# OUTDOOR PARTICLE MATTER INVESTIGATION BEFORE AND DURING COVID-19 PANDEMIC

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*Bucharest is one of the most polluted cities in Romania. The causes of high levels of PM10 (particulate matter that describes inhalable particles with diameter that is 10 micrometers and smaller) concentration are road traffic (59% of the car fleet is over 10 years old), construction and lack of green areas. Given the context created by the COVID-19 pandemic, 2020 is of interest to statistical analyzes performed to observe the evolution of the parameters that characterize the ambient air quality. Results indicate a slightly decrease in PM10 during the state of emergency (March 16-May 13) compared to 2011-2019 and the next period related to of activities related to transport, education, tourism (until December 31). Separate Tables for each pandemic month and comments on wind speed are presented. It is found that the average of the daily values decreasing by more than 35% compared to the average of the 2017-2019.*

**Keywords**: air quality, COVID-19 pandemic, particulate matter PM10, statistics

## 1. Introduction

The World Health Organization (WHO) estimates that globally, one in 9 deaths is caused by air pollution and eight million of premature death take place every year in word wide [1] . The WHO has also demonstrated the link between exposure to air pollution and type 2 diabetes, obesity, systemic inflammation, Alzheimer's disease and dementia [2]. Other effects of pollution are lung cancer, ischemic heart disease, stroke, respiratory infections and chronic obstructive pulmonary disease [3]. Diesel engine exhaust is classified by the International Agency for Research on Cancer as a group 1 carcinogen. In Romania, approximately 25,000 premature deaths are caused by air pollution [4].

Emission trends from anthropogenic activities are reflected in ambient air quality trends, but not directly proportional [5]. Processes such as long-distance transport, dispersion and chemical transformations in the atmosphere influence the level of air pollutant concentrations [6]. However, knowing the level of emissions and their main sources are some basic indicators in assessing air quality.

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Certainly, air pollution, which is generated mostly by anthropogenic activity, has become an overwhelming issue, taking into consideration the effects on human health and climate [7]. Nowadays in the pandemic time more aspects are discussed [8] and more than ever is a need to understand that health and pollution are connected as parts of sustainability which nowadays is redefined [9, 10]. In this context when all over the world many investigations are focused on COVID 19 behavior [11-13] and impact trying to present new information [14-16] this manuscript presents the evolution of particulate matter PM10, one of the most important pollutant that characterize the ambient air quality.

Particulate matter (PM) is a term that describes a mixture of fine solid particles and liquid droplets suspended in the air. The composition of the particles can be very complex and includes nitrates, sulfates, organic substances, heavy metals, black carbon and allergens. The main sources of PM are the traffic [17], residential heating and industry [18]. High levels of PM concentration can be also observed during fires, dust storms, due to long-distance transport or construction [19-20]. Waste burning, a common practice especially in developing countries, was found to have a high impact on the PM10 concentration [21].

The most usual fractions of particles used to assess their effect on health problems are PM10 (particles with a diameter of 10 micrometers or less), that are small enough to pass through the throat and nose and enter the lungs and PM2.5 (particles with a diameter of 2.5 micrometers or less), that are so small they can get deep into the lungs and into the bloodstream [22]. There are studies that show the association of high PM levels with the increase of respiratory and cardiovascular pathology incidences [23]. To reduce the health role of air pollution, the World Health Organization has developed Air Quality Guidelines (AQGs) for several pollutants, including PM10 and particulate matter were included on the list of carcinogens by the International Agency for Research on Cancer [24].

## 2. Data sources and methods

During the state of emergency, all non-essential activities were interrupted, traffic was limited to necessities, such as the purchase of food, medicine. Schools and universities have been closed, switching to online courses. The tourism, culture activities and sports have also been suspended. The reasons for which the analysis in this document was performed for the city of Bucharest, considering the pollutants specific to urban activities, PM10 particulate matter are:

- Bucharest is one of the most polluted city from Romania;
- During the state of emergency there were several episodes of pollution that obviously affected the expected level of air quality for this period.

