Characterization and source apportionment of PM_1 organic aerosol in Krakow, Poland

A. K. Tobler[1], F. Canonaco[1], A. Skiba[2], K. Styszko[3], J. Nęcki[2], J. G. Slowik[1], U. Baltensperger[1] and A.S.H. Prévôt[1]

[1] Laboratory of Atmospheric Chemistry, Paul Scherrer Institute, Villigen, Switzerland
[2] AGH University of Science and Technology, Faculty of Physics and Applied Computer Science, Department of Applied Nuclear Physics, Krakow, Poland
[3] AGH University of Science and Technology, Faculty of Energy and Fuels, Department of Coal Chemistry and Environmental Sciences, Krakow, Poland

Keywords: organic aerosol, positive matrix factorization, ACSM, source apportionment.
Presenting author email: anna.tobler@psi.ch

Because atmospheric aerosols severely impact climate, visibility and human health (Fuzzi *et al.*, 2015), the long-term measurement and source apportionment of such particles is of great importance. The quadrupole Aerosol Chemical Speciation Monitor (Q-ACSM, Aerodyne Research, Inc.) is a robust instrument for real-time and long-term measurements and characterization of the non-refractory (NR) submicron atmospheric particulate matter levels (PM_1).

Here we present results from the first long-term deployment of a Q-ACSM in Poland. The instrument was installed at AGH University in Krakow. Krakow is located in the Vistula river valley in Southern Poland and is known for high air pollution levels. The measurements were conducted from January 2018 to March 2019. The highest pollution levels were measured in January 2018 with concentrations around 100 µg/m^3. During summer, the NR aerosol concentrations were mostly below 20 µg/m^3. During the entire campaign, the organic aerosol (OA) dominated the NR-PM_1 measurements. The OA was further analyzed by Positive Matrix Factorization (PMF) (Paatero & Tapper, 1994) within the SoFi software (Canonaco *et al.*, 2013), developed at PSI.

Figure 1 shows the diurnal patterns of the four factors identified during the winter period (January – March 2018): hydrocarbon-like (traffic related) OA (HOA), biomass burning OA (BBOA), oxygenated OA (OOA), and coal combustion OA (CCOA). CCOA dominates at night, while OOA dominates during the day. In both Krakow and the surrounding communities, residential heating with coal is still widespread.

The main limitation of PMF is the assumption of constant factors. However, the chemical fingerprints of OA factors may change due to meteorology or seasonality. To overcome this limitation, the rolling PMF algorithm will be applied to the full yearly data set. In this approach, a small and rolling PMF window is moved over the dataset and allows the factor profiles to vary over time. Furthermore, the statistical uncertainty estimation will be assessed via resampling strategies e.g. using the bootstrap approach. The PMF runs are then post-analyzed using a set of criteria that defined the environmentally reasonable PMF runs.

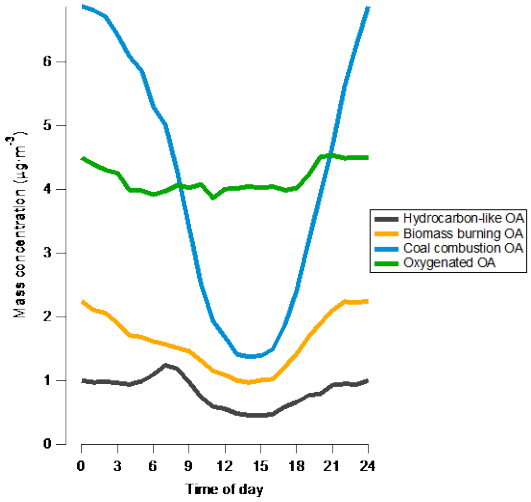

Figure 1. Averaged diurnal pattern of the four OA factors resolved during the winter period 2018 in Krakow, Poland.

This work was supported by the COST COLOSSAL Action CA16109.

Canonaco, F., Crippa, M., Slowik, J. G., Baltensperger, U., & Prevot, A. S. H. (2013). *Atmos Meas Tech*, 6, 3649-3661.

Fuzzi, S., Baltensperger, U., Carslaw, K., Decesari, S., van Der Gon, H. D., Facchini, M. C., Fowler, D., Koren, I., Langford, B., Lohmann, U., Nemitz, E., Pandis, S., Riipinen, I., Rudich, Y., Schaap, M., Slowik, J. G., Spracklen, D. V., Vignati, E., Wild, M., Williams, M., & Gilardoni, S. (2015). *Atmos Chem Phys*, 15, 8217-8299.

Paatero, P. & Tapper, U. (1994). *Environmetrics*, 5, 111-126.