

## **The influence of COVID-19 on air quality in Brasov**

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**Abstract.** Population health and air quality represents the objective of nowadays. Environmental pollution represents its deterioration and involves altering the chemical and structural characteristics of the natural and anthropogenic components of the environment, diminishing the diversity or biological productivity of natural ecosystems, affecting the natural environment with effects on quality of life, mainly caused by pollution. Environmental monitoring becomes a systematic and methodical concern, achieved through various measurement systems, in order to ensure the efficient management of all social activities. The Covid-19 pandemic has left its mark on air quality, reducing the amount of harmful compounds. Consequences of "lockdown" caused by the COVID-19 have been studied in the city Brasov, from Romania country, where the amount of suspended particles of 10 microns, respectively 25 microns.

**Keywords:** *environment, coronavirus, urbanization, transport, pollution*

### **Introduction**

The environment and the population protection are major objectives of humanity, and pollutants and their degradation represent a topical issue and of particular importance. An important aspect to solving these objectives is the monitoring of pollutants. According to a new report from the European Environment Agency, air pollution contributes to one from eight deaths in Europe.

Road traffic is one of the major factors in the degradation of the environment and quality of life, especially in large urban areas; The main toxic compounds resulting from the activities of the urban environment and their influence on human health are: Benzene, sulphur or nitrogen oxides and suspended particulate matter.

### **Air quality pollution with suspended particles**

Particles in the atmosphere can be sedimentary or suspended, sedimentary particles have different sizes and densities and are deposited according to the law of gravity, unlike those in suspension that remain in the air for a long time. The particles can be in the atmosphere and in the form of assemblies, either liquid or solid, which are suspended in the air, in this form are called aerosols. The smoke contains visible aerosols, made up of very fine particles of solids resulting from the burning of fuels or various technological processes.

Atmospheric suspensions can be in the category of coarse fractions, PM10 with an aerodynamic diameter less than or equal to 10µm or in the category of fine fractions, PM2.5 with an aerodynamic

diameter less than or equal to  $2.5\mu\text{m}$ , but there are also submicron fractions, PM1 with aerodynamic diameter less than or equal to  $1\mu\text{m}$ , the schematic representation is found in figure 1.

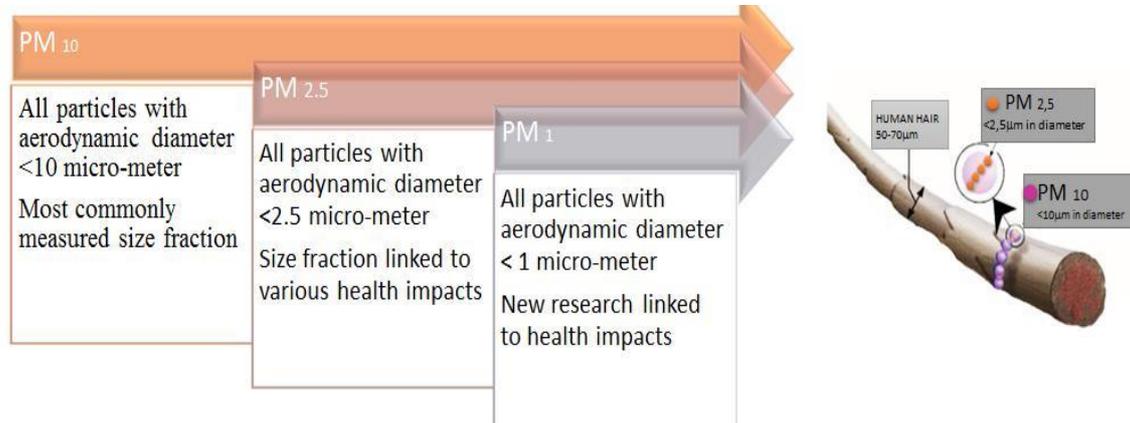


Figure 1. Illustrative representation of PM10 and PM2.5

### European policies on air quality applied in Romania

Romania is situated in the south-east part of central Europe, and is crossed by the Carpathian Arch. In June 1995, Romania applied for membership of the European Union.

One of the ways through which the EU has succeeded in pollution situation is to set mandatory and non-mandatory limits valid throughout the Union for certain airborne pollutants.

In Romania LAW no. 104 of 15 June 2011 stipulates that the limit values for suspended particles for PM10 is  $50 \mu\text{g} / \text{m}^3$  - the daily limit value for the protection of human health, respectively for PM 2.5 is  $25 \mu\text{g} / \text{m}^3$ .

Table 1 shows the limit values for suspended particles imposed by the European Union (EU) and also the values from The World Health Organization (WHO) - Air Quality Guidelines (AQG).

