The Impact of Select Pollutant Sources on Air Quality for Ostrava and the Moravian-Silesian Metropolitan Region by the Positive Matrix Factorization model

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The Ostrava region of the Moravian-Silesia metropolitan area of the Czech Republic represents one of the most highly industrialized areas in Eastern Europe with a large number of coke oven plants, blast furnaces, steel plants, and rolling mills being present. Ostrava is the third largest city in the Czech Republic containing 214 km^2 and with the country's third largest population (app. 300K). This equates to a population density about 1400 inhabitants/km^2. Its documented history dates back to the period of the 13th century. The discovery of high quality black coal in the mid 1700's and its access to four major river systems established the future direction of the area with respect to its industrial development. The primary metropolitan area is bordered by the Beskydy and Jeseniky mountain ranges. The presence of the large number of coal-related industries in addition to geographical conditions often results in weather-related pollution inversions which have a serious impact on local air quality. The region is connected with the Silesian voivodship in Poland which belongs to highly polluted areas by particulate matter and benzo*[a]*pyrene in Europe as well.

The Czech Hydrometeorological Institute (CHMI) working collaboratively with the U.S. Environmental Protection Agency (EPA) have designed a source apportionment study to determine the impact of regional as well as local sources on overall air quality for the region. Intensive (daily 12-hr day-night) fine particulate matter ($PM_{2.5}$), semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), organic and elemental carbon (OC/EC), pollutant gases and meteorology were monitored for approximately a seven week period during the summer of 2012 and the late fall/early winter of 2012 at three primary monitoring locations (Poruba - background suburban in residential area; Radvanice - industrial suburban, downwind of prevailing winds from large industrial source; Vratimov – residential area upwind of prevailing winds from the same large industrial source). All the locations are highly polluted by PM and PAHs as well in the long term.

A variety of multivariate source apportionment models, such as positive matrix factorization (PMF), were be used to develop preliminary source impact categories. Findings associated with a preliminary source apportionment effort will be presented and will include summaries of the spatial (upwind versus downwind) and temporal (seasonal) variability of key source markers observed to influence local air quality.

In summer, large difference between $PM_{2,5}$ and PAHs was found between day and night in terms of concentrations and content as well. Average 12-hr PAHs concentration was 1,97 ng.m^{-3} in Radvanice and 0,87 ng.m^{-3} in Vratimov; maximum 12-hr concentrations were 13,18 and 11,05 ng.m^{-3} respectively. Relevant concentrations were much lower in Poruba, an average of 0,37 ng.m^{-3} and a maximum of 2,71 ng.m^{-3}, An example of one day PAHs content is below. The content of light PAHs was much higher in the night sample of 27 May.

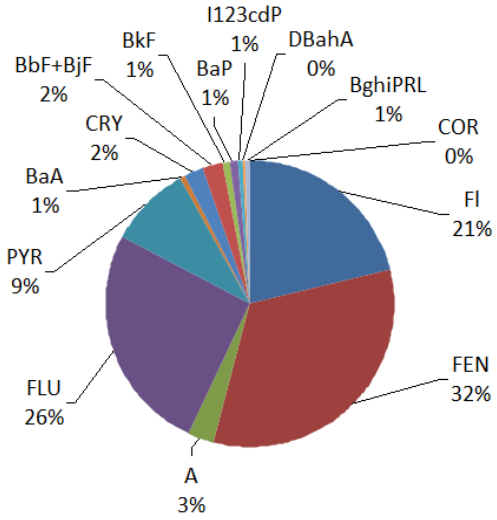

Figure 1. Radvanice, 27. 5. 2012, day: $PM_{2,5}$ = 15,26 µg.m^{-3}, PAHs = 44,4 ng.m^{-3}

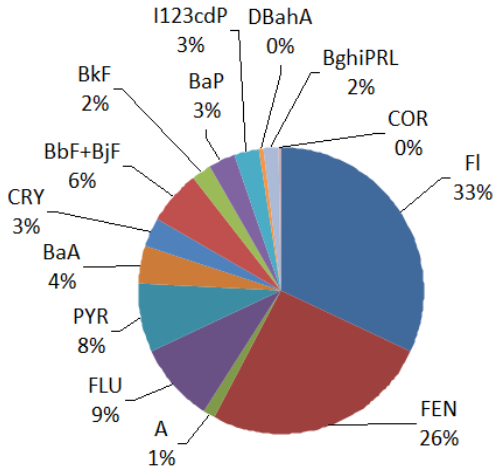

Figure 2. Radvanice, 27. 5. 2012, night: $PM_{2,5}$ = 19,58 µg.m^{-3}, PAHs = 191,2 ng.m^{-3}