdown – W1 and (b) during lockdown – W2

Traffic count data

Total vehicle volume on weekdays and weekends during the W1 was 113310 and 30085, respectively. During the W2, the vehicle count on weekdays was 77863 and on weekends was 17201, which is a decrease compared to W1 of 31% for weekdays, and 42% for weekends. Traffic data was collected from the two traffic counters that were counting traffic from Jaša Tomić boulevard to Kralja Petra I street, and vice versa, had 15 minutes resolution, so they were summed to 24 hours total traffic. In tab. 3, 24 hours vehicle counts by their category during the W1 (09-15 March) and W2 (16-22 March) are given.

Categories with most vehicles were A1, C1, and B1, with vehicle counts from 11079 to 11978, 766 to 890, and from 630 to 690 vehicles, respectively, on weekdays and from 6438 to 7871, 511 to 642, and 269 to 434, respectively, on weekend during the W1. For the purpose of easier data analysis, all traffic data were normalized by the min-max normalization (with min = 0, max ~ 11000, approximate max daily vehicle count in the sampling period). Normalized six-hour vehicle count data on weekdays and weekends during the W1 and W2 are presented in figs. 8 and 9.

Table 3. The 24 hour vehicle count of A1, A2, B1, B2, and C1 category during the W1/W2

Days	9.3.	10.3.	11.3.	12.3.	13.3.	14.3.	15.3.	16.3.	17.3.	18.3.	19.3.	20.3.	21.3.	22.3.
A1	11978	11399	11079	11489	11189	7871	6438	8835	7643	7230	7066	7101	5203	2893
A2	234	225	243	296	248	206	158	242	209	184	191	196	158	78
B1	690	647	671	689	630	434	269	554	501	457	438	446	328	134
B2	101	104	97	97	110	61	56	107	87	76	75	77	53	15
C1	766	830	843	857	890	642	511	761	642	603	546	580	393	90