Table 1. Limit values for suspended particles

Pollutant	Averaging period	Standard type and concentrations
PM10	1 day	EU limit value: $50 \mu\text{g}/\text{m}^3$ WHO AQG: $50 \mu\text{g}/\text{m}^3$
	Calendar year	Limit value: $40 \mu\text{g}/\text{m}^3$ WHO AQG: $20 \mu\text{g}/\text{m}^3$
PM2.5	1 day	WHO AQG: $25 \mu\text{g}/\text{m}^3$
	Calendar Year	EU limit value: $25 \mu\text{g}/\text{m}^3$ EU exposure concentration obligation: $20 \mu\text{g}/\text{m}^3$
		EU national exposure reduction target: 0-20% reduction in exposure WHO AQG: $10 \mu\text{g}/\text{m}^3$

### The influence of the COVID-19 pandemic on air quality

COVID-19 is an infectious disease caused by the most recently discovered coronavirus. This new virus and this disease were not known before the outbreak in Wuhan, China, in December 2019, its symptoms and transmission are illustrated in figure 2.

Over a year since the first death due to COVID-19 was recorded on Jan. 11, 2020, in Wuhan, China, global deaths are set to reach 2 million. It has taken the world less than four months to go from 1 million deaths on September 2020, to 2 million on January 2021.



Figure 2. COVID-19 Symptoms and transmission.

In 2020, satellite data and the data's from city monitoring stations were widely used to monitor air quality fluctuations, following strict measures induced by the COVID-19 pandemic period.

The data show that the strongest decreases in pollution, of 20-30%, were recorded in the first quarantine period, especially in Spain, Italy and France.

In Romania, the percentage of pollution with material particles was between 5 and 10%. In July and August 2020, data's suggest that these concentrations remained 10% to 20% lower than pre-COVID levels.

For example, Copernicus Sentinel-5P satellite data are showing strong reductions in nitrogen dioxide concentrations over several major cities across Europe (Figure 3).

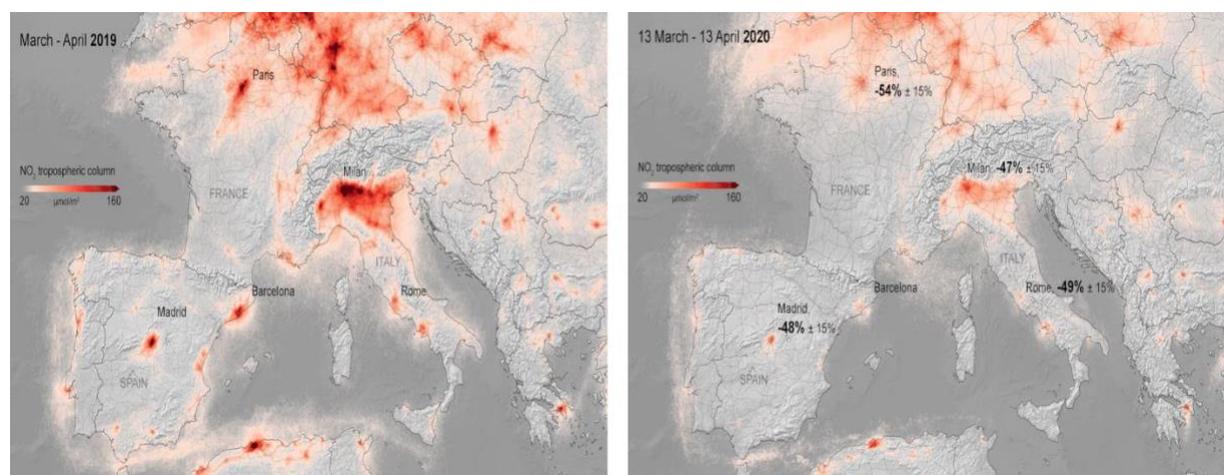
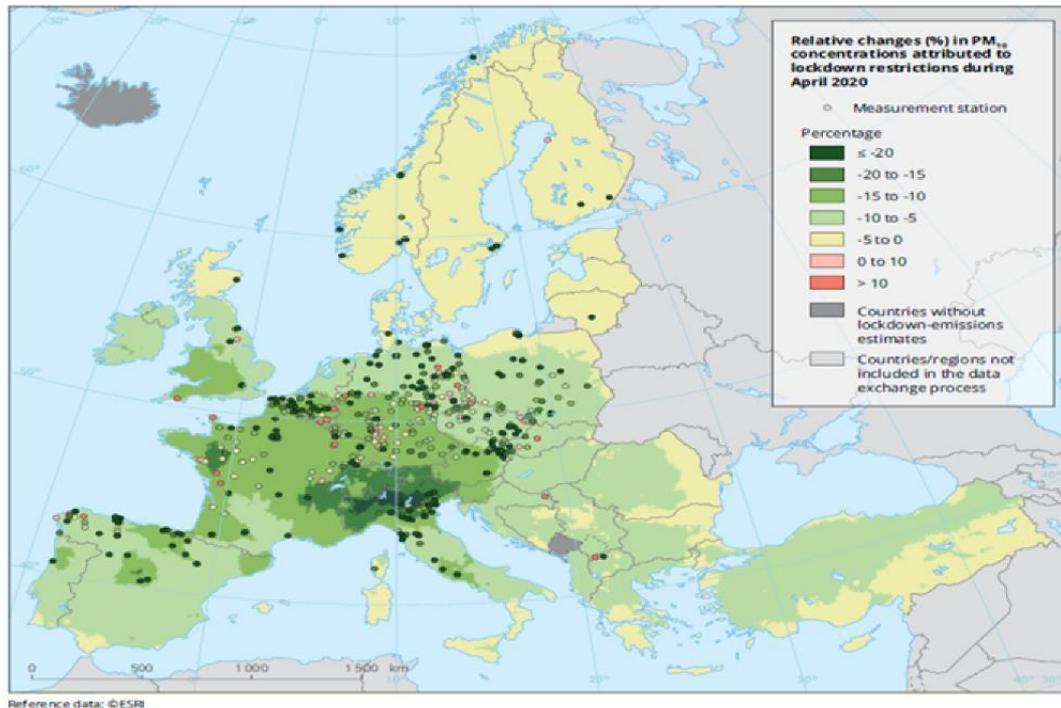