- In Bucharest, there was an integrated air quality plan based on modeling studies. According to them, the main sources of pollution are traffic and construction sites. The analysis could highlight the possible impact of the measures in this plan on air quality or could lead to the conclusion that it is necessary to identify the more appropriate measures.

Data from the eight stations sampling points were took into consideration. All these data are accessible for entire public, using Monitoring/Reports section from the Romanian National Air Quality Monitoring Network website [25] and data were measured according to annex (7) of Law 104/2011 on ambient air quality (Reference methods for the assessment of concentrations of $PM_{10}$ and PM2.5 particulate matter, using TECORA equipments [26].

The sampling points are B1- Lacul Morii- urban background, B2- Titan- industrial type, B3- Mihai Bravu- trafic type, B4- Berceni- industrial type, B5- Drumul Taberei- industrial type, B6- Cercul Militar- trafic type, B7-Magurele – suburban background and B8 – rural background station. Six of these sampling points are located in Bucharest and other two are in Ilfov County (Fig. 1).

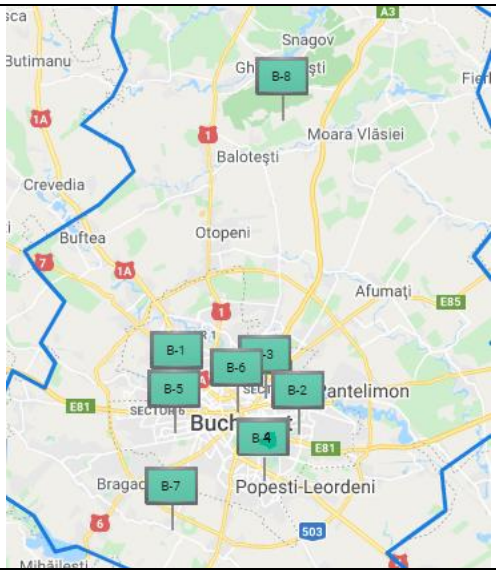


Fig. 1. PM10 sampling points location

Fig. 2. B-8 monitoring station located in Balotesti – Ilfov

In order to study in detail, the evolution of the daily concentrations of PM10 in Bucharest during the period when the state of emergency due to the COVID-19 pandemic was declared, the data series corresponding to the period January 1 - December 31, 2020 was analyzed compared to equivalent periods from the 2011-2019. The PM10 data from National Network for Air Quality.

Monitoring are measured using gravimetric method for PM10. The sampling points are located in monitoring stations (Fig. 2 above), which, except for the traffic ones, are equipped with meteorological sensors.

The standard SR EN 12341 "Ambient air. Standardized gravimetric measurement method for the determination of the mass fraction of PM10 or PM2.5 of suspended particles" establishes the reference method for PM.

The sampling methodology consists in aspirating with the help of a pump some samples with a flow rate of 2-3 $m^3$/h. The air flow is measured by a device containing a hole plate, installed between a filter, usually quartz to minimize artifacts, and the vacuum pump. The sampling time is 24 hours with series of 15 filters. The filters are conditioned under the same conditions as before sampling and then re-weighed. Filters with a separation efficiency> 99.5% must be used. PM10 / 2.5 concentrations are calculated according to the equation (1):

$$C_{PM10/2.5}=\frac{M}{V}\frac{\mu g}{m3} \quad (1)$$

where: CPM10/2.5 is the concentration of PM10/PM2.5 particle (µg/ $m^3$);
M - weight of dust on exposed filters (µg);
V - volume of the aspirated sample ($m^3$);

## 3. Results and Discussions

The data series (2011-2020) were divided and analyzed as follows: a) the entire period January 1 - December 31 and March 16 - May 13, 2020 - (this period corresponds to the state of emergency from 2020 in which all non-essential activities were interrupted, as mentioned above); b) the entire period, except of March 16 - May 13 period).

### 3.1. Evolution of PM10 concentrations

The analysis was performed for two distinct periods, one corresponding to the emergency period March 16, 2020 - May 13, 2020, the other cumulative, for January 1, 2020 - March 15, 2020 and May 15, 2020 –December 31, 2020, compared with the similar intervals from 2019 and the mediated series 2011-2019. The graphs, Fig. 3 and Fig 4, from below show the evolution of PM10 concentrations trends.

