

THE TREND OF PARTICULATE MATTER (PM₁₀) CONCENTRATIONS IN THE WESTERN PART OF ROMANIA

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Abstract: Particulate matter (PM) is one of the most known air pollutant and is formed as a mixture of solid particles and liquid droplets. From them, PM₁₀ are the inhalable particles with diameters smaller than 10 micrometers. Such particles could create seriously health problems for the population as increases the risk of lung cancer and heart diseases. Due to those effects on the human health, the concentrations of PM₁₀ are monitored as a daily routine by National Environmental Agency. The present study compare the concentration of PM₁₀ (as has been reported by National Environmental Agency) during the last three years in the West part of Romania (Timisoara, Arad, Satu Mare and Bihor County). For all county the medium concentrations are under their legal limits (40 µg/m³) with very few exceptions. The highest concentrations have been found in winter due to heating and higher transport fluxes. The maximum concentrations are higher than the daily legal limits (50 µg/m³) mainly in Arad probably due to the high traffic. Anyway, compare with the European trend, the daily concentration limit have been overtaken very few times (less than ten).

Keywords: particulate matter, air pollution, human health

INTRODUCTION

Particulate matter (also called particle pollution) are a complex mixture of liquid droplets and solid particles with different composition and sources. The size of those particles vary between approximately 0.002 and 100 µm aerodynamic diameters. The classification of particulate matter are function of their diameters. Usually, could be distinguish coarse, fine and ultrafine particles as their diameter is less than 10 µm (PM₁₀), 2.5 µm (PM_{2.5}) and 0.1 µm respectively (PM_{0.1}) (Muhlfeld, et al., 2008). The main sources for those pollutants are divided in two main classes: primary (as incomplete combustion, automobile emission, dust or domestic fuel burning) and secondary (particles are formed in the atmospheric reactions) (Kelly and Fussell, 2016, Naidja, et al., 2018). Furthermore, the sources could be anthropogenic as industrial or households and natural as dust, soil, sea salt. In the case of PM₁₀ the main contribution of globally world emission has traffic (25%) followed by natural dust and sea salt (22%), industrial activity(18%), and from domestic fuel burning (15%) (Karagulian, et al., 2015). In Central and Eastern Europe, the main contributor of PM₁₀ emission is domestic fuel burning (45%) while in Middle East and

Southwestern Europe the main source are natural (mainly dust and seasalt) with represent 44% and 39% form total, respectively (Karagulian, et al., 2015). In Romania it has been found that in urban area the main source of PM₁₀ is traffic and fuel burning while in rural zones the natural sources are predominated (Roba, et al., 2014).

Regarding to human health it well known that exposure to PM on short-term or long-term determine negative effects. The influence of PM to human health include lung cancer (Wang, et al., 2018), cardiac and respiratory disease (Lipfert, 2018, Pan, et al., 2018, Wang, Zhang, et al., 2018) even diabetes and pregnancy-birth endpoints (Lipfert, 2018). The main transport mechanism of those particles in the lung is diffusion with only minimal contributions of gravitation or inertia. Therefore, PM₁₀ reach the alveolar region and are not retained in the trachea bronchiolar region (Muhlfeld, Rothen-Rutishauser, et al., 2008). Cellular responses to particle exposure include the generation of reactive oxygen (ROS) and nitrogen species (RNS), the release of proinflammatory, inflammation-associated proteins, and injury of nuclear DNA (Muhlfeld, et al., 2008). Recently, it has been found a link between PM exposure and metabolic syndrome (Matthiessen, et al.,

2018) and the fact that a medium-term PM exposures were positively associated with glucose increases in nondiabetic adults (Lucht, et al., 2018).

The goal of our study has been to show the PM10 trend in four county in Northwest Romania over the last three years.

