European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

WGs & MC Meeting at SOFIA (BG), 16-18 December 2015

New Sensing Technologies for Indoor Air Quality Monitoring: Trends and Challenges

Action Start date: 01/07/2012 - Action End date: 30/04/2016 - Year 4: 1 July 2015 - 30 April 2016

REAL-TIME MEASUREMENTS OF PM10 IN THE INDOOR ENVIRONMENT – COMPARISON OF THE RESULTS

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COST is supported by the EU Framework Programme

ESF provides the COST Office through a European Commission contract

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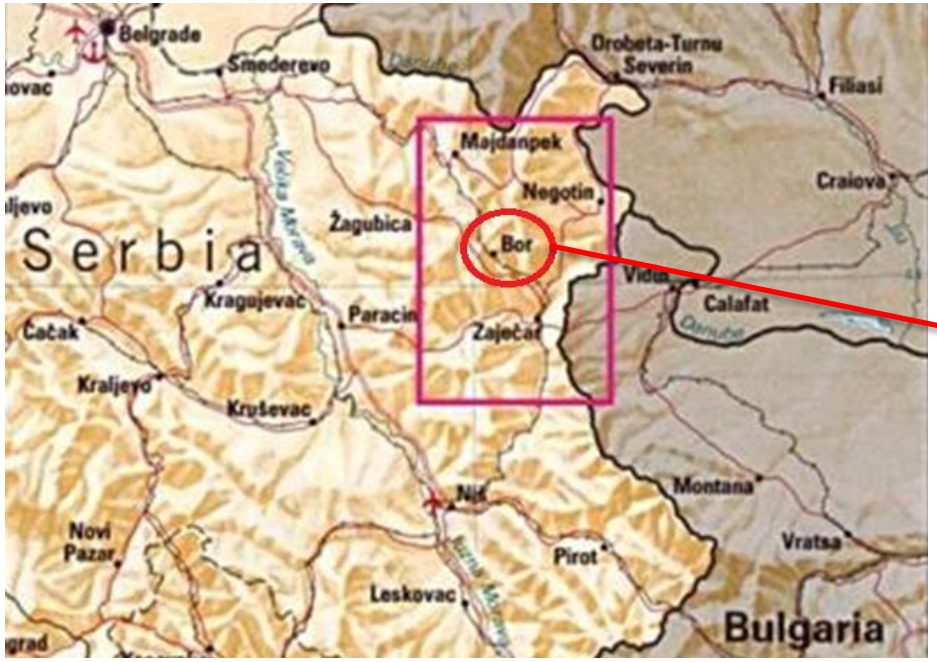
Real-time monitoring of indoor PM mass concentrations

- Monitoring of indoor PM mass concentrations is important for human health risk assessments since most individuals in developed countries spend the majority of their time indoors.
- Automatic air particle monitors can provide insights into particulate levels and temporal variability over short time intervals, which is not possible using gravimetric sampling methods.
- The aim of this study was to investigate the comparability between the indoor PM_{10} mass concentrations measured simultaneously with the two different monitoring instruments, OSIRIS (Turnkey Instruments, Model 2315) and HAZ-DUST EPAM-5000 (SKC Inc.).

Monitoring location

- Measurements were performed for a period of 50 days in the winter of 2012. Automatic PM monitors were placed in the laboratory for applied electronics at the Mining and Metallurgy Institute, in the Bor town, at the east of the Republic of Serbia.



Monitoring location

- The real-time aerosol monitors were collocated in the center of the laboratory. There were 2-3 regular occupants in the laboratory which had a volume of approximately 125 m^3. The laboratory was not carpeted, has windows surface of 3 m^2, and only one door that was usually closed.

- The 24-h average PM_{10} mass concentrations were obtained also by using the LVS3 (SVEN/LECKEL) gravimetric sampler with PM10 sampling head, in the aim to assess the comparability of results and sampling methods.

Monitoring equipment

- Turnkey OSIRIS air particulate monitor gives a continuous indication of TSP, PM_{10}, $PM_{2.5}$ and PM_1 mass fractions.
- This monitor uses a light scattering (diffraction) technique to determine the concentration of airborne dust in the particle size range from about 0.4 µm to about 20 µm.

Monitoring equipment

- EPAM-5000 is a light scattering nephelometer and filter gravimetric air sampler. Size selective sampling was achieved by a single jet impactor for respirable dust (PM_{10}). It can determine the concentration of airborne dust in the particle size range from about 0.1 µm to about 100 µm.

Monitoring equipment

- The real-time aerosol monitors were collocated in the middle of the laboratory together with the LVS3 (SVEN/LECKEL) gravimetric sampler that was carrying PM_{10} sampling head.

- Quartz fiber filters (Whatman QMA 47 mm diameter filters) were used throughout this study for the collection of particulate matter.