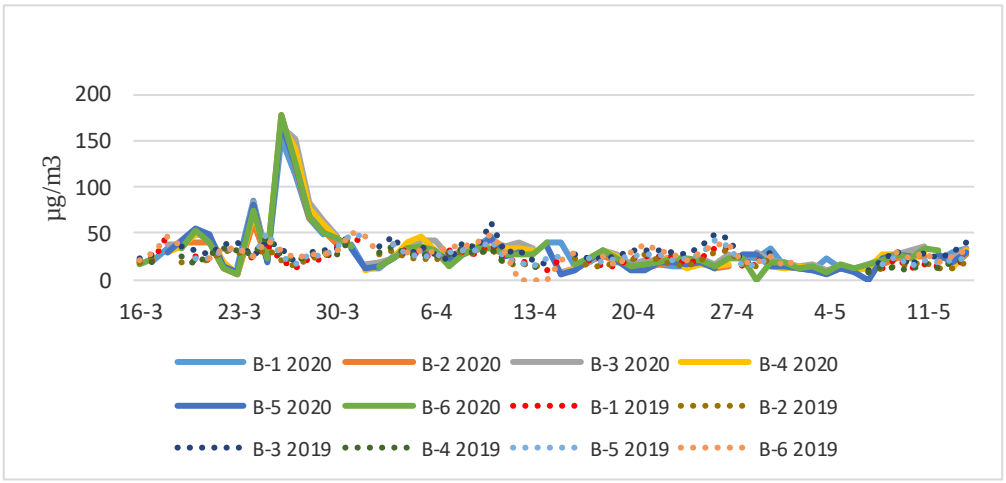


Fig. 3. Evolution of PM10 daily averages over the period March 16-May 13, comparison of 2019 and 2020

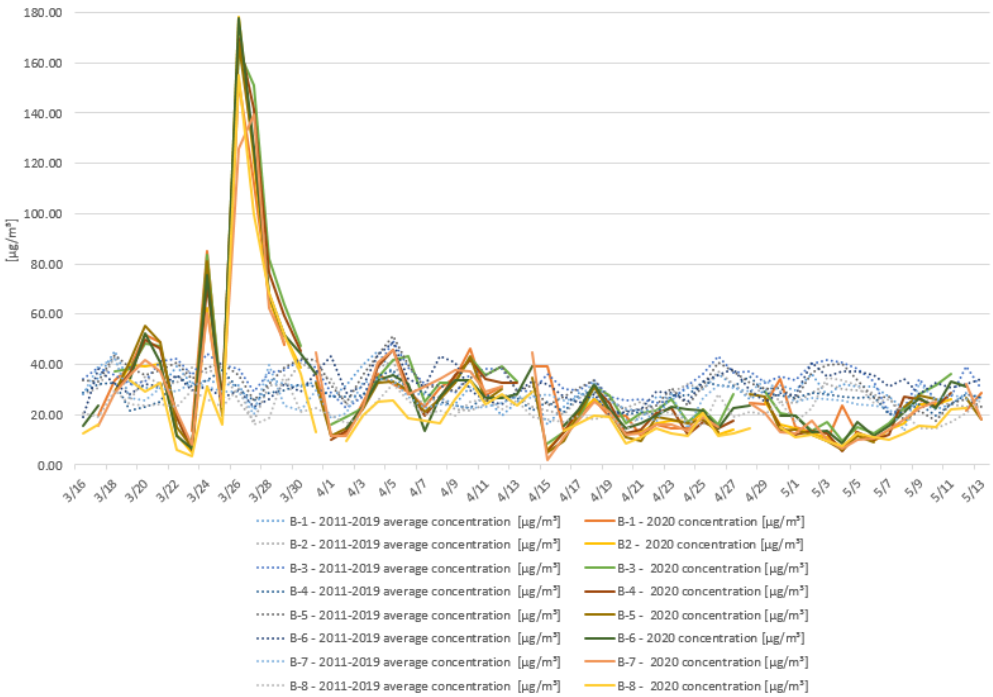


Fig. 4. Evolution of PM10 daily averages - comparison of 2020 and 2011-2019 average

Tables 1-2 show the daily averages during the emergency period compared to 2019 using a graphical representation similar to that of air quality indices established by Romanian legislation and like those on the European Air Quality

Index website (Table 3), that shows the meaning of the colors in the previous Tables (1 and 2) [27].

