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GOVERNMENT OF ROMANIA

GOVERNMENT OF THE REPUBLIC OF SERBIA

Structural Funds 2007 - 2013

UNIVERSITY „POLITEHNICA" from TIMISOARA

ZRENJANIN/ELEMIR AIR QUALITY MONITORING REPORT

TO:

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Results of the Air Quality Monitoring Campaign in Zrenjanin/Elemir

Joint Campaign

Location: Zrenjanin city (Gerontological Center) and Elemir suburb
Coordinates of the AQM stations:
Zrenjanin / Gerontoloski Centar: 45°230362 N , 20°243964 E, altitude 79 m
Elemir: 45°263405 N , 20°175370 E, altitude 79 m
Start on: 5 august 2011 and ended in 10 august 2011
Experts for Romanian team: Francisc Popescu, Nicolae Lontis, Virgil Stoica, Gavrilă Trif-Tordai
Experts for Serbian team: Milan Pavlovic, Slobodan Jankovic, Aleksandar Djuric, Aleksandar Pavlovic, Milan Nikolic, Branko Davidovic

Overview of the Zrenjanin monitoring site:

Zrenjanin is the biggest city of the Serbian part of Banat and it is its political, economic, cultural, and sports center. According to the square area of the territory that administratively belongs to it (1,326 km2), Zrenjanin is the biggest city in the Autonomous Province (AP) of Vojvodina and the second one in the Republic of Serbia, with around 140 thousand inhabitants and over 20 nations living in it. Its development has lasted for almost seven centuries, because, as a settlement under the name of Becskerek, it was first recorded in historical documents way back in 1326.

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Today, when you come to Zrenjanin, you are coming to the city of multi-culturalism, multi-denominationalism, and tolerance among nations, you are coming to the city of culture, arts, sports, to the city of bridges, the city of the young ones, and the to city of vigorous economic growth. Zrenjanin can be recognized by glee clubs of international reputation, the National Museum or Historical Archives, the best ones in Serbia in 2007, but also by sports names of Dejan Bodiroga, Snežana Perić, Grbić brothers, Ivan Lendjer, Ivana Španović or Maja Ognjenović. It can also be recognized by superior performances of the puppet theater, and by the watercolor colony gatherings, but also by numerous cultural events in the course of the traditional tourist and commercial event "Beer Days", which has been held in the last week of August for already 23 years. After being known as "the biggest food factory in the Balkans", the foodstuffs industry of which had been the main supplier of the entire market of the former Yugoslavia, and after it has got over difficult years and the period of transition, today, Zrenjanin is one of the most attractive cities for investment in Serbia. It received such flattering plaudits in 2006, from the US Agency for International Development USAID, after the competition between the local self-governments with respect to the conditions created for doing business called "Invest in Serbia".

At the crossroad of major inland routes and waterways, 50 kilometers away from Novi Sad, 75 from Belgrade, and 50 from the border with the European Union (Romania), Zrenjanin is nowadays an open city, ready to accept new ideas, way of business thinking or development of new technologies. Zrenjanin is also the city of traditional hospitality and opportunities for a pleasant stay in its environs.

Citation from http://www.zrenjanin.rs/

The monitoring station was located on the Zrenjanin Gerontoloski Centar entrance from the Svetozare Miletica street.

Equipment used in the monitoring campaign in Zrenjanin, location Gerontoloski Centar

In table 1 the measurement techniques involved, equipments and the measurement uncertainty is presented.

Table.1. Equipments used and relevant informations.

Pollutant	Methods	Standard	Equipment	Measurement uncertainty
CO	NDIR	EN 14626:2005	Environnement CO12M	4 %
NO (NO2, NOx)	Chemiluminescence	EN 14211:2005	Environnement AC31M	2.06 %
O3	UV photometry	EN 14625:2005	Environnement O341M	6.98 %
CH4, NMHC, THC	FID (flame ionization detection)	EN 12619:2002 EN 13526:2002	Horiba APHA 370	0.9 %
SO2	UV fluorescence	EN 14212:2005	Environnement AF21M	1.76 %
PM10	Gravimetric / Light scattering	EN12341	TSI Dusttrack	5 %
Wind speed and direction, air pressure, temperature and humidity	Professional mobile wetter station	-	KRONEIS	-

The equipments are 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. The laboratory is the property of "Politehnica" University of Timisoara and more details and information's (including certifications) can be found on www.mediu.ro. Linde and DKD (Deutsche Kalibrierdienst) calibrations gases (NO, SO2, CO, CH4 in N2) were used.

