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Short term variability of elemental, molecular and isotopic composition of PM2.5 atmospheric pollutants during warm and cold season in the urban atmosphere of Krakow, southern Poland

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In recent years, the awareness of the negative impact of air pollution (AP) on human health has been growing. Particulate matter (PM) is one of the most frequently studied components of AP. It consists of mineral particles as well as organic and elemental carbon coated by other chemicals such as nitrates, sulphates, transition metals and carcinogenic organic components such as polycyclic aromatic hydrocarbons. Especially fine fraction having aerodynamic diameter below 2.5μm is dangerous, because may penetrate the lung alveoli and enter the blood-stream, thus exerting adverse health effects. The concentration and chemical composition of PM depends on the season reflecting different pollutant sources emission variability. The city of Krakow located in southern Poland ranks among the most polluted urban agglomerations in Europe. There is an ongoing discussion on the impact of different pollution sources operating in Krakow agglomeration on the air quality in the city.

The presented work was aimed at characterization of elemental, molecular and isotopic composition of PM2.5 samples collected on daily basis on 47 mm diameter quartz filters during two sampling campaigns performed in Krakow during two contrasting seasons of the year. Collected PM samples were dedicated for Medical College group to determine whether in vitro acute exposure of peripheral blood monocytes to different concentration of PM2.5 is associated with changes in the miRNA profile. First, concentration of particulate matter was determined using gravimetric method. Next, the elemental analysis were performed using EDXRF method. Finally chemical and carbon (^{13}C, ^{14}C) isotopic composition was determined using liquid/gas chromatography and IRMS/AMS methods respectively.

Obtained results revealed large seasonal variability in both concentration and composition of the samples. On the average, PM2.5 concentration in winter samples was three times higher when compared to summer samples. Observed large contrast in ^{14}C content points to the difference in anthropogenic origin of carbon contribution re-flecting the seasonal difference of emission source associated with residential heating sector. Carbon-13 analysis indicate coal burning as a dominant source of carbonaceous aerosols during the heating season, however even dur-ing the warm season a significant share of anthropogenic carbon is observed. The summer season carbon emission can be attributed to communication sector including car exhausts as well as wearing of car tires and asphalt. Con-centration of Fe, Zn and Pb was two times higher in winter than in summer. In case of Sr and Br, we observed five times higher concentration in winter than in summer. On the other hand concentration of Ca, Ti and Cr was higher in summer compared to winter. Main source of these elements could be soil dust and re-suspended street dust. For Ni, Rb, Mn, Cu similar concentration was during both seasons. The dominant ions observed in the samples were ammonia, nitrate and sulphates.

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