Source Apportionment of Brown Carbon from Urban Ambient Aerosols

N.K.Kumar[1], K.R. Daellenbach[1], J.G. Slowik[1], U. Baltensperger[1], A. S. H. Prévôt[1] and I. El. Haddad[1]

[1]*Laboratory of Atmospheric Chemistry, Paul Scherrer Institute, Villigen, CH- 5232, Switzerland*
Keywords: Brown Carbon, PMF, ambient aerosol
Presenting author email: imad.el-haddad@psi.ch

Biomass burning and vehicle emissions have been identified as two major sources of brown carbon (BrC) (Saleh et al., 2013). Identifying the contributions of BrC sources to the total aerosol and interpreting the optical properties of these sources in the context of atmospheric processing is one of the key objectives of ambient measurements. The main objectives of this work includes measurement of the water and methanol soluble organic aerosol (OA) absorbance at two different sites followed by apportionment of the most important sources of BrC using advanced receptor models such as positive matrix factorization (PMF).

We performed UV-Vis measurements of water and methanol extracts of ambient filter samples at an urban site (Zurich, Switzerland) and in a region heavily impacted by wood burning (Magadino, Switzerland). The UV-Vis spectra were used to estimate the absorbance of water and methanol soluble OA for 24-hour ambient filter samples, over a one-year period. Figure 1 shows a seasonal trend in the absorbance of the water and methanol soluble OA fraction in Zurich and Magadino. UV-Vis analysis of the extracted ambient aerosol shows higher absorbance in the winter time versus the summer time likely due to higher biomass burning activity during this period.

Although ambient sources of BrC are poorly understood to date, BrC absorbance has not been directly incorporated into sophisticated source apportionment models such as PMF (Paatero and Tapper, 1994). Using PMF statistical analysis techniques we have tried to assess the contributions of different sources to the absorbance of ambient OA. We conducted preliminary PMF analysis on water soluble OA from offline samples collected in Zurich, over a year. Figure 2 shows initial results, in which three BrC factors are resolved. Although further analysis is needed, the strong correlation of the absorbance profile of Factor 1 with that of water-soluble primary biomass burning suggests the potential of this technique to provide a quantitative BrC source apportionment.

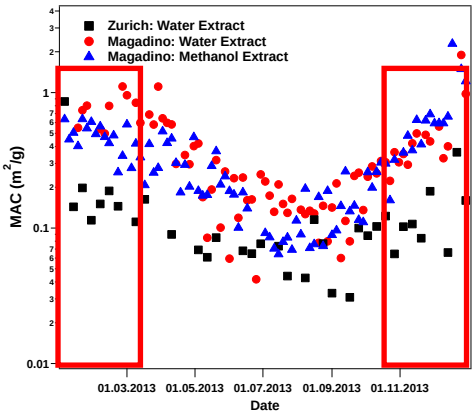

Figure 1: Mass absorption coefficient (MAC) of OA at 370 nm estimated by UV-vis analysis of water and methanol extracted ambient aerosol in Zurich and Magadino over a one-year period, showing a seasonal trend in absorbance with higher absorbance in the winter months (indicated by the red box) in comparison to summer months.

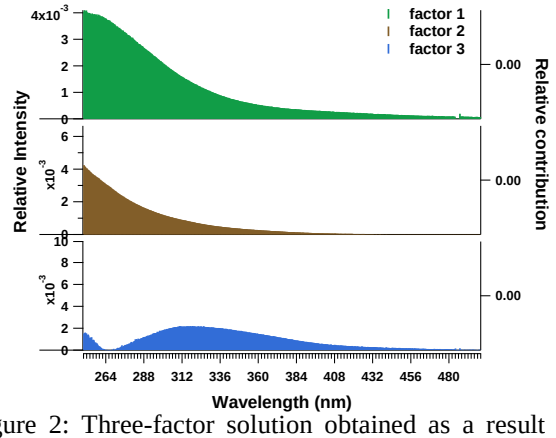

Figure 2: Three-factor solution obtained as a result of PMF on a UV-vis absorbance data matrix of water extracted ambient aerosol in Zurich over a one-year period.

This work was supported by the Swiss Federal office for the Environment.

Saleh, R., et al. (2013) Atmos. Chem. Phys. 13, 7683-7693.

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