High time-resolved measurements of fine aerosol (PM2.5) in a hot-spot area during wintertime: multi-wavelength optical absorption properties and source apportionment

V. Bernardoni[1], G. Calzolai[2], F. Lucarelli[2], D. Massabò[3], S. Nava[4], P. Prati[3], G. Valli[1], R. Vecchi[1]

[1]Department of Physics, Università degli Studi di Milano and INFN - Sezione di Milano, Milan, 20133, Italy
[2] Department of Physics and Astronomy, Università degli Studi di Firenze and INFN - Sezione di Firenze, Sesto Fiorentino, 50019, Italy
[3] Department of Physics, Università degli Studi di Genova and INFN - Sezione di Genova, Genova, 16146, Italy
[4] LABEC INFN - Sezione di Firenze, Sesto Fiorentino, 50019, Italy

Keywords: aerosol absorption, multi-wavelength measurements, high-time resolved measurements, source apportionment
Presenting author email: roberta.vecchi@unimi.it

Black Carbon (BC) is the main absorber of solar radiation among the aerosol components, it influences cloud processes, and alters the melting of snow and ice cover. Although it is one of the most important individual climate-warming components, uncertainties on the radiative forcing related to BC-radiation interaction still cover more than one order of magnitude. Moreover, weakly absorbing organic material (brown carbon, BrC) in the form of particle coating or as particle as-is can be considered a further important contributor to aerosol absorption. The peculiarity of BrC is that it is very effective in the absorption of short-λ radiation whereas its contribution to aerosol absorption is negligible in the red or near-IR bands. It is noteworthy that BC and BrC can also be used for source apportionment purposes (e.g. they can be helpful for the discrimination between fossil fuels combustion vs. biomass burning). Thus, aerosol absorption properties possibly related to mixing and/or size information, and BC content are currently of great interest.

Moving in this frame, a multi-λ polar photometer (PP_UniMI) has been developed at the Department of Physics of the University of Milan in the last years. The instrument is based on the measurement on the scattering plane of the light transmitted and scattered in the forward and back hemispheres by unloaded and loaded samples using a rotating photodiode. Data reduction aiming at the determination of the sample absorbance follows Petzold et al. (2004) and therein cited literature.

Currently, PP_UNIMI allows performing 4-λ measurements (870, 633, 532, 405 nm) on aerosol collected on different substrates, including aerosol collected with high-time resolution using a streaker sampler. Such sampler collects aerosol segregated in two size-classes (fine and coarse) on a rotating frame with hourly resolution. The set-up of the instrument was validated against independent measurements carried out using a Multi-Angle Absorption Photometer for what concerns the red-light results, considering possible artefact effects shown in Vecchi et al. (2013).

The results presented here are related to the analysis of the high time-resolved trends of multi-wavelength aerosol absorption properties measured on the fine aerosol fraction during a field campaign performed in Milan (Italy) in November 2015 (see an example in Figure 1).

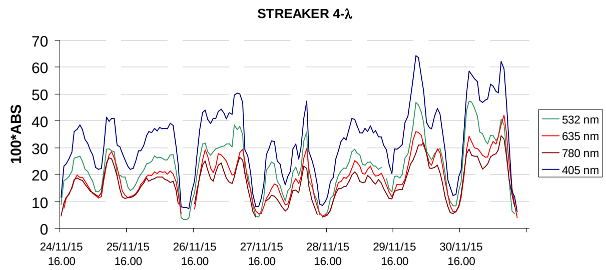

Figure 1. Example of 1-hour multi-λ absorbance measured on fine aerosol collected on a streaker frame during 1-week sampling.

Such data will be used to test the possibility of applying source apportionment models based on optical properties (es. Aethalometer model) using off-line high-time resolved data.

It is also noteworthy that equivalent BC can be quantified from the polar photometer measurements at 635 nm using a suitable mass absorption coefficient. Such information will be joined to the elemental components (Na-Pb) detected by Particle-Induced X-ray Emission technique carried out at the INFN-LABEC in Florence to perform receptor modelling analysis (e.g. Positive Matrix Factorization). The results of the source apportionment using such data will be also presented.

This work was partially funded in the frame of the INFN-experiments NUMEN, MANIA, DEPOTMASS.

Petzold, A., Schönlinner, M. (2004) *J. Aerosol Sci.,* **35,** 421–441

Vecchi, R., Bernardoni, V., Paganelli, C., Valli, G. (2013) *J. Aerosol Sci.* **70**, 15–25