Monitoring results.

The mobile laboratory is equipped with reference point instruments for major pollutants (SO_2, O_3, NOx, 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** measured with Environnement AF21M 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 **NOx** measured with Environnement AC31M instrument, measurement principle is chemiluminescences, reference method: EN 14211:2005. The combined measurement uncertainty is U = 2.06 % for recorded values;
- **O_3** measured with Environnement O341M instrument, measurement principle is UV photometry, reference method: EN 14625:2005. The combined measurement uncertainty is U = 6.98 % for recorded values;
- **CO** and **CO_2** measured with Environnement CO12M instrument, measurement principle is NDIR (Non Dispersive Infrared), reference method EN 14626:2005. The combined measurement uncertainty is U = 4 % for recorded values;
- **CH_4**, **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), TSI DUSTTRACK, measurement principle is light scattering / laser.

In table 2 the resulted values for daily mean values for all pollutants are presented.

Table 2. Daily mean values for relevant pollutant concentration in ambient air

Timp	O_3 $\mu g/m^3$	SO_2 $\mu g/m^3$	NO $\mu g/m^3$	NO_2 $\mu g/m^3$	NO_x $\mu g/m^3$	CH_4 mg/m^3	NMHC mg/m^3	THC mg/m^3	CO mg/m^3	CO2 ppm	PM10 $\mu g/m^3$
08/05/11	14.91	3.71	10.70	12.85	23.55	4.22	0.26	4.48	0.42	397.74	38.553
08/06/11	40.29	3.05	9.98	16.64	26.63	3.99	0.21	4.20	0.76	368.14	34.285
08/07/11	41.32	3.21	10.25	19.00	29.26	3.97	0.26	4.23	0.87	351.45	48.704
08/08/11	55.19	4.28	12.62	23.58	36.20	3.95	0.31	4.26	1.42	360.50	55.340
08/09/11	18.54	4.05	14.92	19.03	33.95	4.03	0.36	4.39	1.45	355.24	44.563
08/10/11	19.07	3.03	9.37	14.23	23.60	4.19	0.37	4.56	1.16	355.66	41.061