*Table 1*

**Comparative analysis of PM10 concentration-first month of state of emergency**

| station type | month/ day | 2020-03 16 | 2020-03 17 | 2020-03 18 | 2020-03 19 | 2020-03 20 | 2020-03 21 | 2020-03 22 | 2020-03 23 | 2020-03 24 | 2020-03 25 | 2020-03 26 | 2020-03 27 | 2020-03 28 | 2020-03 29 | 2020-03 30 | 2020-03 31 | 2020-04 01 | 2020-04 02 | 2020-04 03 | 2020-04 04 | 2020-04 05 | 2020-04 06 | 2020-04 07 | 2020-04 08 | 2020-04 09 | 2020-04 10 | 2020-04 11 | 2020-04 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F | B-1 | - | 19.8 | 33.8 | 38.5 | 51.7 | 49 | - | 13.7 | 85.2 | 20.7 | 153 | 112 | 66.7 | 47.7 | - | 37 | 11.7 | 12.6 | 24.6 | 36.4 | 32.3 | 29.3 | 23.3 | 30.8 | 34.9 | 46.2 | 27.9 | 31.3 |
| | B-5 | - | - | 28.6 | 41.22 | 55.2 | 48.80 | 15.03 | 7.01 | 80.9 | 19.6 | 168 | 125 | 67.2 | 51.5 | - | 32.9 | 11.6 | 14.4 | 22.1 | 32.8 | 33.2 | 29.9 | 21 | 26.4 | 32.7 | 43.5 | 25.7 | 30.4 |
| T | B-3 | 17.6 | - | 37.2 | 38.1 | 48.6 | 47.26 | 19.09 | 5.85 | 83.4 | 24.1 | 165 | 151 | 82.3 | 63.7 | 47.3 | - | 16.3 | 19.2 | 22.8 | 34.5 | 41.8 | 43.3 | 25 | 32.5 | 32.5 | 42.7 | 35.6 | 39.3 |
| | B-6 | 15.5 | 23.8 | - | 34 | 52.5 | 41.00 | 11.61 | 6.37 | 75.3 | 22.9 | 178 | 126 | 67.8 | 51.6 | 44.1 | 36.5 | - | 14.6 | 23.4 | 33.7 | 35.7 | 32.3 | 13.7 | 27 | 33.5 | 33.6 | 26.9 | 26.6 |
| I | B-2 | 13.5 | - | 29.21 | 40.00 | 39.42 | 40.43 | 11.95 | 5.26 | 62.6 | 21.2 | ##### | ##### | 65.6 | 52 | 38.97 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | B-4 | 14.6 | - | 29.06 | 36.9 | 49.8 | 46.23 | 19.09 | 6.23 | 71.3 | 26.4 | ##### | 142 | 76.6 | 59.6 | 45.5 | - | 9.95 | 13.6 | 22.8 | 39.5 | 46 | 31.4 | 19.8 | 26.9 | 35.8 | 41.9 | 34.2 | 33 |