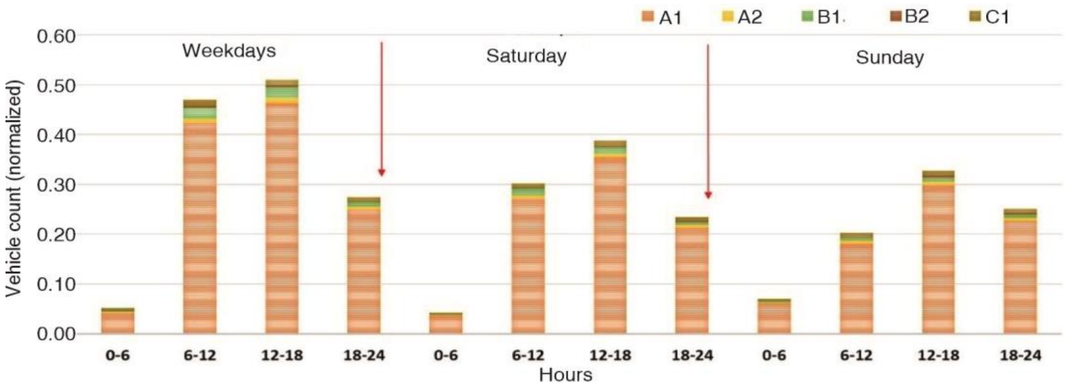

Figure 8. Six hours vehicle count data on weekdays and weekends during the W1

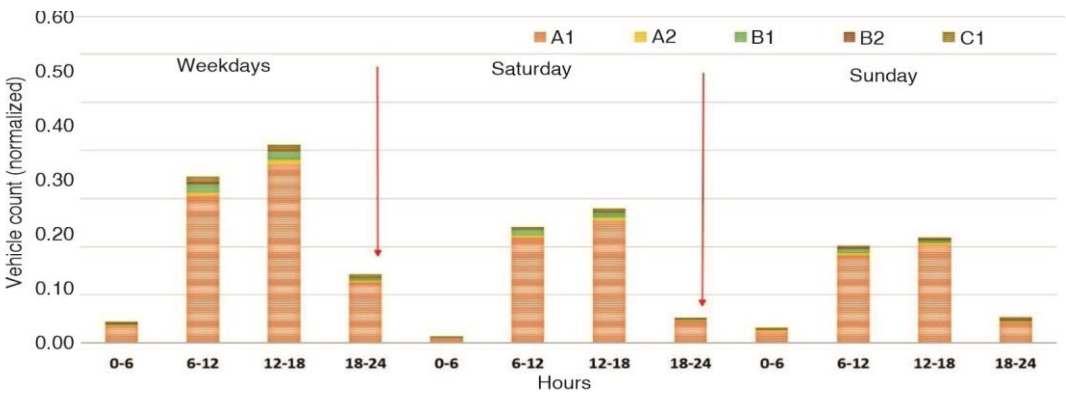

Figure 9. Six hours vehicle count data on weekdays and weekends during the W2

Besides the total traffic volume decreasing during the W2, the total traffic volume variations between the days were similar during W1 and W2, with the highest volumes between 6 a. m.-6 p. m. on weekdays and weekends for A1, B1, C1, A2, and B2 vehicles. According to figs. 8 and 9, traffic density modestly decreased during the W2, especially on Saturday and Sunday. Vehicle count decrease by the category on weekdays during the W2 was 33% (A1), 17% (A2), 27% (B1), 17% (B2), and 25% (C1). During W2, vehicle count decreased on weekends: 2% (A1), 35% (A2), 34% (B1), 41% (B2), and 58% (C1).

Comparison of PM concentrations and traffic data

In this section traffic data were normalized by the min-max normalization (with min = 0, and max = 11978, max = 296, max = 690, max = 110, max = 890 for A1, A2, B1, B2, and C1 class, max daily vehicle count by the category in the sampling period). Possible relations between the 6 hour $PM_{2.5}$ and PM_{10} concentration data at the TRF with each vehicle category and their normalized 6-hour count data, were analysed for a period of W1, fig. 10, and W2, fig. 11.

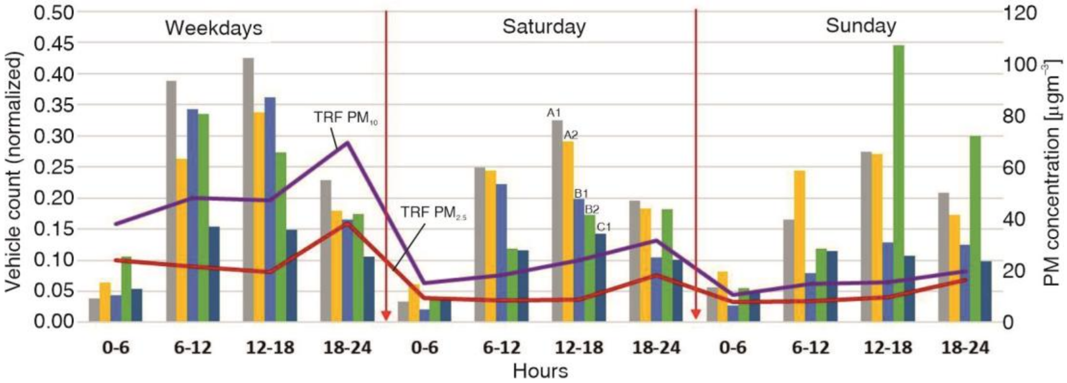

Figure 10. The $PM_{2.5}$ and PM_{10} comparison with A1, A2, B1, B2, and C1 category (W1)