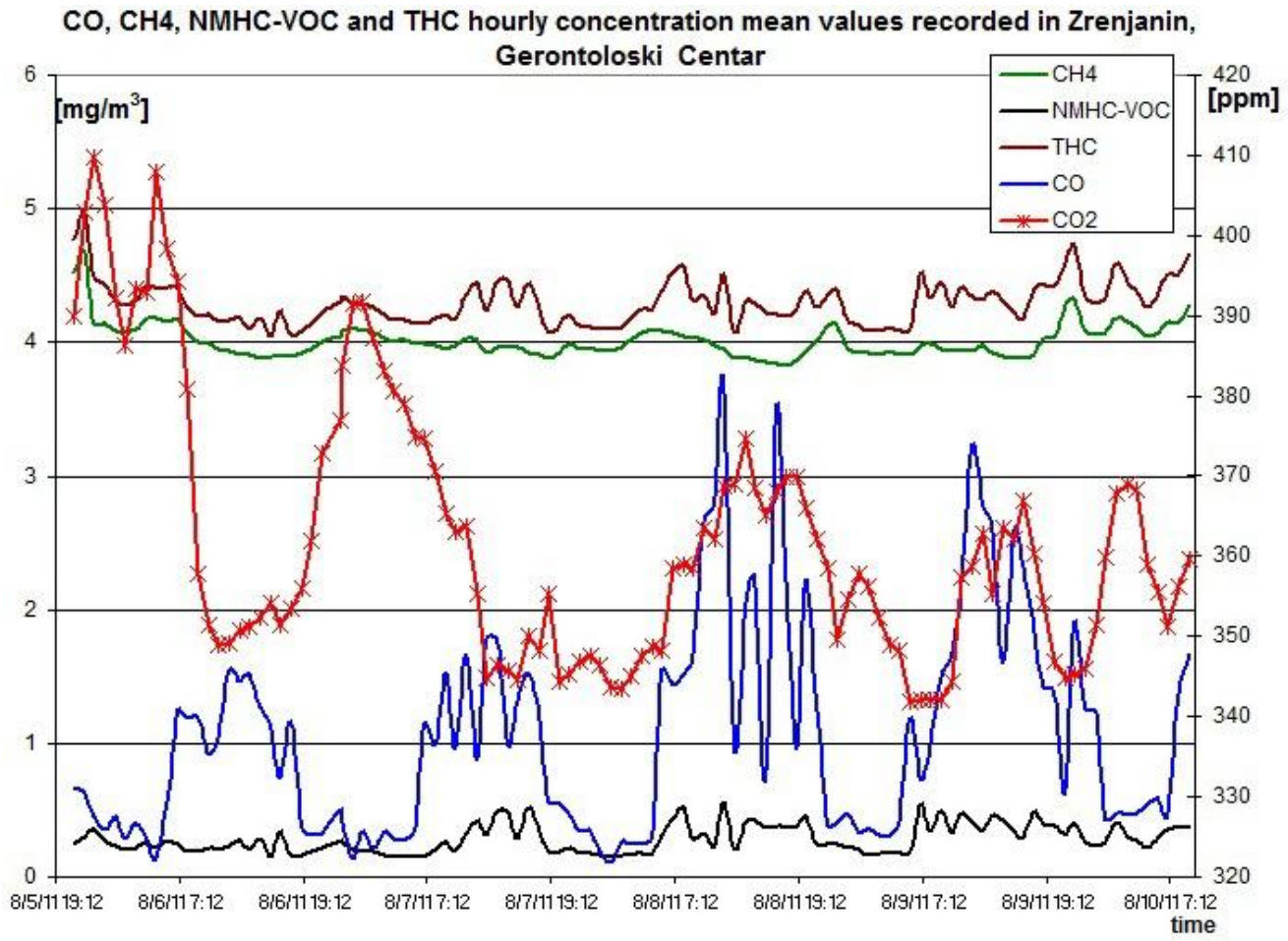

Fig 1. Hourly mean values recorded for CO2, CH4, NMHC, THC and CO in Zrenjanin, location Gerontological Center