| station type | month/ day | 2019-03 16 | 2019-03 17 | 2019-03 18 | 2019-03 19 | 2019-03 20 | 2019-03 21 | 2019-03 22 | 2019-03 23 | 2019-03 24 | 2019-03 25 | 2019-03 26 | 2019-03 27 | 2019-03 28 | 2019-03 29 | 2019-03 30 | 2019-03 31 | 2019-04 01 | 2019-04 02 | 2019-04 03 | 2019-04 04 | 2019-04 05 | 2019-04 06 | 2019-04 07 | 2019-04 08 | 2019-04 09 | 2019-04 10 | 2019-04 11 | 2019-04 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F | B-1 | 19 | 20.3 | 48.66 | - | 24.3 | 20.4 | 32.6 | 31.4 | 23 | 37.6 | 21.6 | 12 | 22.6 | 19.9 | 36.7 | 46 | 37 | - | 38.6 | 29.1 | 27 | 23.3 | 30.8 | 30.1 | 27.8 | 38.7 | 21.8 | 20.1 |
| | B-5 | - | - | - | - | 23.6 | 23.1 | 32.6 | 33.5 | 25.7 | 51.2 | 25.5 | 17.2 | 28 | 24.6 | 36.5 | 49 | 47.1 | - | 38.7 | 26.5 | 26.1 | 24.4 | 29.2 | 32 | 31 | 41.7 | 22.5 | 19 |
| T | B-3 | 23 | 28 | - | 36 | 31.3 | 28.3 | 38.8 | 39.2 | 26.1 | 42.8 | 33.2 | 19.4 | 29 | 31.4 | 34.3 | 50 | - | 35.8 | 46.2 | 25.9 | 35.2 | 26.9 | 20.6 | 39.5 | 34 | 61.4 | 29.1 | 32.6 |
| | B-6 | 20.2 | 28.5 | 45.57 | 35.9 | - | 23.6 | 33.1 | 34.2 | 24.5 | 43 | 30.7 | 22.5 | 26.5 | 28.1 | 32.3 | 50.6 | 46.1 | 28.2 | - | 28.9 | 32.1 | 30 | 36.3 | 35.9 | 39.7 | 48.7 | 29.8 | - |
| I | B-2 | 18 | 25.3 | - | 17.8 | 20.1 | 21.6 | 31.5 | 28.7 | 25 | 33.7 | 21.6 | 15.3 | 23 | 24.1 | 31.1 | 45.2 | - | 27.4 | 32.5 | 22.6 | 23.6 | 21.6 | 28.8 | 29.2 | 27.3 | 34 | 17 | 17.2 |
| | B-4 | 20.4 | 18.7 | - | 25.7 | 16.8 | 27.4 | 33.1 | 31.8 | 26.4 | 45.7 | 25.8 | 20.2 | 25.4 | 28.4 | 26.9 | 44.7 | - | 29.5 | 35.1 | 27.5 | 26.9 | 25.4 | 28.1 | 33.8 | 27 | 33.4 | 17.2 | 19 |

