# COMPARATIVE RESULTS OF FOUR CAMPAIGNS MEASUREMENTS ACCOMPLISHED IN URBAN AND PERIURBAN OF THE TIMIŞ COUNTY

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**REZUMAT. Lucrarea prezintă un studiu al calităţii aerului efectuat pentru mai multe campanii de monitorizare in patru oraşele din judeţul Timiş. Campaniile de monitorizare au fost efectuate cu Laboratorul mobil din cadrul Universităţii „Politehnica" din Timişoara, care funcţionează după standardul ISO/CEN 17025:2005, standard care asigură calitatea pentru laboratoarele analitice. Laboratorul mobil este echipat cu instrumente, care sunt în conformitate cu metodele referenţiale ale lui ISO/CEN 17025:2005, şi au o capacitate de a înregistra datele cu o frecvenţă de eşantionare de 10 s/eşantion. Majoritatea poluanţilor, $O_3$, CO, $SO_2$, $NO/NO_2/NO_x$, $CH_4$/NMHC/THC şi PM10 au fost monitorizaţi şi înregistraţi continuu pentru o perioadă de 7 zile.**

**Cuvinte cheie:** calitatea aerului, campanii, poluanţi, metode de referinţă.

**ABSTRACT. The present paper reveals a study of air quality monitoring campaigns performed in four towns in Timiş County. The monitoring campaigns were performed by Politehnica University of Timişoara Mobile Laboratory Station that has implemented the ISO/CEN 17025:2005 standards for quality assurance in analytic laboratories. The mobile laboratory station is equipped whit instruments that are in compliance whit the reference methods of the ISO/CEN 17025:2005, and has a capacity of recording data whit a sampling frequency of 10 s/sam. Major pollutants, $O_3$, CO, $SO_2$, $NO/NO_2/NO_x$, $CH_4$/NMHC/THC and PM10 were monitored and recorded continuously for a period of 7 days.**

**Key words:** Air quality, campaigns, major pollutants, reference methods.

## 1. INTRODUCTION

Air quality evaluation is important for assessing the nature of population exposure to air pollution. Assessment of population exposure is necessary for health impact assessment, which in turn is crucial for developing plans for air quality management and protecting the public health [1].

Human exposure to air pollutants may result in a variety of health effects depending on the type of pollutant; the magnitude, duration and frequency of exposure; and the associated toxicity of the specific pollutant. People come in contact with pollutants in the air both indoors and outdoors during their daily activities. Consequently, the differences in the sources and composition of indoor and outdoor pollutants and their relative contribution to total personal exposure should be recognized [1, 2, 3].

Air quality management includes all activities aimed at managing air quality in the environment. The aim of air quality management is to keep the ambient air clean enough so that it is safe for the public health and the environment [4, 6].

The monitoring of ambient air quality focuses on the concentrations of outdoor pollutants. Different time-activity patterns and microenvironments determine personal exposure. The exposure to outdoor pollutants determines the dose to human lungs and, subsequently, the dose delivered to the different target body organs. The pollutant dose received by the different biological systems along with the toxicity of the pollutant or its metabolites, as well as individual susceptibility, and then determines the individual health effects. Thus, the monitoring results at best only indirectly indicate the risk of potential health effects. Even though exposure is a reasonable measure of risks to health, different people exposed similarly may receive different doses of the same pollutant and may experience dissimilar health effects. To account for the exacerbated reaction of the sensitive people, the exposure levels of various population groups should be assesed, especially vulnerable ones such as children, elderly people and handicapped people. This involves evaluating human time–activity patterns and micro-environmental concentrations for different population groups [7, 9].

The sources of ambient air pollution, especially in urban environments, are often quite diverse. These sources can be broadly classified as stationary, mobile and area emission sources. Emissions of pollution from these three classes of sources typically result in complex spatial and temporal distributions of ambient air pollution concentrations. Emission inventories form a cornerstone for planning a monitoring strategy. Many

air pollutants have the highest ground-level concentrations near the local sources. Emission inventories indicate the areas where the emissions of air pollutants are highest, and thus, where the concentration hot spots might be expected [5, 8].