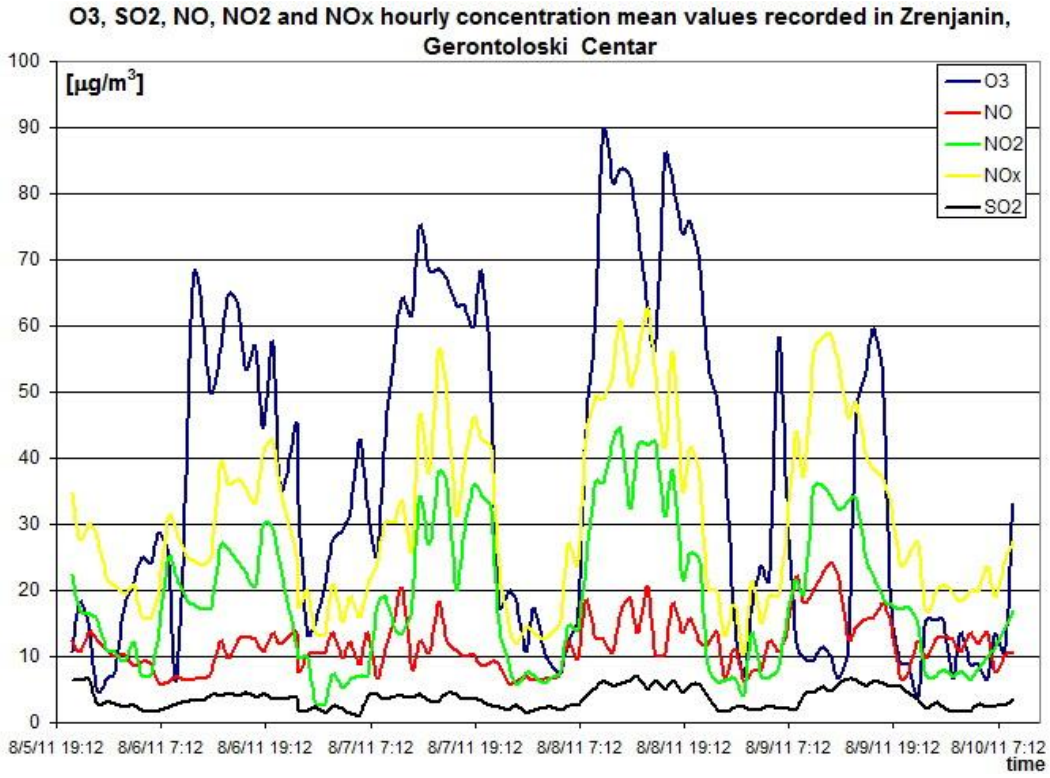

Figure 2. Hourly mean values recorded for O_3, SO_2, NO, NO_2 and NOx in Zrenjanin, location Gerontological Center

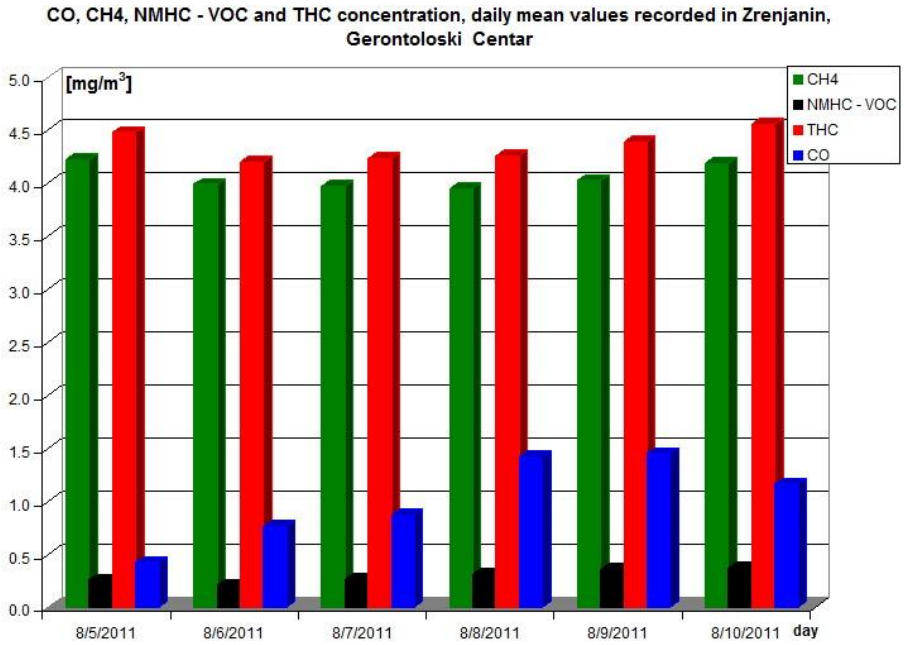

Figure 3. Daily mean values recorded for O_3, SO_2, NO, NO_2 and NOx in Zrenjanin, location Gerontological Center

