

## **Application of GRIMM analyzers for identification of PM sources in industrial region in Czech Republic**

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Adverse health effects were reported by the people living in the small settlement in the vicinity of the steel work, located in heavy industrialized region in north-eastern part of the Czech Republic. The steel work represents a significant source of particles and gaseous pollutants. Furthermore, the settlement is framed by intensively trafficked motorway and a main road intersecting it influences the air quality as well. Moreover, the local heating impact also cannot be considered as negligible.

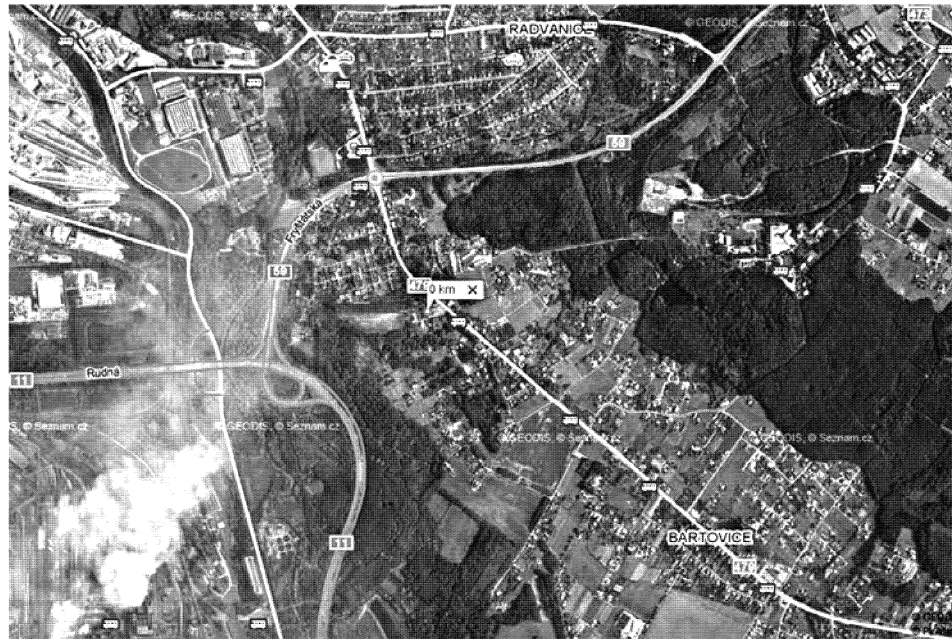
With the aim to gather relevant information for resolution in such complex sources configuration an automatic monitoring station has been installed by Institute of Public Health of Ostrava inside the village. The station provides hourly data on gaseous pollutants concentrations, particles and meteorology as well. Particle analyzer GRIMM Model 180 is applied for PM<sub>10</sub>, PM<sub>2.5</sub> and PM<sub>1</sub> fractions monitoring. The data were analyzed attempting to reveal the contribution of particular sources mentioned above. The results led to the hypothesis that not all particle and gaseous pollutants should be attributed to the steel work. Especially the local heating and adjacent motorway are suspected of being a notable source of particle contamination.

### **1. Problem and area of study**

Adverse health effects were reported by the people living in the small settlement Bartovice, located in heavy industrialized region in north-eastern part of the Czech Republic (Ostrava region). The nearby steel work situated south-westerly from Bartovice, on the up-wind side of prevailing winds, represents a significant source of particles and gaseous pollutants. Furthermore, the settlement is framed by intensively trafficked motorway and a main road intersecting it influences the air quality as well. Moreover, the local heating impact also cannot be considered as negligible. Fig. 1 depicts the situation.

