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TECHNISCHE UNIVERSITÄT WIEN
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COLOSSAL
Chemical On-Line cOmpoSition and Source Apportionment of fine aerosoL

Source apportionment of atmospheric carbonaceous aerosols collected in Krakow, based on concentrations of organic/elemental carbon (OC/EC) and carbohydrates

Alicja Skiba[1], Katarzyna Styszko[2*], Anne Kasper-Giebl[3], Jarosław Nęcki[1], Anna Tobler[4], Roberto Casotto[4], Andre S. H. Prevot[4], Kazimierz Różański[1]

[1] AGH University of Science and Technology, Faculty of Physics and Applied Computer Science, Department of Applied Nuclear Physics, Krakow, Poland
[2] AGH University of Science and Technology, Faculty of Energy and Fuels, Department of Coal Chemistry and Environmental Sciences, Krakow, Poland
[3] TU Wien, Institute of Chemical Technologies and Analytics, Vienna, Austria
[4] Paul Scherrer Institute (PSI), Laboratory of Atmospheric Chemistry, Villigen, Switzerland

Background

Air pollution is nowadays a growing problem of global significance, mainly due to adverse health effects such as cancer, asthma, allergies or cardiovascular diseases. Especially large urban centres are heavily affected by deterioration of air quality. Atmospheric aerosol particles consist of both organic and inorganic compounds as well as materials of biogenic origin. Airborne particulate matter (PM) is emitted by numerous sources, most of them related to anthropogenic activities such as coal or biomass combustion in heat generation processes, gasoline and diesel combustion in car engines, and uncontrolled burning of solid wastes. One of the main atmospheric aerosol pollutants is black carbon (BC) which is emitted during incomplete combustion of biomass or fossil fuel.

Kraków location

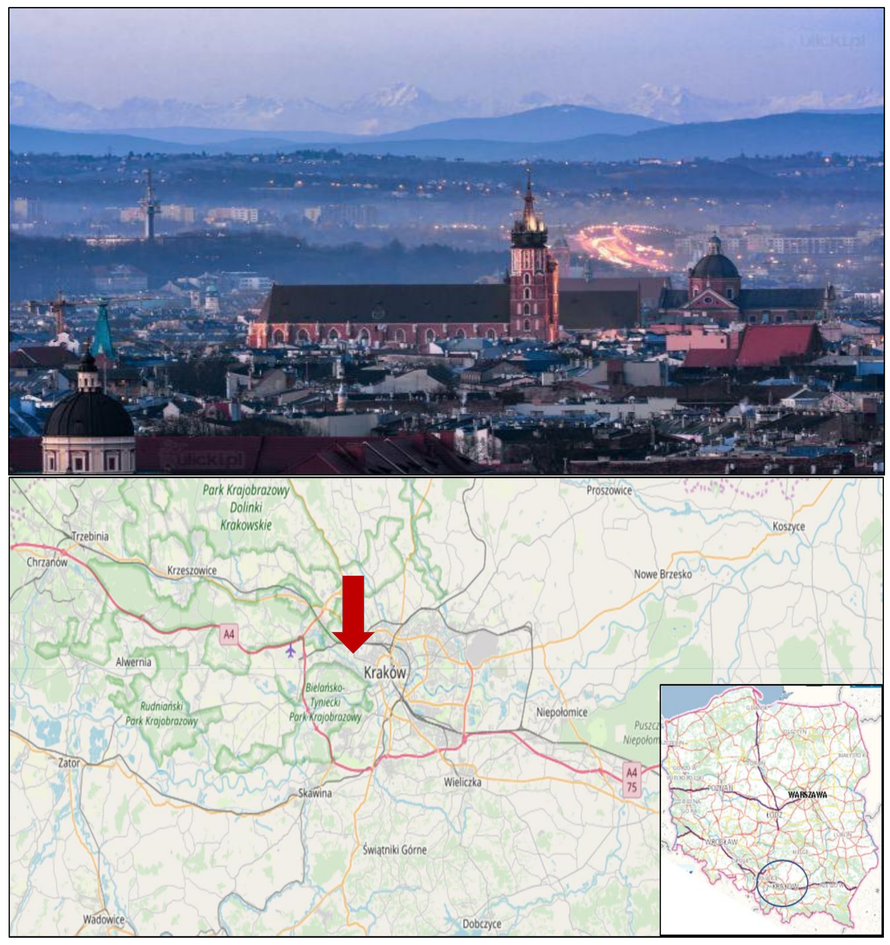


Fig.1: Sampling site.