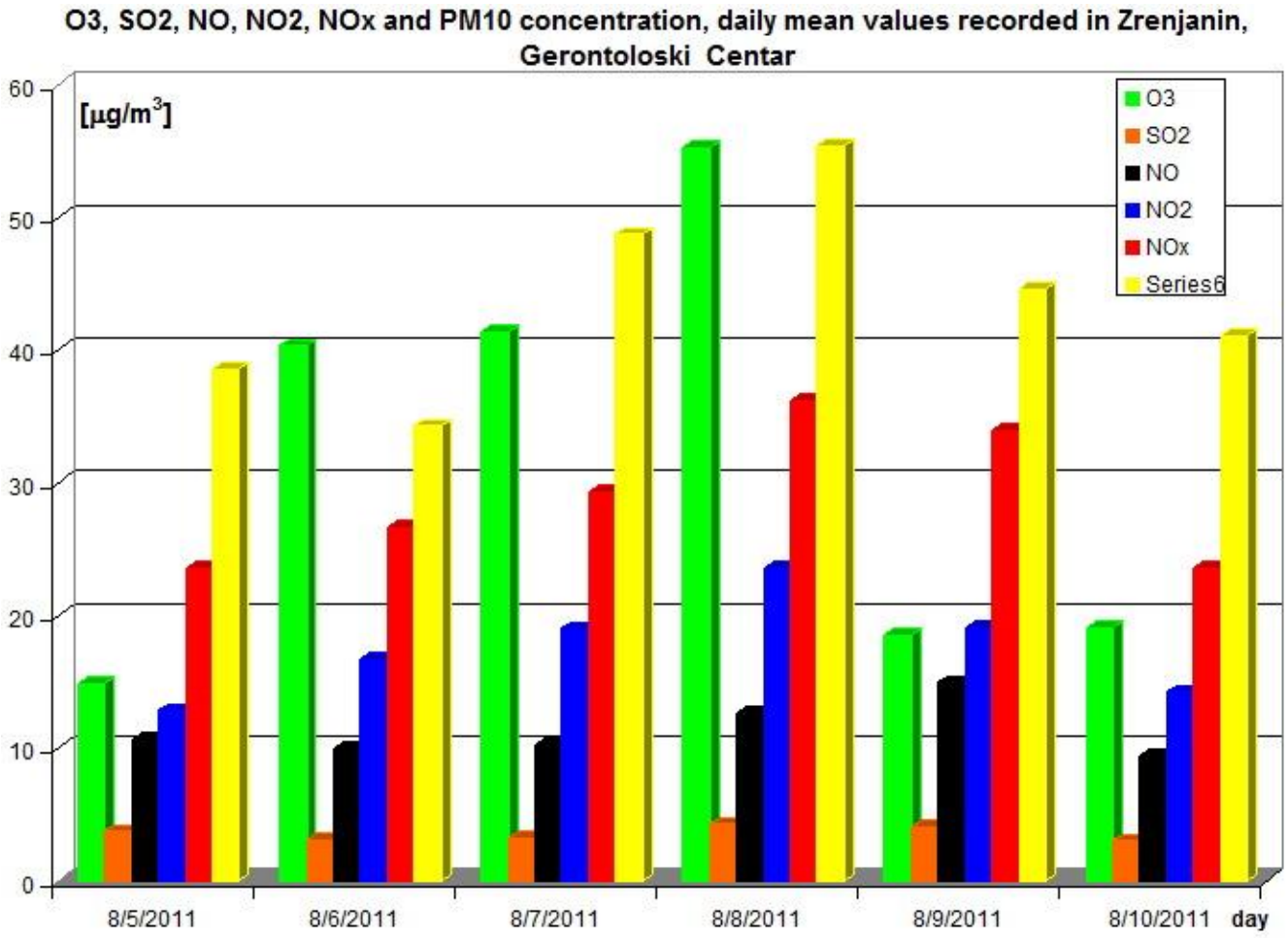

Figure 4. Daily mean values recorded for CH4, NMHC, THC and CO in Zrenjanin, location Gerontological Center

Table 3. EU air quality standards

Pollutant	***Concentration***	***Averaging period***	***Permitted exceedences each year***
Sulphur dioxide (SO2)	350 µg/m3	1 hour	24
	125 µg/m3	24 hours	3
Nitrogen dioxide (NO2)	200 µg/m3	1 hour	18
	40 µg/m3	1 year	n/a
PM10	50 µg/m3	24 hours	35
Carbon monoxide (CO)	10 mg/m3	Maximum daily 8 hour mean	n/a
Ozone (O3)	120 µg/m3	Maximum daily 8 hour mean	25 days averaged over 3 years

**Under the new Directive the member State can apply for an extension of up to five years (i.e. maximum up to 2015) in a specific zone. Request is subject to assessment by the Commission. . In such cases within the time extension period the limit value applies at the level of the limit value + maximum margin of tolerance (* 48 µg/m3 for annual NO2 limit value).
***Under the new Directive the Member State was able to apply for an extension until three years after the date of entry into force of the new Directive (i.e. May 2011) in a specific zone. Request was subject to assessment by the Commission. In such cases within the time extension period the limit value applies at the level of the limit value + maximum margin of tolerance (35 days at 75*µg/m3 for daily PM10 limit value, 48 µg/m3 for annual Pm10 limit value).