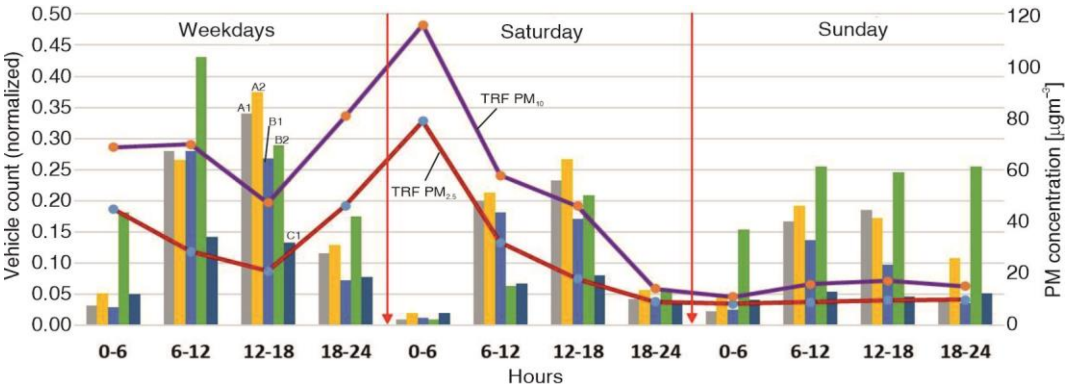

Figure 11. The $PM_{2.5}$ and PM_{10} comparison with A1, A2, B1, B2, and C1 category (W2)

Based on fig. 10, $PM_{2.5}$ and PM_{10} concentrations for W1 are related to certain vehicle categories during the first part of the day (6 a. m.-6 p. m.), during the weekdays and weekend.

During the W2, fig. 11, PM concentrations showed no immediately apparent relation with dominant vehicle categories.

Furthermore, to quantify amount of possible relation between PM and vehicle counts correlation analysis of 24 hour averages of $PM_{2.5}$ and PM_{10} concentrations, and A1-C1 vehicle categories during the W1 and W2, tab. 4, was performed. Moderate positive correlations are found for $PM_{2.5}$/A1 (r = 0.8, p = 0.03), $PM_{2.5}$/B1 (r = 0.78, p = 0.04), PM_{10}/A1 (r = 0.85, p = 0.02), PM_{10}/B2 (r = 0.77, p = 0.04) and PM_{10}/C1 (r = 0.84, p = 0.02). Strong positive correlations are found for PM_{10}/A2 (r = 0.87, p = 0.01) and PM_{10}/B1 (r = 0.89, p = 0.007). During the W2, no strong correlations were present between PM and any of the vehicle categories. In the previous discussion, the distinction between moderate and strong correlation was made based on p-value, and levels were also indicated in tab. 4 by the following criteria: $p < 0.05$ (moderate correlation, marked by *), and $p < 0.01$ (strong correlation, marked by **). Note again that tab. 4 features no strong correlations, despite the relatively high values of r for certain vehicle categories.

Table 4. The PM / A1, A2, B1, B2, C1 (W1 and W2)

PM/vehicle category	r (W1)	p	r (W2)	p
$PM_{2.5}$/A1	0.80*	0.03	0.36	0.43
$PM_{2.5}$/A2	0.44	0.32	0.38	0.40
$PM_{2.5}$/B1	0.78*	0.04	0.41	0.36
$PM_{2.5}$/B2	0.71	0.07	0.32	0.48
$PM_{2.5}$/C1	0.59	0.17	0.39	0.39
PM_{10}/A1	0.85*	0.02	0.50	0.25
PM_{10}/A2	0.87**	0.01	0.53	0.23
PM_{10}/B1	0.89**	0.007	0.56	0.19
PM_{10}/B2	0.77*	0.04	0.48	0.28
PM_{10}/C1	0.84*	0.02	0.53	0.22

Emission contribution

Daily average BCG concentrations of PM are used for the calculation of traffic contribution along with the TRF data. Descriptive statistics of 24 hours values for $PM_{2.5}$ and PM_{10} during the W1 and W2 are given in the tab. 5. Min/max BCG values of $PM_{2.5}$ and PM_{10} were 9.27/20.8 μg/m^3 and 13.7/30.7 μg/m^3 during the W1, respectively. During the W2, min/max concentrations were 7.03/22.1 μg/m^3 for $PM_{2.5}$ and 10.3/32.5 μg/m^3 for PM_{10}. Compared to TRF PM concentrations during W2, BCG PM concentrations were similar during both weeks and didn't change noticeably.