MATERIALS AND METHODS

The data have been provided by National Agency for Environmental Protection. All data regarding to PM10 for Arad (AR), Bihor (BH), Satu Mare (SM) and Timis (TM) for 3 years (2015-2017) have been downloaded from (<http://www.anpm.ro/raport-de-medi>) and processing using Origin 8.0 (OriginLab Corporation, USA). The monitoring station for every county have been situated in the city centre of the town.

RESULTS AND DISCUSSIONS

Arad (AR), Bihor (BH), Satu Mare (SM) and Timis (TM) counties are located in the west part of Romania at the border with Hungary and Serbia. The air quality in this region is consider good. The trends for PM10 concentration are presented in Figure 1.

For all counties, the emission of PM10 have been shown the same trend with high values in the winter months and lower ones in the summer. Anyway, the emission of such particles exceed the approved level ($40 \mu\text{g}/\text{m}^3$) only punctually in winter 2017 for Arad and in winter 2015 for Bihor. The source for such high emissions in winter are the heating of houses and road transportation. Such trend of PM 10 emissions are compare with the ones found in Stockholm, Gothenburg, and Malmoover 2005-2017 (Olstrup et al., 2018). The total emission of particulate in suspension are decreasing in Romania from 16000 tones/year in 2002 at 5300 tones/year in 2015 which are collaborated with the fact that all emission of pollutants as SO_2 , NO_x , CO_2 are decreasing. PM10 concentration decrease with 78 % in 2015 compare with 2002 while over the period of 2009-2015 the values are almost constant.

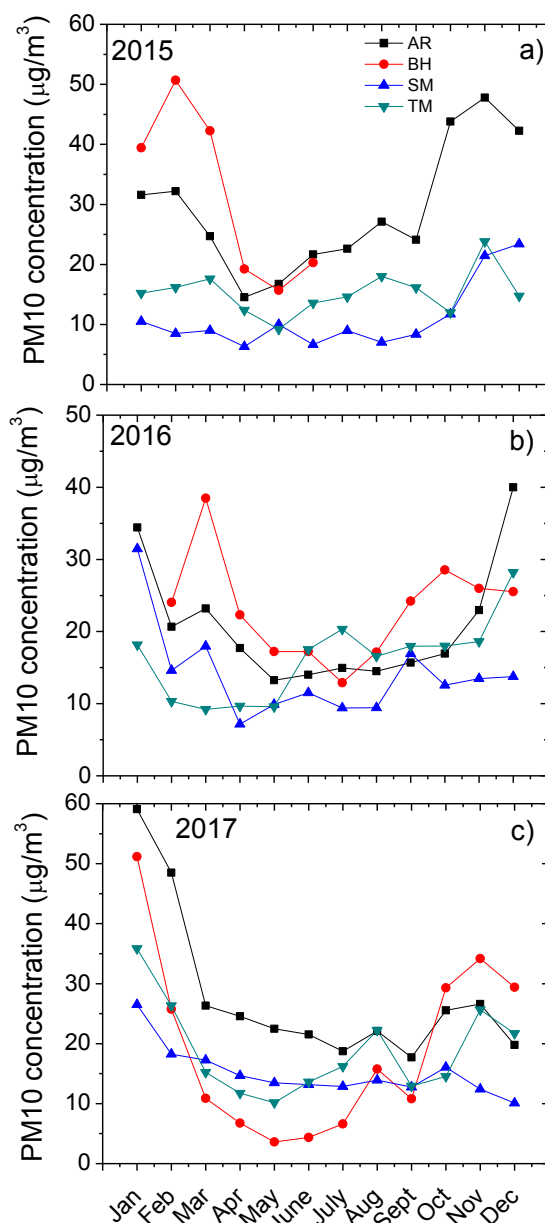
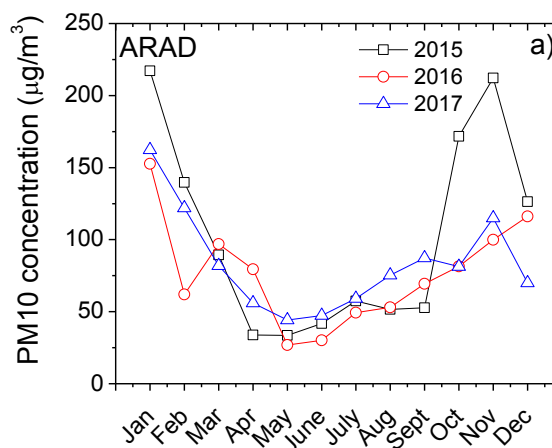