Despite the remedial measures reported by the steel work the air quality in the settlement remains poor and people complain continually. With the aim to gather relevant information for resolution in such complex sources configuration, an automatic monitoring station has been installed by Institute of Public Health of Ostrava in the village. In June 2007 GRIMM Analyzer has been put into operation. Station location is marked approximately in the centre of Fig. 1. The station provides hourly data on

gaseous pollutants concentrations, particles and meteorology as well. Particle analyzer GRIMM Model 180 (GRIMM Aerosol Technik, 2003) is applied for PM<sub>10</sub>, PM<sub>2.5</sub> and PM<sub>1</sub> fractions monitoring.



*Fig. 1: Aerial photo of study area. The measuring station position is plotted about in the picture centre. The steel work is located south-westerly from the station, marked by its smoke plume*

## 2. Data collected and their analysis

From the data provided by monitoring station in Bartovice, hourly means of mass concentrations of sulphur dioxide, nitrogen oxides, PM<sub>10</sub>, PM<sub>2.5</sub> and PM<sub>1</sub> fractions were chosen for analysis. Metrological data, primarily wind speed and wind direction, were utilized in exploration of pollutants origin and their apportionment to particular sources. Data from June 2007 till end of February 2008 are analysed in this paper. This period covered winter season 2007/2008, when domestic furnaces in Bartovice were activated.

Mean values of particular PM fractions for period June 2007 – February 2008, together with their variances, are depicted at Fig. 2. It confirms that PM concentrations levels in Ostrava region are very high in general, even for the fine particles being most dangerous for the human health.

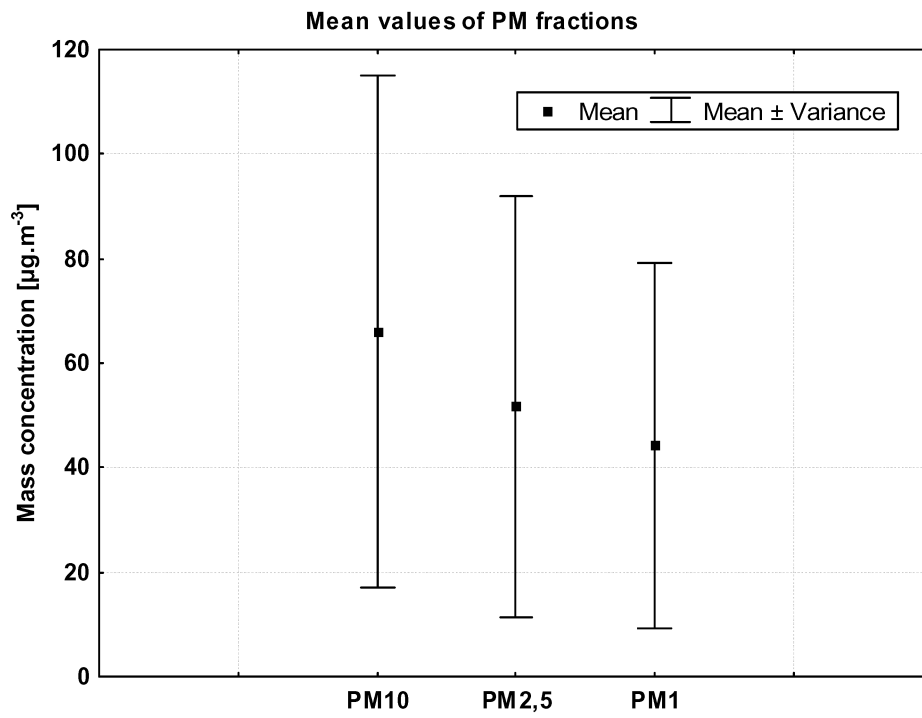


Fig. 2 Mean values of PM fractions measured during period June 2007 - February 2008