Meteorological parameters, T, P, and RH values, varied during the W1 and W2 and their 1 hour data descriptive statistics are shown in tab. 6. The T and RH decreased during the W2, and pressure values increased. Minimum T values during W2 decreased for 2 ºC, and maximum for 4 ºC. Pressure values during the W1 and W2 ranged from 1003-1020 mbar and 1003-1022 mbar. The RH values ranged from 31-86% during the W1 and from 23-77% during the W2.

Since BCG concentrations did not change much during the lockdown, the influence of total traffic emission from TRF to PM concentrations on BCG was analyzed by the correlation analysis for both weeks. Positive moderate correlations were found only in W1 between the $PM_{2.5}$ BCG/TRF (r = 0.87, p = 0.02) and PM_{10} BCG/TRF (r = 0.84, p = 0.02). For the W2, there were no significant correlations between $PM_{2.5}$ BCG/TRF (r = 0.52, p = 0.37) and PM_{10} BCG/TRF (r = 0.52, p = 0.37).

Table 5. Descriptive statistics of 24 hours PM [μg/m^3] BCG values during the W1 and W2

Stat.	$PM_{2.5}$		PM_{10}	
	W1	W2	W1	W2
Mean	14.95	13.51	22.00	19.88
MED	16.30	10.91	24.00	16.04
STD	4.58	6.63	6.73	9.75
Min	9.27	7.03	13.67	10.33
Max	20.83	22.08	30.67	32.48

Table 6. Descriptive statistics of *T* [°C], *P* [mbar], and RH [%] during the W1 and W2

Stat.	*T*		*P*		RH	
	W1	W2	W1	W2	W1	W2
Mean	11	11	1009	1015	56	48
MED	11	10	1007	1017	56	45
STD	5	5	4	5	14	14
MIN	3	1	1003	1003	31	23
Max	25	21	1020	1022	86	77

The difference in levels of PM concentrations at TRF and BCG is assumed as the *traffic contribution* with the assumption that emission contribution from other local sources and regional-long range transported pollution outside the city borders are similar at TRF and BCG site. The emission contribution caused by the traffic was calculated using [18]:

$$\Delta C(poll.) = C_{\text{TRF}} - C_{\text{BCG}}$$

where $\Delta C(poll.)$ [μgm^{-3}] is the emission contribution of the traffic to specific pollutant, C_{TRF} – the average pollutant concentrations during the study period on TRF, and C_{BCG} – the average background pollutant concentrations during the study period

Note that since C_{BCG} was available only in the form of daily averages, emission contribution and average pollutant concentration were resampled to daily average also. Emission contribution to PM concentrations was highest during the W2, with concentration ranges of 2.9-48.2 μg/m^3 for $PM_{2.5}$ and 5.1-88.3 μg/m^3 for PM_{10}. Traffic contribution concentrations to $PM_{2.5}$ and PM_{10} by each day during the study period for W1 and W2 are shown in the tab. 7.

Table 7. Emission contribution to PM concentrations before lockdown (W1) and during lockdown (W2)

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
ΔC ($PM_{2.5}$) in W1	13.4	17.7	10.9	8.44	4.32	2.57	2.12
ΔC ($PM_{2.5}$) in W2	5.46	20.9	16.1	44.9	48.2	31.9	2.95
ΔC (PM_{10}) in W1	15.6	25.7	38.6	45.1	23.2	9.90	2.80
ΔC (PM_{10}) in W2	21.3	58.4	34.9	76.1	88.3	56.4	5.08

Positive correlation between the PM BCG/TRF total during the W1 indicated the fact that PM emission contributions originated from traffic only in W1, and the existence of other PM emission source in W2. Comparison of *T*, *P*, RH values and ΔC ($PM_{2.5}$ and PM_{10}) values during the W1 and W2 is presented in fig. 12.