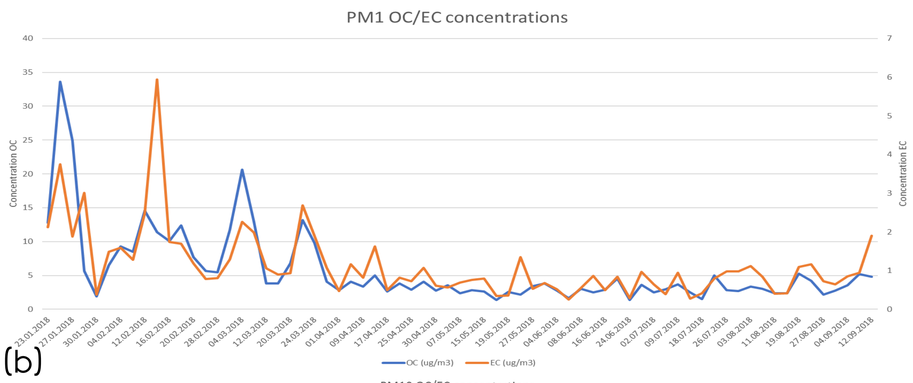
Objective

The study was focusing on determination of chemical composition of atmospheric aerosols collected in Krakow, Poland, from 23th Jan. 2018 to 12nd Sep. 2018 in order to obtain information on their sources. The samples represent PM10 and PM1 fractions collected with 24 h resolution. The analytical work comprised thermo-optical carbon analysis (Sunset OC/EC Lab Analyser), determination of 14 carbohydrates by means of High-Performance Anion-Exchange chromatography with Pulsed Amperometric Detection (ICS 3000, Dionex). The results have been expanded with black carbon on-line measurements performed in the same period of time with AE33 Aethalometer (Magee Scientific).

Results

Fig. 2a-b: Concentrations of Organic Carbon and Elemental Carbon during analyzed period in PM1(a) and PM10 (b) fractions

(a)



(b)