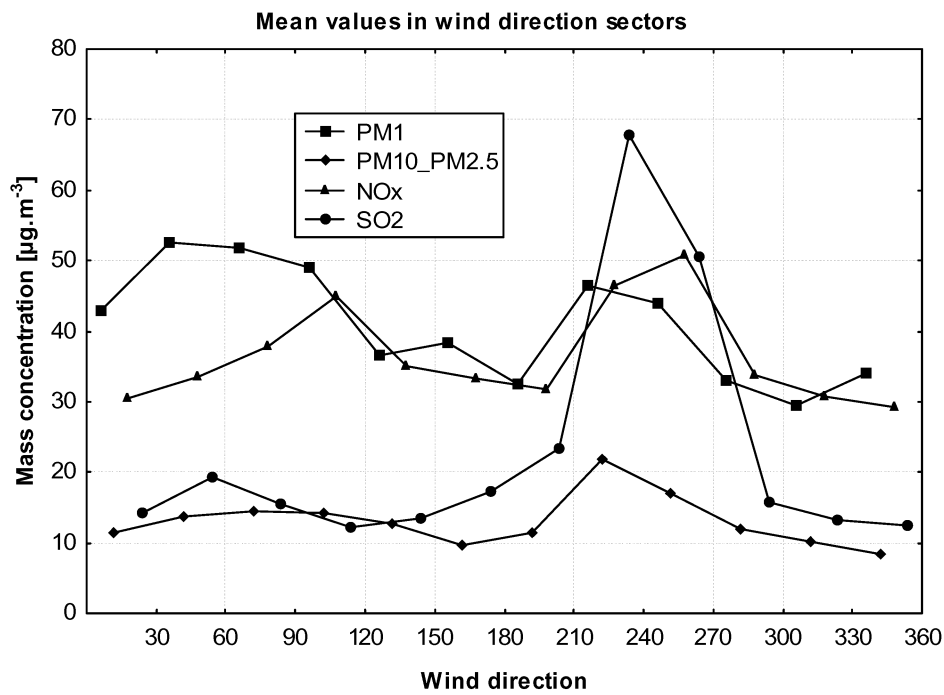


Fig. 3 Mean values of pollutants concentrations in wind direction sectors

Fig. 3 shows that concentrations of  $\text{NO}_x$ ,  $\text{SO}_2$  and particles, averaged over the 30 degrees sector, are not uniformly distributed depending on wind direction. The most distinct maximum of sulphur dioxide concentration is related to winds from sector 210 - 240, which transport the pollutants from the steel work. High concentration of fine PM1 particles and nitrogen oxides and maximum concentration of coarse particles (marked as PM10\_PM2.5) are connected with winds blowing from this sector as well. Nevertheless,  $\text{NO}_x$  concentration maximum occurs in sector 240 - 270 where a big motorway junction is situated. High concentrations of fine PM1 particles which might have their origin in traffic are also observed in this sector. Secondary maximum of  $\text{NO}_x$  concentration in sector 90 - 120 can be related to traffic on the main road intersecting Bartovice village.

The highest fine particles concentrations are connected to easterly winds from directions 30 - 120. It should be noted that air masses transported from these direction cross the village area where local heating facilities are used widely. At the same time, these air masses cannot contain pollutants originating from the steel work.