In the present paper a study regarding the impact of major pollutants upon the environment mainly cultural sites and people that are in the closure of the sites in Timis county is presented. The study was performed by the „Politehnica“ University of Timişoara Air Quality Mobile Laboratory that is certified by RENAR in accordance whit ISO/CEN 17025:2005. Four cities were chosen to perform the air quality monitoring campaigns. The criteria for witch ware chosen were: number of inhabitants, surface, geographic position and cultural sites. The cities chosen for this study ware: Timişoara, Sânicolau Mare, Buziaş and Lugoj.

## 2. MOBILE LABORATORY DESCRIPTION

### 2.1. Mobile laboratory equipment

The mobile laboratory is equipped with reference point instruments for major pollutants, measuring $SO_2$, $O_3$, $NO_x$, CO, $CH_4$, NMHC, THC and PM10). Meteorological sensors (wind speed and direction, air temperature, pressure and humidity) are mounted around the mobile laboratories. The following pollutants have been continuously measured, with 10 second resolution, over the entire measuring episode with high precision equipment:

– $SO_2$, is measured with HORIBA APSA370 instrument, measurement principle is UV fluorescence, reference method: EN 14212:2005. The combined measurement uncertainty is U = 1.76 % for recorded values;

– NO, $NO_2$ and $NO_x$, is measured with HORIBA APNA370 instrument, measurement principle is chemiluminescences - reference method: EN 14211: 2005. The combined measurement uncertainty is $U$ = 2.06 % for recorded values;

– $O_3$, is measured with HORIBA APOA370 instrument, measurement principle is UV photometry - reference method: EN 14625:2005. The combined measurement uncertainty is U = 6.98 % for recorded values;

– CO, is measured with HORIBA APMA370 instrument, measurement principle is NDIR (Non-Dispersive Infrared) - reference method EN 14626: 2005. The combined measurement uncertainty is $U$ = 4 % for recorded values;

– CH4, NMHC and THC measured with Horiba APHA370 instrument, measurement principle is FID (flame ionization detection) - reference method EN 12619:2002. The combined measurement uncertainty is $U$ = 0.9 % for recorded values;

– PM10 (suspended particles, fraction PM10), Sven Leckel LVS3, measurement principle is gravimetric.

The equipment is part of the air quality monitoring mobile laboratory and procedures used are in full compliance with ISO/CEN 17025:2005 standard for quality assurance in analytic laboratories. Linde and DKD (Deutsche Kalibrierdienst) calibrations gases (NO, $SO_2$, CO, $CH_4$ in $N_2$) whith trasability were used.

## 3. RESULTS

### 3.1. Air quality monitoring campaign in Timişoara

One reference measurement point in Timişoara is Queen Maria Square in front of the Piaristi Complex (fig. 1). For seven days the air quality monitoring station was submitted to assess the pollution.


**Fig. 1.** Position of the air quality monitoring station in Queen Maria Square – Piaristi Complex [10].

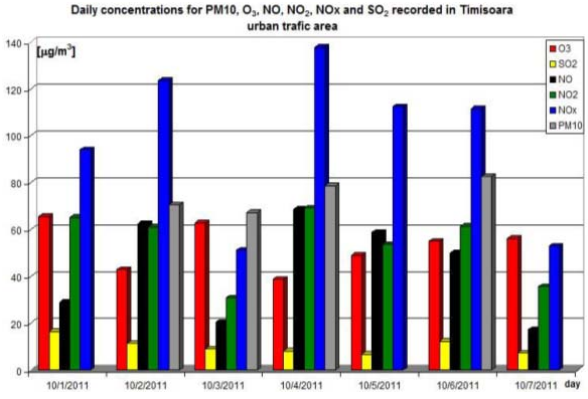


**Fig. 2.** Daily mean concentration of major pollutants in Timişoara – Piaristi Complex area [10].

## 3.2. Air quality monitoring campaign in Sânnicolau Mare

The second air quality measurement campaigns were performed in Sânnicolau Mare. The sampling method used in the second air quality measurement campaign is the same and in compliance whit the laboratory standard procedures.