Overview of the Elemir monitoring site:

Elemir (Елемир) is a village located in the Zrenjanin municipality, in the Central Banat District of Serbia. It is situated in the province of Vojvodina. The village has a population of approximately 4,690 people, according to the 2002 census. The location was chosen as a second location for Zrenjanin campaign due to its remote location, far from road traffic pollution. In its vicinity an natural reservation is found. Also a major industrial plant is located in the Elemir vicinity, the HIP Petrohemija has the FSK – Synthetic Rubber Plant specialized on the production of emulsive Styrene Butadiene Rubber (SBR), in accordance with the license of Bunawerke Huls (Germany), design capacity 40,000 t/y. Three different SBR types are produced and marketed under the HIPREN® trade mark: two of the 1500 series and one of the 1700 series. The FSK – Synthetic Rubber Plant was closed in 2010 due to lack of supply with butadiene.
The site is interesting because the pollution should be at its lowest levels if VOC concentrations do not occur from the FSK – Synthetic Rubber Plant.
The instrument used is AIRPOINTER, acquired in BANATAIR project and it was its first use. A more detailed description of the instrument capabilities will be done in the next campaigns reports.

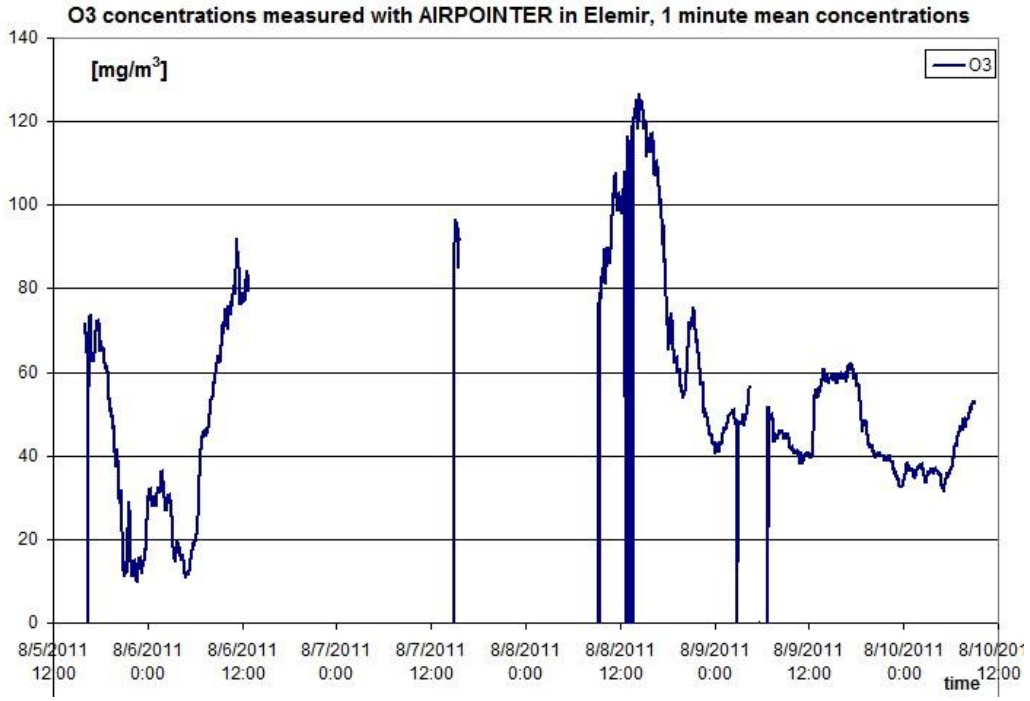

Figure 5. One minute mean values recorded for O3 in Elemir location with AIRPOINTER