*Table 2*

**Comparative analysis of PM10 concentration-the second month of state of emergency**

| station type | month /day | 2020-04 13 | 2020-04 14 | 2020-04 15 | 2020-04 16 | 2020-04 17 | 2020-04 18 | 2020-04 19 | 2020-04 20 | 2020-04 21 | 2020-04 22 | 2020-04 23 | 2020-04 24 | 2020-04 25 | 2020-04 26 | 2020-04 27 | 2020-04 28 | 2020-04 29 | 2020-04 30 | 2020-05 01 | 2020-05 02 | 2020-05 03 | 2020-05 04 | 2020-05 05 | 2020-05 06 | 2020-05 07 | 2020-05 08 | 2020-05 09 | 2020-05 10 | 2020-05 11 | 2020-05 12 | 2020-05 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F | B-1 | - | 39.29 | 39.38 | 13.58 | 19.5 | 26.36 | 19.23 | 19.5 | 11.63 | 16.24 | 14.75 | 14.4 | 21.95 | 13.1 | - | 24.43 | 24 | 34.11 | 15 | 12.84 | 9.8 | 23.51 | 11.95 | - | - | - | - | - | - | 21.88 | 28.74 |
| | B-5 | - | 34.84 | 4.89 | 9.77 | 20.88 | 31.03 | 21.38 | 10.89 | 9.77 | 19.03 | 18.23 | 16.84 | 18.2 | 12.83 | - | 28.05 | 27.27 | 13.37 | 13.96 | 11.96 | 9.78 | 6.09 | 11.4 | 8.9 | - | 22.91 | 27.86 | 26.14 | - | 26.59 | 18.06 |
| T | B-3 | 33.04 | - | 8.45 | 13.18 | 18.78 | 31.44 | 27.62 | 16.83 | 20.54 | 21.74 | 26.15 | 17.15 | 22.34 | 16.19 | 28.23 | - | 29.05 | 20.52 | 19.63 | 13.54 | 17.13 | 9.34 | 15.07 | 12.45 | 16.44 | 22.69 | 28.08 | 31.67 | 36 | - | 23.41 |
| | B-6 | 28.3 | 39.51 | - | 15.52 | 22.15 | 32.46 | 22.16 | 14.57 | 16.5 | 19.68 | 22.92 | 22.16 | 21.69 | 14.44 | 22.6 | 23.8 | - | 19.41 | 19.47 | 13.03 | 13.46 | 8.38 | 17.22 | 11.49 | 15.56 | 21.08 | 26.65 | 22.87 | 33.19 | 31.37 | - |
| I | B-2 | - | - | 6.28 | 12.96 | 21.05 | 26.14 | 21.04 | 12.74 | 12.86 | 16.76 | 17.75 | 16.97 | 20.60 | 11.87 | 14.04 | - | 24.97 | 16.16 | 14.34 | 12.41 | 11.31 | 7.16 | 12.69 | 9.73 | 13.98 | 16.67 | 23.96 | 24.33 | 26.06 | - | 14.14 |
| | B-4 | 32.47 | - | 5.62 | 13.02 | 22.19 | 31.19 | 24.67 | 12.60 | 13.91 | 20.85 | 22.58 | 12.08 | 17.15 | 14.46 | 17.47 | - | 26.65 | 15.04 | 11.85 | 13.58 | 12.57 | 5.41 | 13.12 | 10.23 | 11.98 | 27.31 | 26.33 | 23.29 | 28.81 | - | 12.15 |

| station type | month /day | 2019-04 13 | 2019-04 14 | 2019-04 15 | 2019-04 16 | 2019-04 17 | 2019-04 18 | 2019-04 19 | 2019-04 20 | 2019-04 21 | 2019-04 22 | 2019-04 23 | 2019-04 24 | 2019-04 25 | 2019-04 26 | 2019-04 27 | 2019-04 28 | 2019-04 29 | 2019-04 30 | 2019-05 01 | 2019-05 02 | 2019-05 03 | 2019-05 04 | 2019-05 05 | 2019-05 06 | 2019-05 07 | 2019-05 08 | 2019-05 09 | 2019-05 10 | 2019-05 11 | 2019-05 12 | 2019-05 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F | B-1 | 16.11 | 9.86 | 22.81 | - | 20.5 | 13.94 | 14.85 | 22.85 | 25.58 | 24.7 | 24.05 | 15.68 | 23.11 | 33.16 | 32.88 | 14.14 | 15.57 | - | - | - | - | - | - | - | - | 12.79 | 23.27 | 12.57 | 16.44 | 14.67 | 18.52 |
| | B-5 | 14.83 | 23.07 | 25.13 | - | 22.95 | 19.68 | 22.75 | 25.79 | 27.16 | 26.51 | 20.87 | 22.25 | 27.99 | 41.63 | 35.66 | 14.4 | 17.32 | 23.8 | - | - | - | - | - | - | - | 16.81 | 25.03 | 14.85 | 20.70 | 17.68 | 21.03 |
| T | B-3 | 19.82 | 16.52 | - | 27.1 | 23.84 | 22.25 | 24.6 | 31.02 | 31.94 | 30.7 | 29.19 | 26.89 | 35.73 | 47.93 | 43.38 | 18.25 | 19.04 | 28.51 | - | - | - | - | - | - | 10.16 | 19.99 | 31.97 | 14.74 | 29.19 | 23.08 | 28.57 |
| | B-6 | - | - | 20.88 | 29.73 | - | 24.99 | 14.87 | 29.68 | 38.69 | 31.53 | 26.79 | 20.9 | 30.41 | 37.93 | 37.08 | 19.32 | 17.85 | 25.65 | 14.43 | 23.66 | - | - | - | - | - | - | 29.48 | 22.49 | 28.56 | 19.63 | 24.78 |
| I | B-2 | 16.12 | 9.46 | - | 23.07 | 15.41 | 14.87 | 18.1 | 21.16 | 26.24 | 20.27 | 17.53 | 15.01 | 20.63 | 30.11 | 31.45 | 15.52 | 14.74 | 22.28 | - | - | - | - | - | - | 8.90 | 12.84 | 14.43 | 15.51 | 18.54 | 12.66 | 12.58 |
| | B-4 | 13.82 | 10.65 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 7.11 | 14.81 | 11.89 | 9.33 | 17.92 | 12.11 | 18.41 |