Figure 3. Coronavirus lockdown leading to drop in pollution across Europe [Image: European Space Agency].

The coloured dots which are represented in the bottom figure show that for the large majority of PM10 stations the generalized additive model (GAM) presents a decrease in concentrations during the lockdown period. The largest reductions were estimated at traffic stations in Spain with an average reduction of almost 40 % and also in Italy the average reduction was of almost 35 %, followed by France and Norway with an approximately 25 % reduction in PM10 concentrations at traffic stations. The lowest relative reductions were estimated at rural background stations, like the northeast part of Europe (Figure 4).



**Figure 4.** Relative changes (%) in PM10 concentration attributed to lockdown restrictions during April 2020 [1]

The dots represent measurements stations, where the changes have been estimated using UTD monitoring data and the GAM. The background shading represents the changes estimated using CAMS chemical transport modelling with an emission inventory estimated for the lockdown conditions.

Air quality in Romania is constantly monitored at measuring stations, distributed across the entire territory of the country, which are part of the automatic air quality monitoring network.

In accordance with the World Health Organization's guidelines, the air quality in Romania is considered moderately unsafe. The most recent data indicates the country's annual mean concentration of PM10 is  $30\mu\text{g}/\text{m}^3$  which exceeds the recommended maximum of  $20\mu\text{g}/\text{m}^3$ .

Contributors to poor air quality in Romania include power generation, the mining industry, petroleum refining, food processing, and vehicle emissions.

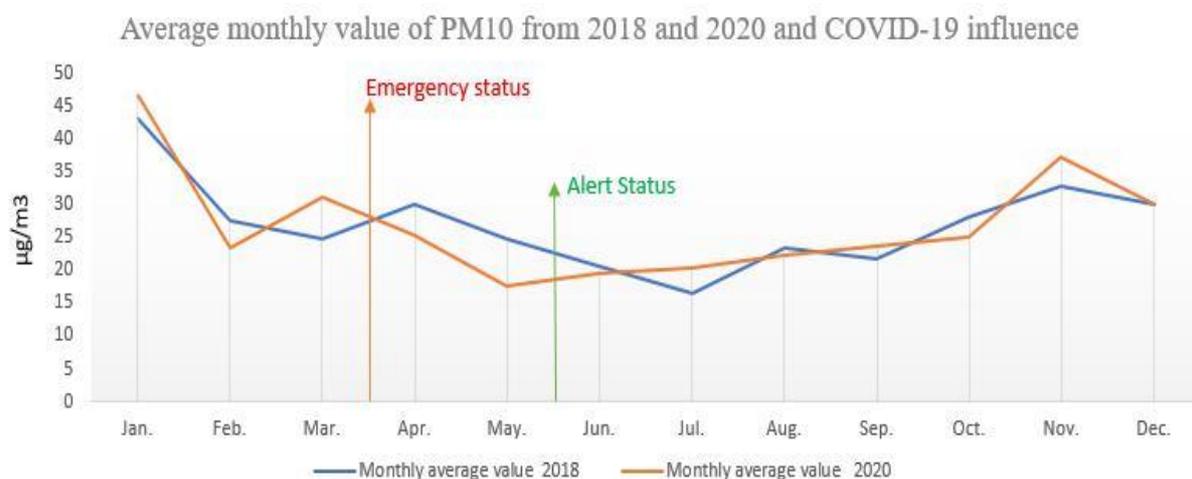
### **The influence of the COVID-19 pandemic on the air quality in Brasov**

The most polluted Romanian city is Iasi, the top three is completed by Cluj-Napoca and the mountain city Brasov, which is Romania's 7th largest city, with a population of around 250,000 inhabitants, and the biggest one in the Development Region Centre.