According to fig. 12, and along with tabs. 6 and 7 values of ΔC ($PM_{2.5}$ and PM_{10}) and meteorological parameter values, ΔC ($PM_{2.5}$ and PM_{10}) increasment in W2, was followed by *P* increasment, lower minimum and maximum *T* values, and RH lower values, generally. In fig. 12 meteorological values were normalized for the purpose of easier data comparison, by the min-max normalization (with min = 1003 mbar, max = 1022 mbar for *P*; min = 0.7 °C, max = 24.5 °C for *T*; and min = 22.5%, max = 85.7% for RH, max and min daily meteorological parameter values are within the sampling period). The ΔC ($PM_{2.5}$) was higher during Monday and Tuesday in W1 and Thursday-Saturday in W2. In days of higher ΔC ($PM_{2.5}$) in W1, *T*, and *P* had lower values, while RH had higher. In W2 during these days, RH was mostly constant, *P* was decreasing, while *T* was increasing. Considering ΔC (PM_{10}), highest values were on Tuesday-Friday in W1, and in W2 were on Tuesday and

Thursday-Friday. During these days in W1, P and RH were lower, while T was higher. In W2, in days of higher ΔC (PM_{10}), T had higher values, P was decreasing and RH was constant during most of the days.

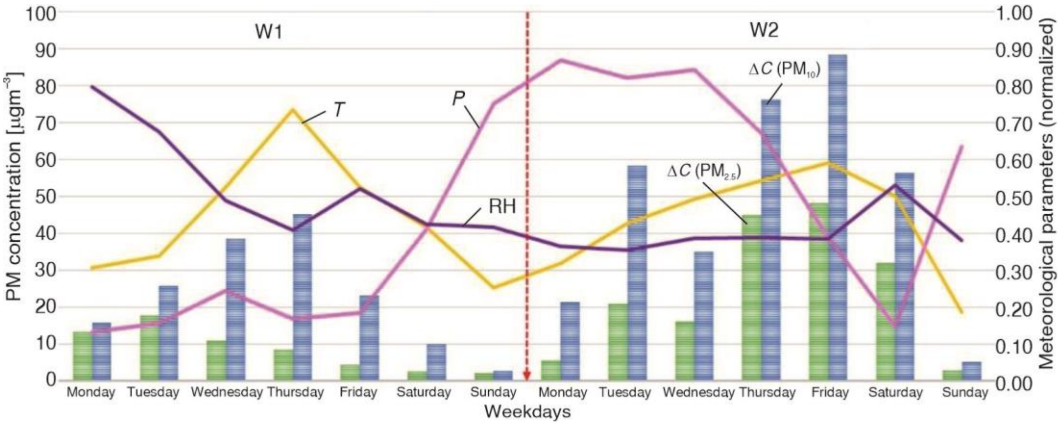

Figure 12. Comparison of T, P, RH, ΔC ($PM_{2.5}$) and ΔC (PM_{10}) values in a week before lockdown (W1) and during lockdown (W2)

Possible relations of T, P, RH values and TRF PM are explored by correlation analysis for the W1 and W2, tab. 8.

Table 8. The $PM_{2.5}$ and PM_{10} correlation with T, P, and RH (W1 and W2)

Particle/meteo parameter	r (W1)	p	r (W2)	p
$PM_{2.5}/T$	–0.002	1	0.97***	< 0.001
$PM_{2.5}/P$	–0.73	0.06	–0.36	0.43
$PM_{2.5}$/RH	0.77*	0.04	0.25	0.59
PM_{10}/T	0.68	0.09	0.91**	0.004
PM_{10}/P	–0.78*	0.04	–0.22	0.64
PM_{10}/RH	0.19	0.69	0.10	0.83

