

Interactive comment on “Exploiting multi-wavelength aerosol absorption coefficients in a multi-time source apportionment study to retrieve source-dependent absorption parameters” by Alice C. Forello et al.

Anonymous Referee #1

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This is a paper which succeeds in combining two areas of investigation in a rather successful way. It takes multi-component chemical data from atmospheric aerosol collected in Milan and processes it together with multi-wavelength optical absorption data in a single analysis using the multi-linear engine ME-2. As well as successfully combining two different kinds of data with different metrics, which has been done before but not for these specific metrics (more usually for particle mass and number size distribution data), it also successfully combines data measured over different averaging periods. The latter is not entirely novel but there are only a small number of earlier

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reports in the literature. Consequently, this is advanced receptor modelling work which shows both how using the multi-wavelength optical absorption data from an aethalometer can strengthen source apportionment of light-absorbing components and also that the data can be used in reverse to estimate the optical properties of particles from specific sources.

The paper is in general well written although some aspects of the English could be improved. My main criticism of the science is the lack of detail over the methods. For example, the procedures appear to be successful in combining elemental data and optical absorption data with entirely different metrics and yet outputting concentrations and explained variation for both types of constituent in their original units. This has previously posed problems for PMF but presumably also for ME-2. Secondly, there is no information on whether an error matrix was constructed, and if so, how this was carried out. There are fairly widely accepted methods for chemical data, but how was this achieved for the optical absorption data?

The assignment of identity to the eight factors output by the ME-2 looks very reasonable but there are some specific points that are not addressed. The sulphate factor contains a higher concentration of organic carbon than of sulphur and possibly a higher concentration of organic matter than sulphate (although this is not possible to read from the graph). No mention is made of this organic matter which accounts for a significant proportion of the explained variation of the optical absorption. Presumably this is secondary organic matter correlated with sulphate, but does it have light absorbing properties which are of interest? As various workers have pointed out, this creates problems for the two component “aethalometer” model widely used for source apportionment of wood smoke (but which is not in itself a problem for the ME-2 method). The resuspended dust also appears to have some optical absorption. Could this be associated with the iron minerals? The aged sea salt factor contains substantially more sulphate than sodium and unusually absolutely no nitrate. Although it is shown that the temporal variation of this factor correlates with that of chloride, it appears that this

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factor is very atypical of aged sea salt and may well be mixed with other components.

The derivation of Ångström coefficients from the apportioned optical absorption data is interesting but there is little comment on the fact that the value for fossil fuel is 0.78 to 0.88 (25th-75th percentile) which extends slightly below the range of typically reported values and is distinctly different from the value of 1.0 used by most workers in the “aethalometer” model. The value of Ångström coefficients for the biomass burning factor is well within the very wide range of literature values which depend very much upon combustion conditions and is a useful addition to the literature, as are the estimated mass absorption cross-sections.

In addition to addressing the points above, there are two lesser issues which should be considered.

(a) Line 254 – the intercept requires units to be meaningful.

(b) Line 307 – it is stated that “in the factor interpreted as nitrate the explained variation is fully ascribed to NO_3^- ”. Would it not be more correct to state that the nitrate factor accounts for 100% of the explained variation in NO_3^- ?

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