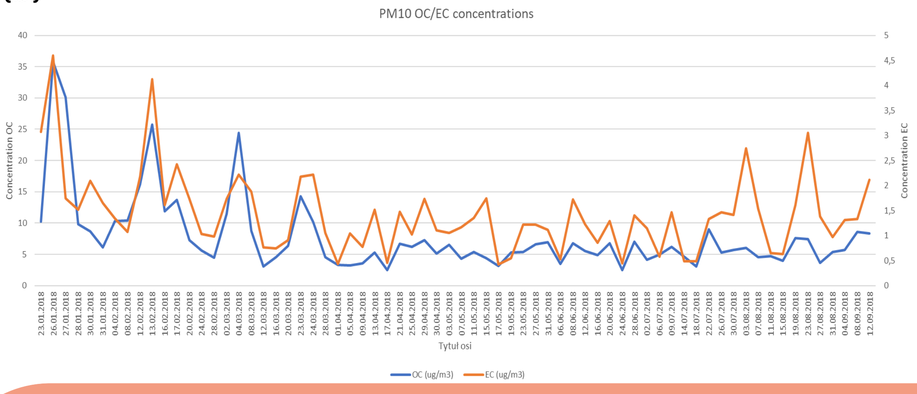


Fig. 3 Daily eBC concentrations for the period 23 Jan. 2018 to 12 Sep. 2018

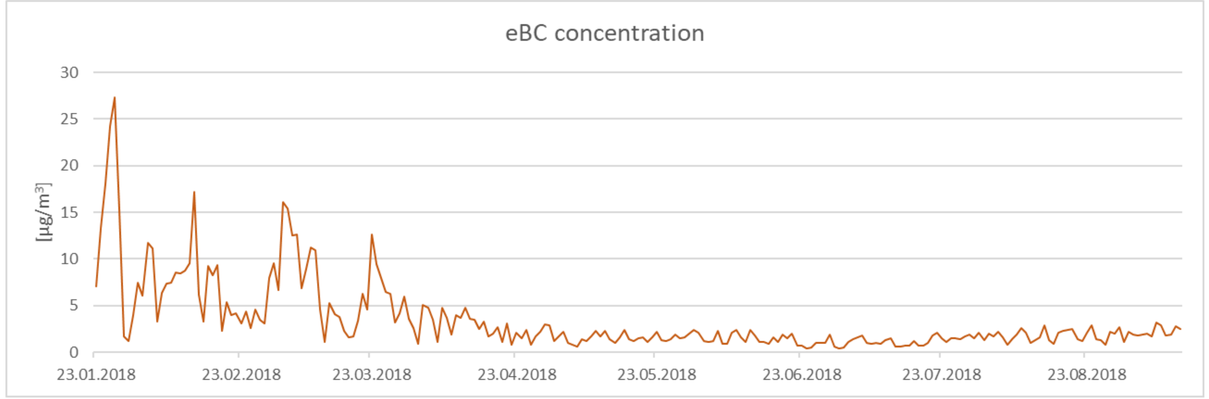
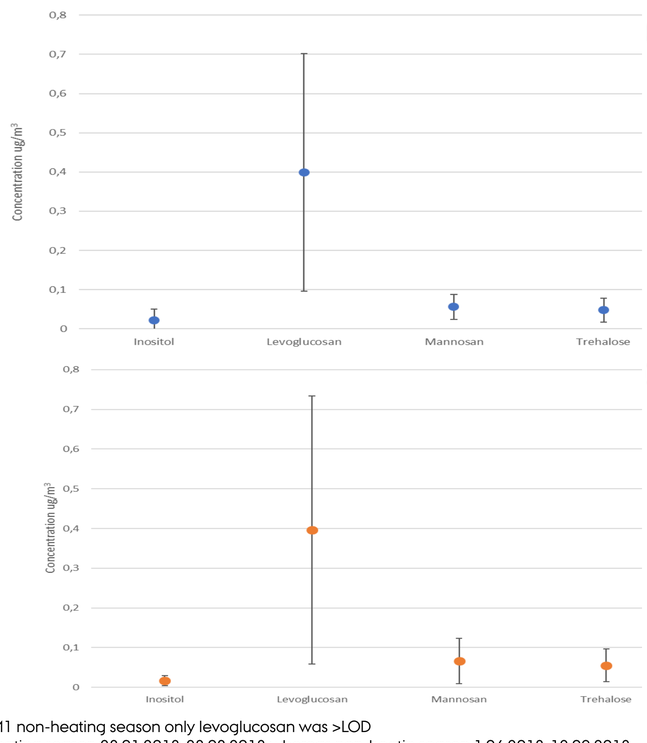
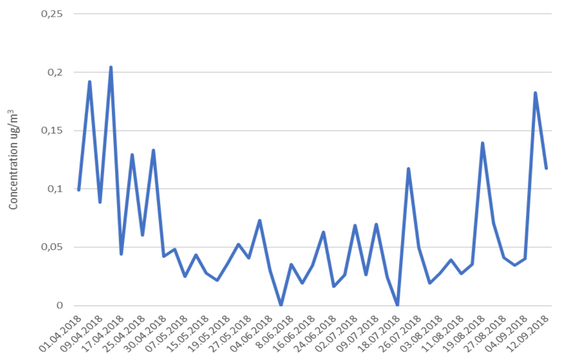


Fig. 4a-d: Mean concentrations and standard deviations of carbohydrates in PM1 (a-b)* and PM10 (c-d) fractions in heating and non-heating season**.