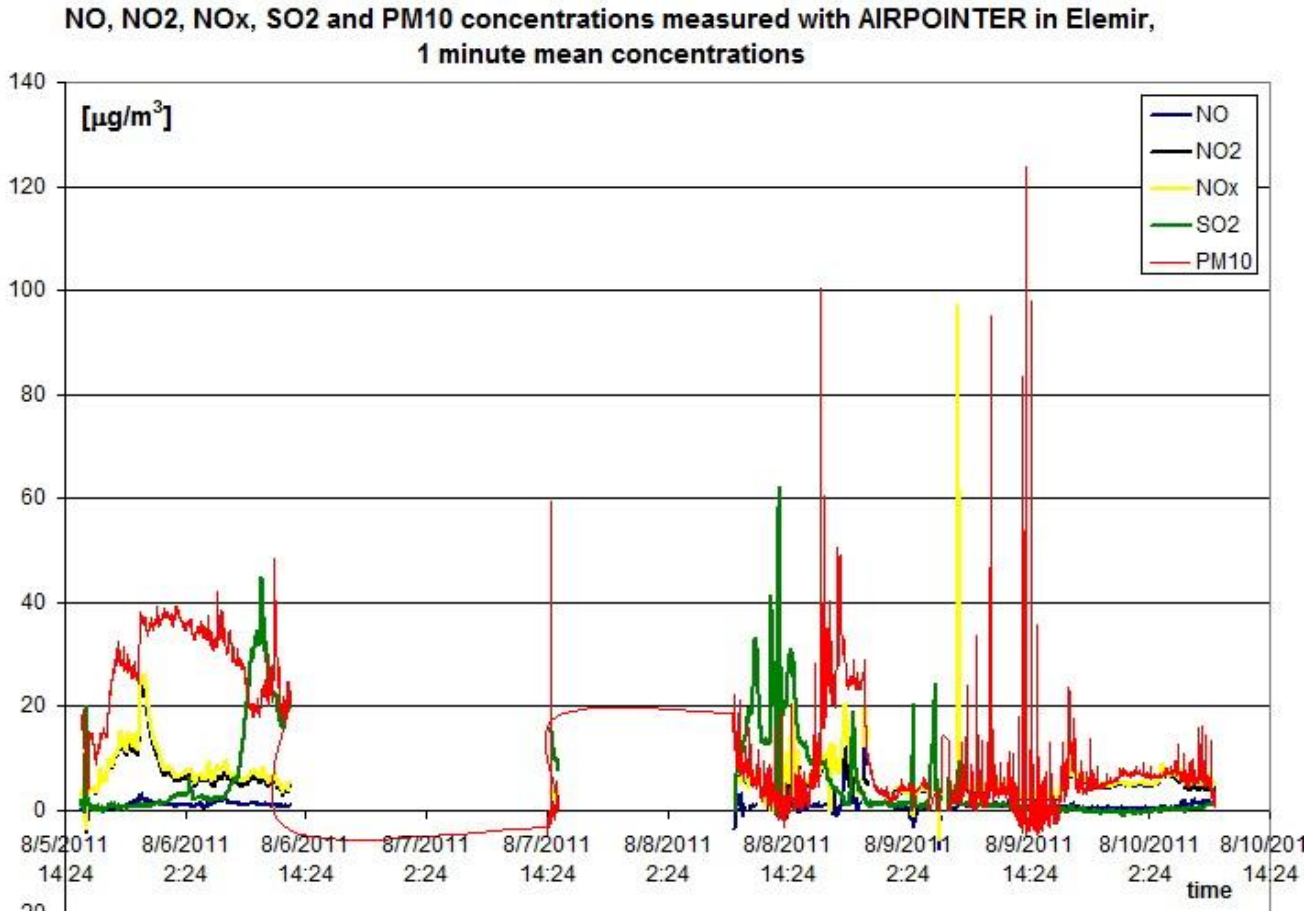

Fig 6. One minute mean values recorded for NO, NO2, NOx, SO2 and PM10 in Elemir location with AIRPOINTER