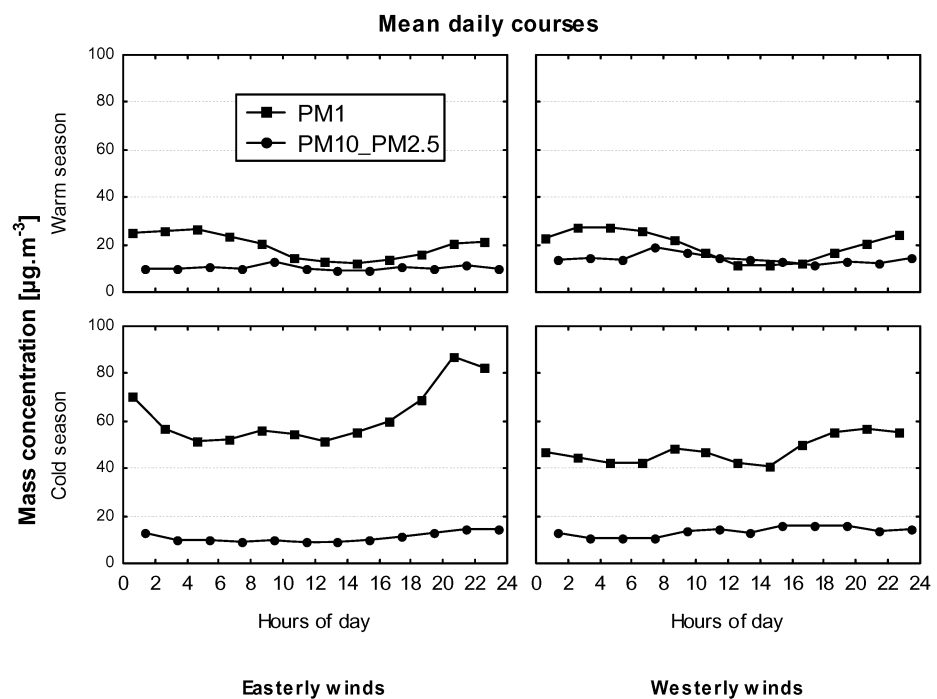


Fig. 4 Mean daily courses of fine and coarse particles concentrations for winds from eastern and western sectors and warm and cold season

With the aim to reveal origin of particles, mean daily courses of fine and coarse particles concentrations were constructed for warm and cold season of the year. Moreover, these courses were calculated with respect to wind direction: separately for winds from eastern part of horizon which transport the air masses over the village area, and for westerly winds blowing over the steel work grounds. Fig. 4 summarises the results.

In warm season, there are no significant differences between fine and coarse particles concentrations during mid-day hours. PM1 concentrations on the morning and at the evening are about double of the coarse ones.

Quite different picture is observed in cold months when domestic furnaces are expected to be put into operation. While the coarse particle concentrations level remains in principle the same as in warm season, a significant increase of fine particles occurred. For the transport from the western directions PM1 concentrations ranged between 40 and 60  $\mu\text{g}\cdot\text{m}^{-3}$ . The PM1 concentration increase is particularly distinctive for easterly winds. In this case, well expressed daily course with maximum about 90  $\mu\text{g}\cdot\text{m}^{-3}$  in the evening is evident. Based on these facts one might conclude that the fine particles, transported to the monitoring station from the village area, have their origin in domestic heating. The highest concentrations ever observed during the period of the study are connected with such conditions.

### 3. Conclusions

Hourly concentration and meteorological data from the automatic monitoring station installed in the village where the air quality is adversely influenced, among others, by the nearby steel work were analyzed with the aim to reveal the contribution of particular sources.

Data on concentrations of PM1, PM2.5 and PM10 particle size fractions gathered by GRIMM Model 180 analyzer, in combination with concurrent meteorological data, appeared as very useful for this purpose.

The analysis showed that the steel work, despite it represents a massive air pollution source situated upwind of prevailing winds, cannot be considered as the only cause of problems in air quality which citizens complain about. Highly trafficked motorway encircling the village on the west and main road intersecting it should also be considered as indispensable sources of particles.

During the cold season domestic heating operated in the village causes the air quality deterioration comparable with this attributed to the steel work or even overcoming it. This fact might be difficultly accepted by the village citizens but it must be inevitably taken into account when any further remedial measures would be discussed and prepared.

There is an urgent need for the further data and widely established measuring campaign, especially in the winter season when local heating effects become significant. Analyses of physical properties and chemical composition of particles gathered from various wind direction sectors are planned to be provided with the aim to find “sources signatures” and make the particles source apportionment even more

### **5. Acknowledgment**

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### **5. References**

GRIMM Aerosol Technik GmbH & Co. KG, (2003). *GRIMM Environmental Dust Monitor #180 User Manual*, [www.grimm-aerosol.com](http://www.grimm-aerosol.com)