SMALL FILTER DEVICE LVS3

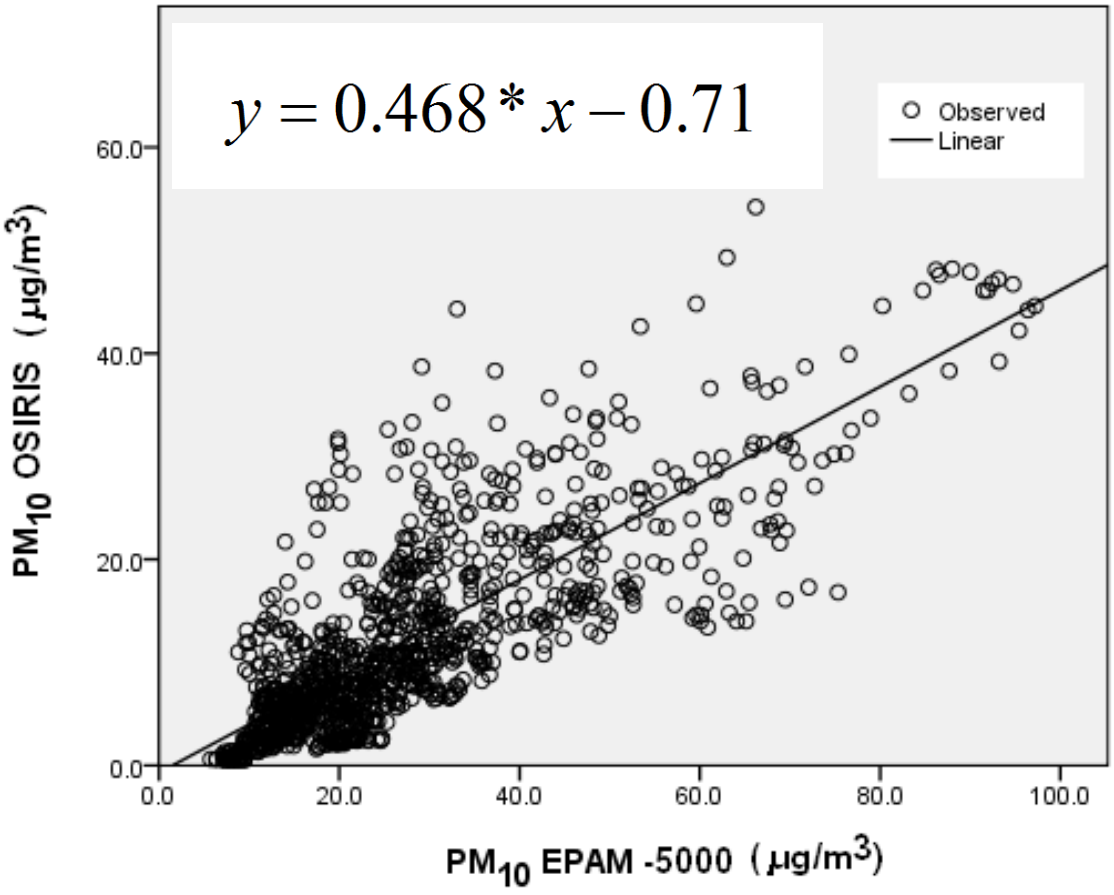
Results

- We have compared PM_{10} mass concentrations provided by OSIRIS and EPAM-5000 monitors in the whole period of the measurements (1-hour averages). The regression equation is presented as:

$$y = 0.468 * x - 0.71$$

- In the above equation, ***y*** expresses PM10 concentration measured by the OSIRIS while ***x*** expresses PM10 mass concentration measured by the EPAM-5000 monitor. The results obtained by the OSIRIS monitor strongly correlated (**R^2=0.61**) with the results of the EPAM-5000 monitor.

Results



Scatter plot of 1–h average PM_{10} mass concentrations, EPAM-5000 vs. OSIRIS

Results

Table 1 - Statistics of 24-h average PM_{10} concentrations (SD - standard deviation)

	PM_{10} OSIRIS	PM_{10} EPAM-5000	PM_{10} LVS3
Min	8.7	12.2	7.8
Max	25.8	53.3	48.2
Mean	14.0	28.5	19.8
SD	6.9	12.0	12.5

- OSIRIS monitor underestimated the 24-h average PM_{10} concentrations (27%) compared to the reference gravimetric method.
- EPAM-5000 monitor overestimated the 24-h average PM_{10} concentrations (35%) compared to the reference gravimetric method.