The air quality in the Brasov agglomeration is monitored by continuous measurements in 6 automatic stations located, according to the criteria indicated by the legislation, in representative areas for each type of station.

Law 104/2011 on ambient air quality established the agglomeration of Brasov within the administrative limits of the municipality of Brasov, the agglomeration representing an area with a population exceeding 250,000 inhabitants, thus justifying the need to evaluate and manage ambient air.

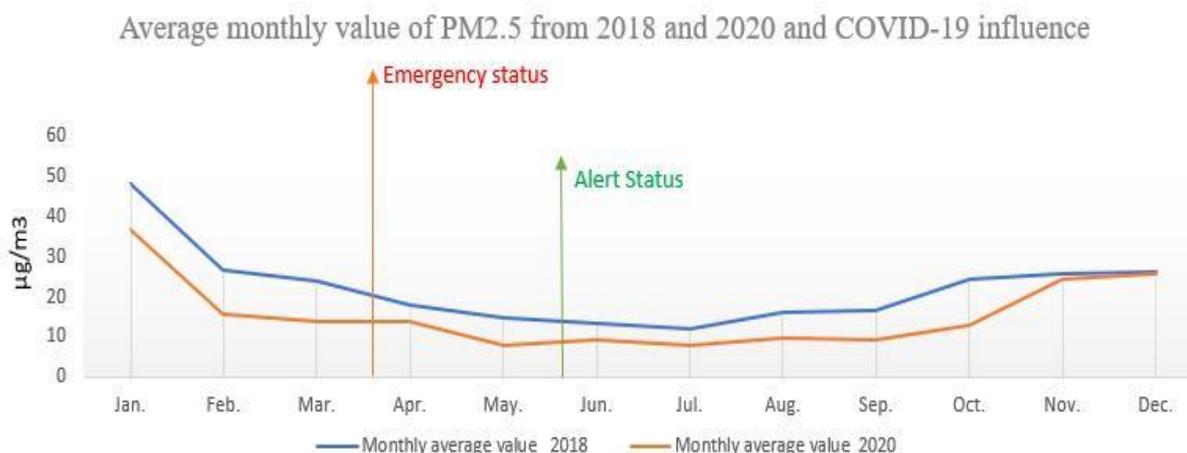
With the help of the data's from the air quality reports from Brasov, the average monthly quantity of PM10 measured in 2018 was represented in figure 5 also with the quantity from 2020, at the same time, the state of emergency was marked in this representation, where the majority of the population unfolded activity from home. In the state of emergency, only justified situations were accepted, such as the provision of goods or medical necessities. The state of alert was also marked, but in this period the restrictions were much more permissive.



**Figure 5.** Average monthly value of PM10 from 2018 and 2020 and COVID-19 influence

The average monthly amount of PM2.5 measured in 2018 and the amount in 2020, marking the same periods, respectively emergency and alert it is showed in figure 6.

The higher values in the frosty months are due to the degree of dispersion of the pollutant, because the wind speed is not high, as in the hot months.



**Figure 6.** Average monthly value of PM2.5 from 2018 and 2020 and COVID-19 influence

The influence of the COVID-19 pandemic period for air quality is demonstrated in figure number 5 and number 6, for example in April (lockdown) was the month that recorded a considerable decrease in the average monthly values of material particles generated. But in both figures there is a reduction throughout the year 2020. As road traffic has decreased considerably, the urbanization phenomenon stagnating during the Covid-19 pandemic.

### **Conclusions**

The present paper aimed to present the positive effects that the "lockdown" period brought on air quality in Brasov. With the help of the obtained results it can be said that the amount of polluting results was much lower in year 2020, despite the fact that the pollution increased from year to year. So the population breathed a much cleaner air than in previous years.

It is very important to pay attention to air quality because the effects of pollution with PM10 and PM 2.5 are very dangerous for human health, for example, long-term (months to years) exposure to PM2.5 has been linked to premature death, particularly in people who have chronic heart or lung diseases, and reduced lung function growth in children. The effects of long-term exposure to PM10 are less clear, although several studies suggest a link between long-term PM10 exposure and respiratory mortality. Also particles can be carried over long distances by wind and then settle on ground or water. Depending on their chemical composition, the effects of this settling may include changings by the nutrient balance in coastal waters and large river basins or are depleting the nutrients in soil, also are damaging sensitive forests and farm crops, in short it affects the diversity of ecosystems.

For a sustainable development of the world, we must be aware that we are largely responsible for air quality, the restrictions during the COVID-19 pandemic showing the positive effects of air quality.

### **References**

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