Figure 1. The evolution of the average PM10 concentration over the year for 2015 (a), 2016 (b) and 2017 (c)



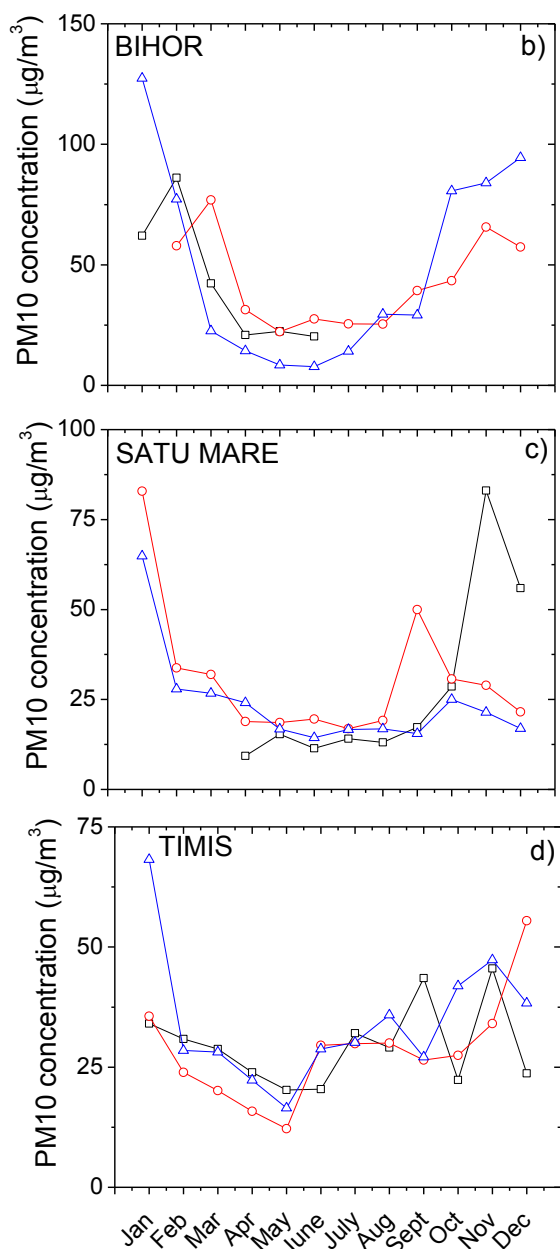


Figure 2. The evolution of maximum concentration over 3 years for counties in the west part of Romania

Regarding to the highest values of PM10 over every months there are many values which are over the approved limits. In Arad for example the PM10 concentrations exceed $150 \mu\text{g}/\text{m}^3$ every year in January. The presence of PM10 particles in the air at such high concentration could determine important health concerns as respiratory problems or cardiological diseases.

In contrast, in Timis county the PM10 concentrations the approved limits only ones in January. Such difference could be due to the fact that in Timis the monitoring station is situated in the city centre (a pedestrian zone) while in Arad

is in the most circulated intersection. Anyway, such behaviour could underline that the traffic is the most important sources of particles in the atmosphere.

CONCLUSIONS

In the present study it has been shown the trend of particles matter PM 10 over the year in four counties. The average values are mostly under the legal limits. On the other hand, the maximum values exceed in Arad $200 \mu\text{g}/\text{m}^3$ which is over the attention limits regarding to human health.

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