*Table 3*

**Air quality indices**

| PM10 polluants concentrations (µg/m3) | Index level | |
|---|---|---|
| 0-20 | 1 | Good |
| 20-40 | 2 | Fair |
| 40-50 | 3 | Moderate |
| 50-100 | 4 | Poor |
| 100-150 | 5 | Very poor |
| 150-1200 | 6 | Extremely poor |

## 3.2 Particular episodes of air pollution

Between March 24, 2020 and March 29, 2020, there was a very high increase in PM10 level (Table 4), which, based on PM2.5 levels and PM2.5/PM10 ratios [28,29], was attributed to a long distance transport from the surrounding area of the city and a resuspension of particles in conditions of higher values of wind speed (Fig. 5) and lack of precipitation.

*Table 4*

**The level of PM10 and PM2.5 concentration on March 24- 29 2020**

| | B-1 | | PM2.5/ | B-2 | B-3 | B-4 | B-5 | | PM2.5/ | B-6 | | PM2.5/ | B-7 | | PM2.5/ | B-8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PM10 | PM2.5 | PM10 | PM10 | PM10 | PM10 | PM10 | PM2.5 | PM10 | PM10 | PM2.5 | PM10 | PM10 | PM2.5 | PM10 | PM10 |
| **2020-03 24** | 85.19 | 3.61 | 0.04 | 62.62 | 83.39 | 71.25 | 80.93 | 17.92 | 0.22 | 75.31 | 12.50 | 0.17 | 60.29 | 21.92 | 0.36 | 31.42 |
| **2020-03 25** | 20.72 | 11.37 | 0.55 | 21.20 | 24.11 | 26.41 | 19.62 | 8.43 | 0.43 | 22.87 | 6.91 | 0.30 | 23.16 | 9.69 | 0.42 | 16.30 |
| **2020-03 26** | **152.67** | **6.56** | **0.04** | **178.04** | **164.81** | **169.84** | **168.26** | **24.17** | **0.14** | **177.73** | **20.39** | **0.11** | **125.98** | **21.61** | **0.17** | **155.32** |
| **2020-03 27** | **112.45** | **14.59** | **0.13** | **121.20** | **151.04** | **141.66** | **124.54** | **20.64** | **0.17** | **126.41** | **18.41** | **0.15** | **139.24** | **28.76** | **0.21** | **99.65** |
| **2020-03 28** | 66.73 | 24.40 | 0.37 | 65.64 | 82.29 | 76.63 | 67.22 | 14.56 | 0.22 | 67.78 | 11.56 | 0.17 | 62.38 | 17.29 | 0.28 | 68.32 |
| **2020-03 29** | 47.72 | 10.27 | 0.22 | 51.98 | 63.71 | 59.56 | 51.50 | 15.62 | 0.30 | 51.63 | 13.65 | 0.26 | 49.04 | 16.50 | 0.34 | 51.81 |