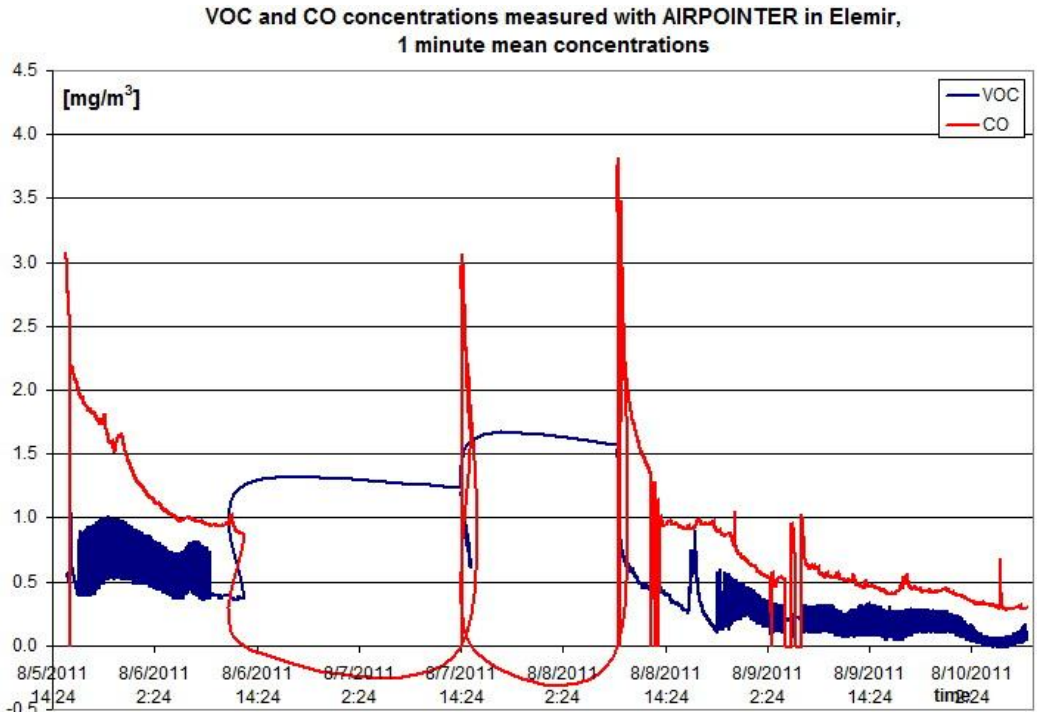

Figure 7. One minute mean values recorded for VOC and CO in Elemir location with AIRPOINTER

From a preliminary analysis of data recorded by AIRPOINTER we can observe a large amount of missing data and the measurement cannot be validated. The instrument was working inside parameters but the electrical power was interrupted several times. This leads to conclusion that an UPS (uninterrupted power source) should be used in the future. However, several conclusions could be drowning:

- the NOx concentrations are low, under 40 µg/m3 for one hour mean values
- one episode with relatively high SO2 concentration occurred in 8 august
- the PM10 concentration are low, under 15 µg/m3 for daily mean values
- the VOC concentrations around 0.3 – 0.5 mg/m3 are low but due to Elemir location the composition of those imissions should be further investigated, what kind of VOC's are involved? Knowing that benzene concentration in ambient air should not be more than 5 µg/m3 (0.005 mg/m3)

We recommend the development of an Excel file to create one hour mean values and daily mean values, from the data recorded.

An analysis of data recorded by UPT mobile stations one can conclude:

- there are no limit excedances for any pollutant
- the NO/NOx and CO recorded concentrations shows the influence of road traffic and vehicle emissions
- SO2 and VOC concentrations also follows the trend of NO/NOx and CO so we can believe that they are caused by vehicles and the sulphur content of the fuels used
- The PM10 concentrations are very high, close or above the limit.

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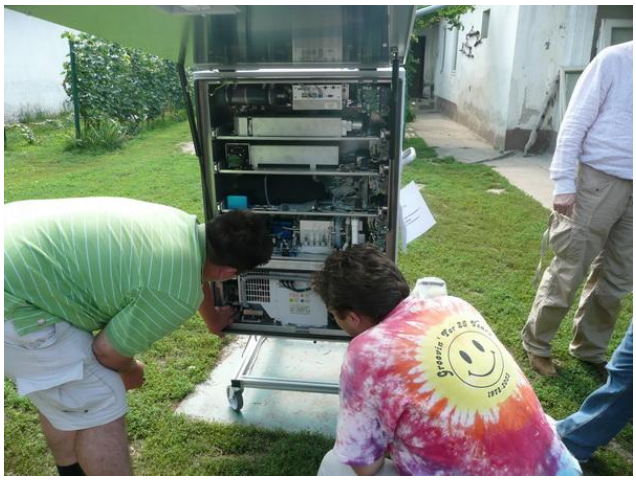
View on the ELEMIR monitoring campaign site



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View on the Zrenjanin (Gerontoloski Centar) monitoring campaign site

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