Sânnicolau Mare was chosen as second air quality measurement campaign due to the fact that is located in the most western part of Romania, it is attested as Town and has a population under 13 000 inhabitants.

In Figure 3 is presented the position of the air quality mobile station in Sânnicolau Mare.


**Fig. 3.** Location of the air quality mobile station in Sânnicolau Mare [11].

The location chosen for the air quality mobile station was in central part of the town, in front of the Nako Castel.

In Figure 4 results of the daily mean values for Sânnicolau Mare are presented.

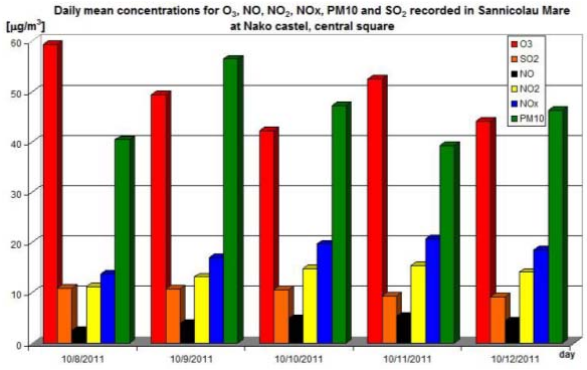


**Fig. 4.** daily mean concentration of major pollutants in Sânnicolau Mare – Nako Castel [11].

## 3.3. Air quality monitoring campaign in Buziaș

The third air quality monitoring campaign was chosed to be performed in Buziaș. Buziaș is a town that has a population of 7738 according to the latest census. Although it has a lower number of attested inhabitants Buziaș is a resort whit thermal baths, and the number of tourists that visit the town during the year is more than 2 times the population of the town, an air quality monitoring campaign was needed.

In figure 5 is presented the location of the air quality monitoring station in Buziaș.


**Fig. 5.** Air quality mobile station situated in the Colonnade/Dendrology park [12].

The results of the air quality measurement campaigns presented as mean daily values are frizzed in figure 6.

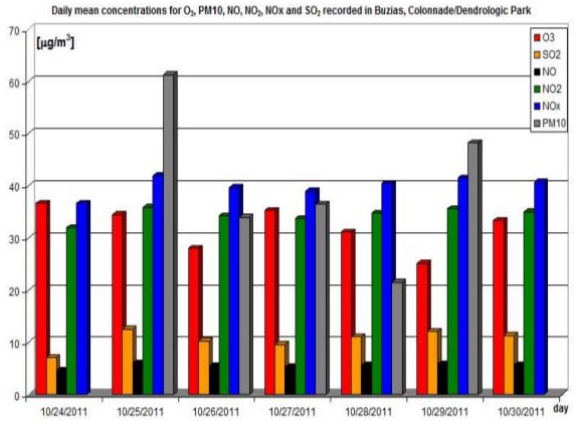


**Fig. 6.** Daily mean values of the results in Buziaș air quality monitoring campaign [12]

## 3.4. Air quality monitoring campaign in Lugoj

The fourth air quality monitoring campaign chosen for the study was selected to be performed in Lugoj. The measurement principle applied in this situation was the same.

Lugoj is a city in Timiş County, Banat, western Romania, situated on both banks of the Timis River (which divides the city in two halves, the so called Romanian Lugoj on the right and the German Lugoj on the left bank. Taking into consideration the numbers of inhabitants, Lugoj is the second town in Timis County.

The position chosen as reference point in air quality measurement campaign was near the Dragan Univeristy square (Fig. 7)

**Fig. 7.** Dragan University Square [13].

Results of the mean daily values of the major pollutants for Lugoj air quality monitoring episode are presented in figure 8.