Results

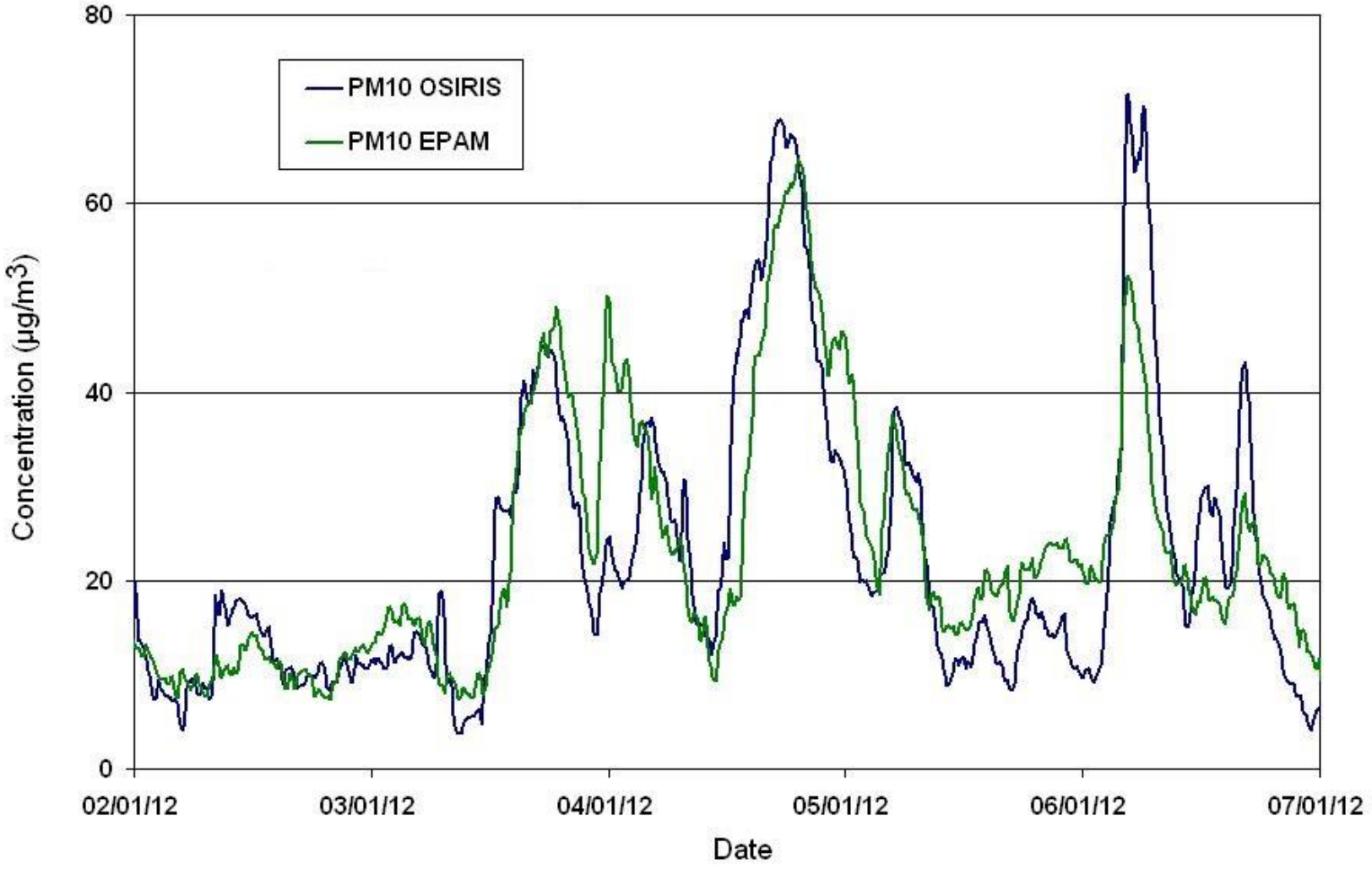
- In order to more accurately calculate and display the temporal distribution of PM mass concentrations, the measurements of automatic PM10 monitors were calibrated following the method of *Ramachandran et al.
- The measurements of automatic PM10 monitors were scaled using a specific calibration factor for each 24-hour period:

$$F = G/S$$

- Where ***F*** is the calibration factor, ***G*** is the 24-hour average gravimetric PM10 concentration and ***S*** is the corresponding 24-hour average OSIRIS or EPAM-5000 PM10 concentration.
- For each hour, the average PM10 concentration obtained by automatic monitors was multiplied by this calibration factor.

*G.Ramachandran, J.L. Adgate, G.C. Pratt, K.Sexton, 'Characterizing indoor and outdoor 15-minute average $PM_{2.5}$ concentrations in urban neighborhoods', *Aerosol Sci Technol,* 37(2003) 33-45.

Results



Line chart of 1–h average PM_{10} mass concentrations after calibration

Conclusions

- Both of the air particle monitors used in this study proved to be practical for PM_{10} measurements in the indoor environments, as it is small, portable, and quiet enough not to disturb the occupants of rooms where monitoring is performed.
- The results from the present study indicate that both monitors provide the 24-h average PM_{10} concentration of acceptable accuracy, comparable to the reference gravimetric method.

Thank You for Your patience!