During the W1, a moderate positive correlation n between the $PM_{2.5}$/RH ($r = 0.77$, p = 0.04) and moderate negative correlation between the PM_{10}/P ($r = –0.78$, $p = 0.04$) is observed, confirming that any meteorological parameter did not have any influence on PM concentrations. According to tab. 8, $PM_{2.5}$ and PM_{10} concentrations at TRF are only correlated to T values during the W2 by very strong positive correlation for $PM_{2.5}$ ($r = 0.97$, $p = <0.001$) and strong positive correlation for PM_{10} ($r = 0.91$, $p = 0.004$), which implicate that T influenced PM concentrations in ambient air. In tab. 8 following criteria of $p < 0.001$ is addition to previous distinction in section *Comparison of PM concentrations and traffic data* between moderate and strong correlation that was made based on p-value, and represents very strong correlation, marked by ***.

Conclusion

Fine and coarse particulate matter concentrations increased during the COVID-19 week, while total traffic decreased by 31% on working days and 42% on weekends, as the impact of lockdown measures on traffic regime and intensity.

Concentrations of PM during the first week were the highest on working days, in the periods from 6-9 a. m. and 6-10 p. m., while on weekends concentrations were higher from 6-9 a. m. and 6-12 p. m.. During the COVID-19 week, concentrations were more uniform during the day with the highest concentrations on Saturday morning from 1-6 a. m., and on working days from 1-7 a. m. and 6-12 p. m..

The most numerous categories of vehicles were A1, C1, and B1. Besides total traffic decreasing during the COVID-19 week, the pattern of traffic count data was similar to the first week, with the highest volumes between 7 a. m. -6 p. m. on working days and weekends for A1, B1, C1, A2, and B2 vehicles. Vehicle count decrease by their category during the COVID-19 week on working days, was 33% (A1), 17% (A2), 27% (B1), 17% (B2), and 25% (C1). During the COVID-19 week on weekends, the vehicle count decrease was 2% (A1), 35% (A2), 34% (B1), 41% (B2), and 58% (C1).

The relationship between $PM_{2.5}$ and PM_{10} from the traffic site, and different vehicle categories were confirmed by moderate or strong positive correlations only during the first week, moderate correlations for $PM_{2.5}$/A1 and $PM_{2.5}$/B1 (r = 0.80, r = 0.78) and for PM_{10} moderate positive correlation are found for PM_{10}/A1, PM_{10}/B2, PM_{10}/C1 (r = 0.85, r = 0.77, r = 0.84) and strong correlations for PM_{10}/A2 and PM_{10}/B1 in the first week (r = 0.87, r = 0.89). These correlations indicated a strong influence of traffic as an emission source since in the second week, there was no correlation between PM and traffic count.

Background PM concentrations were not noticeably different between the first week and COVID-19 week, but a moderate positive correlation between background $PM_{2.5}$, and PM_{10} with total traffic only during the first week, was also confirmed on traffic as the dominant emission source of $PM_{2.5}$ and PM_{10}.

Besides this fact, during the COVID-19 week, PM and emission contribution concentrations were higher, which strongly indicated a secondary emission source of PM. Emission contribution concentrations for $PM_{2.5}$ during the first week and COVID-19 week (working days and weekends) were in the range of 4.32-17.7 μg/m^3, 2.12-2.57 μg/m^3 for the first week and from 5.46-48.2 μg/m^3, 2.95-31.9 μg/m^3 for the COVID-19 week. Coarse particle matter emission contributions during the first week and COVID-19 week (working days and weekends) were in the range of 15.6-45.1 μg/m^3, 2.80-9.90 μg/m^3, and from 21.3-88.3 μg/m^3, 5.08-56.4 μg/m^3.

Very strong and strong positive correlation of $PM_{2.5}$, and PM_{10} with temperature during the COVID-19 week (r = 0.92, r = 0.91) confirmed lower temperature impact on PM concentrations and, consequently, increased impact of heating, as an emission source, arguably due to lockdown measures and people staying more at their homes.

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