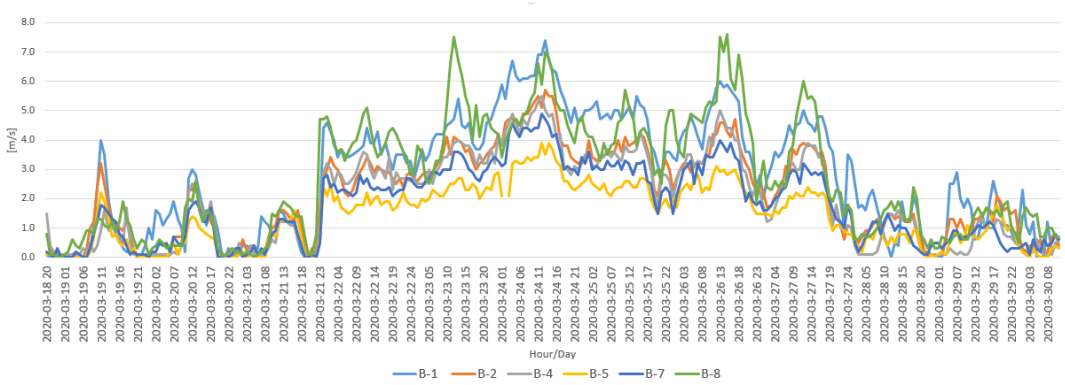


Fig. 5. Wind speed during the air pollution episode- March 24, 2020 - March 29, 2020
(Data provided by the meteo sensors from air quality station)

On April 6-7, 2020, there were several fires in the western part of the city (near Peris city – several km from Bucharest), which was reflected in slightly higher values of PM10.

On May 11, 2020, and April 24, 2019, respectively, transport of the sand from the Sahara that reached over Bucharest had no significant effect on PM10 concentrations.

From these analyzes it can be shown that the impact of the reduction of activity in Bucharest at PM10 level was significant compared to the period 2011-2019. But, during the state of emergency for 2020, it should be reiterated that there were several episodes of massive pollution caused by the resuspension of coarse particles and possible transport of particles, in unfavorable weather conditions and by the fire of vegetation on the farm in Peris (early April). From the Table 5 below, the averages calculated for different time intervals and types of conditions indicate that the reduction in activities is still reflected in the reduction of measured concentrations in traffic conditions, which supports the idea that traffic is a source of emissions, but not one of the most important.

As it could be observed in Table 5, in the absence of usual heavy traffic, severely restricted during state of emergency, the PM10 concentration shows a very slight decreasing trend which leads us to consider that traffic is a contributing factor to PM10 emissions, but not the most important.

*Table 5*

**The levels of PM10 concentration during 2020 compared with levels from 2011-2019**

| | | **2011-2019** | **2020** | | **2011-2019** | **2020** | | **2011-2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|
| | | [µg/m³] | | | [µg/m³] | | | [µg/m³] | |
| **Average-state of emergency** | All sampling points | 29.85 | 29.66 | Traffic station points (B3, B6) | 32.95 | 32.33 | Urban background sampling points (B1) | 29.85 | 29.21 |
| Average January 1-December 31 | | 31.80 | 25.92 | | 35.26 | 30.33 | | 32.61 | 29.28 |
| Average January 1-December 31 without **state of emergency** | | 32.29 | 25.84 | | 35.71 | 30.14 | | 32.37 | 28.65 |

A detailed analysis of the composition of PM10 filters and using sources apportionment models could provide us a lot of useful information for establishing the sources of emissions, as well as for establishing the adequate measures to reduce their effects in order to minimize the health risk associated to PM10 exposure. The long-term exposure to air pollution would have contributed to about 15% of all COVID-19-related deaths worldwide, according to a study by the Max Planck Institute for Chemistry in Mainz, Germany [30].

## 4. Conclusions

The crisis generated by the COVID-19 pandemic is a major challenge both the individual and the whole society level because it obliges us to find new approaches on the way we move or carry out our daily activities. The periods of restrictions (state of emergency in Romania) can also be interpreted as an opportunity to observe the evolution of air quality in an unprecedented period.

First, we can see that are coming to a normal level of our regular activities, such as the use of conventional personal transport vehicles leads to a decrease in concentrated levels of air pollutants and therefore the emphasis should be on the development of public transport as a means fast and safe or the promotion of clean means of transport.

It should be noted that working from home in many sectors of activity and the flexibility of the work schedule also led to a reduction in traffic in general and the pressure on public transport, which in turn contributed to improving air quality, given that, that the long-term exposure to air pollution would have contributed to about 15% of all COVID-19-related deaths worldwide, according to a study by the Max Planck Institute for Chemistry.

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