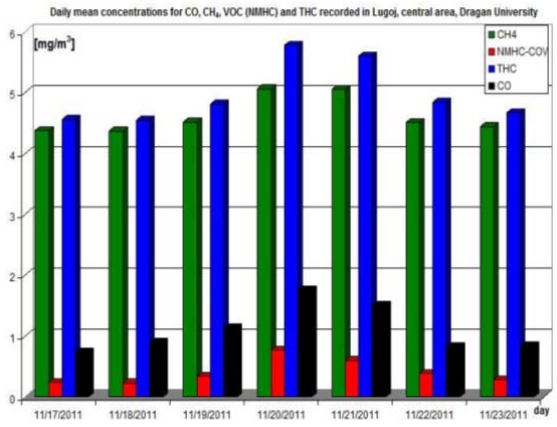


**Fig. 8.** Daily mean values of the results in Lugoj air quality monitoring campaign [13].

## 4. CONCLUSIONS AND COMPARISONS

### 4.1 Conclusions regarding the Timişoara air quality monitoring campaign

The entire data recorded for PM10 concentration are above allowed limit of 50 μg/m$^3$. The hourly concentration measured for $NO_x$ is above the allowed limit of 200 μg/m$^3$ in all days, with high peaks in morning/afternoon and evening hours, directly connected with road traffic.

The $SO_2$ and CO hourly and daily concentrations are well under the allowed limits.

Of major concern are the daily concentrations measured for $NO_2$, higher than 40 μg/m$^3$, in all situations. The critical yearly allowed level for the protection of vegetation is 30 μg/m$^3$ of $NO_x$ and the allowed yearly limit for human health protection is 40 μg/m$^3$ of $NO_2$.

Even if the duration of the AQM campaign was short, the fact that in all days the yearly critical and yearly limits for $NO_2$ and $NO_x$ are exceeded daily is of major concern.

The high concentrations measured for $NO/NO_2/NO_x$ constantly are of major concern for the preservation of the monuments in the area, Piarist Complex.

### 4.2. Conclusions regarding the Sannicolau Mare air quality monitoring campaign

From the data presented in this report we can observe that for the Sânnicolau central square, front of Nako Castle location the concentrations of all relevant pollutants is well under the EU air quality standards. The location was chosen in order to obtain an overview of the background air pollution in the vicinity of the most representative Sannicolau cultural site, Nako Castle. The concentration recorded for $NO_x$ and $SO_2$ are very low, up to 40 μg/m$^3$ of $NO_x$ and up to 10 μg/m$^3$ of $SO_2$, so that those pollutants with high possible potential to form airborne acids and to erode construction are not of concern for the preservation of Nako Castle. The $CH_4$ concentration was higher than normal background, most probably due to influence of nearby thermal springs or local known geothermal reservoir.

### 4.3. Conclusions regarding the Buziaș air quality monitoring campaign

From the data presented in this report one can observe that all recorded pollutants concentrations are very low under the EU limits, and that the quality of air in the Colonnade/Dendrology park in Buzias is very good, making it ideal for his past, today and future purposes: spa, recreation and health/tonus recovery.

### 4.4. Conclusions regarding the Lugoj air quality monitoring campaign

From the results presented an conclusion regarding the hourly concentration measured for $NO_x$ presents several peaks of 200 μg/m$^3$ in 21$^{nd}$ and 22$^{nd}$

November, higher peaks occurring in morning and evening hours, probably related with road traffic.

Regarding the $SO_2$ and CO hourly and daily concentrations are well under the allowed limits.

One concern are the hourly concentrations measured for $NO/NO_2/NO_x$, with peaks of 200 $\mu g/m^3$ recorded at about 100 meters away of the Huniade street and 20 December 1989 street, as the major amount of the city traffic is on those streets, trough the main bridge over the Timis river. The city has one automated air quality monitoring station TM-7, managed by Romanian National Agency for Environmental Protection (www.calitateaer.ro), located on the Cotu Mic street, where environmental results can by cosulted.

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