(a)

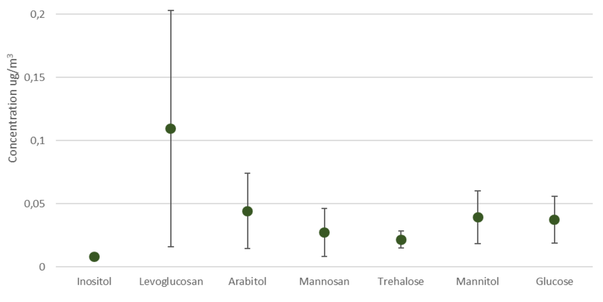


(b)



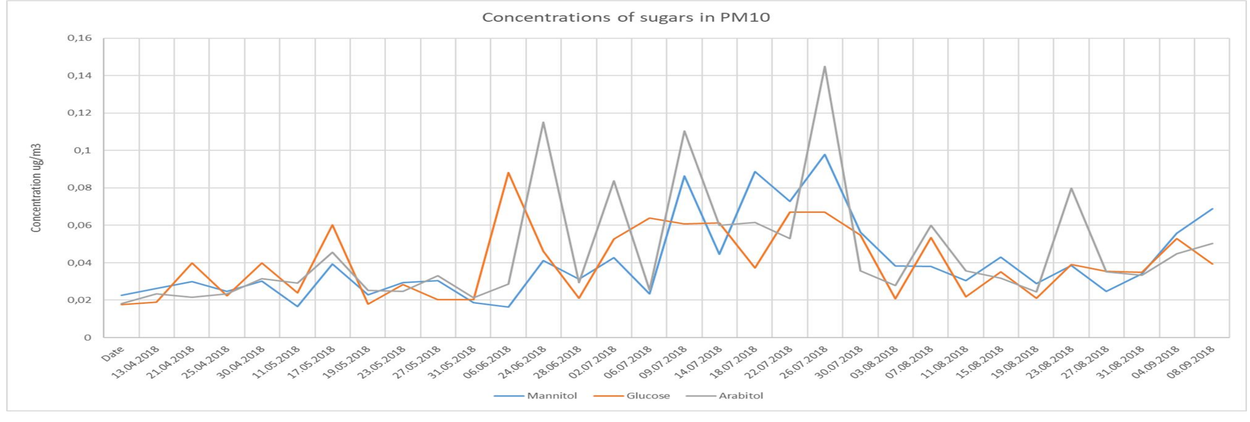
(c)

(d)



* PM1 non-heating season only levoglucosan was >LOD
** Heating season 23.01.2018-23.03.2018 whereas non-heatin season 1.04.2018-12.09.2018.

Fig.5: Concentrations of carbohydrates determined in PM10 fraction (April-September)



Conclusion

1. The dominance of levoglucosan during winter time point to combustion sources (e.g. heating) while the occurrence of arabitol in the coarse aerosol fraction in the warm season points to biogenic sources.
2. 3 of analysed carbohydrates were determined in PM10 only from April to September whereas they not appeard in PM1 fraction - it might be related to high levels of blossom vegetation during spring and their autumn decomposition
3. Differences in concentration of OC/EC are significant for the heating (Jan-Mar) and non-heating seasons (Apr-Sep) what is considered to be caused by biomass and coal combustion during the wintertime in Poland.
4. The presence of different sources and processes generating various proportions of carbonaceous fractions is reflected by highly variable OC/EC ratios. The mean OC-to-EC ratio for PM10 was accounted for 5.6 (2.2-17.3) while for PM1 5.1 (1.6-13.3). The results average EC-to-TC ratio was accounted for 0.2 (PM10 and PM1).
5. The online measurements of eBC daily concentration also showed higher values on winter season (up to 27,31 µg/m^3) than in spring season (up to 12,59 µg/m^3) .

Acknowledgement
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