# A link between optical absorption wavelength dependence and morphology in black carbon particles from residential woodstove emissions

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Black carbon (BC) is considered as a major potential global warming agent (Bond et al., 2013), and the usage of fossil fuel and biomass as energy sources by mankind are central to the climate debate. A better understanding of the potential impacts in each case requires an accurate estimation of the source apportionment. In this regard, multi-wavelength aethalometers have become a useful tool to quantify the contribution of biomass *vs* fossil fuel combustion to BC in the atmosphere (Drinovec et al., 2014 and references herein).

The method –based on the wavelength dependence of aerosol optical absorption by selecting a specific absorption Ångstrom exponent (α) for each source– has its drawbacks. A recent study has demonstrated the uncertainty that can be associated with the use of a pre-fixed α value for woodsmoke, since the values are highly variable throughout the combustion within the same experiment, and ranged from 1 to 3 (Harrison et al., 2014). In this study, we present a direct mathematical link between the α values, the organic to elemental carbon (OC/EC) mass ratio, and the mathematical descriptors used to quantify the morphology of the black carbon particles during the experiments described in Harrison et al. (2014).

The experimental study was conducted in an experimental facility equipped with a manually operated woodstove. Three common Southern and mid-European wood types (*Quercus pyrenaica* -oak-, *Populus nigra* -poplar-, and *Fagus sylvatica* -beech-) were used for the experiments. Specific details of the facilities and the method used to estimate the OC/EC ratios can be also found in Calvo et al. (2014) and the aethalometer method to retrieve α in Harrison et al. (2014). A total of 30 samples in polycarbonate filters were taken for the electron microscopy study. Several different parameters were tested, such as compactness, circularity or fractal dimension. The aspect ratio (AR) was strategically chosen here. AR mathematically quantifies the particle elongation -longest to shortest axis ratio- of a regular ellipse of equivalent area and same longest projection.

A summary of the results obtained is shown in Figure 1. The results show there is a good linear correlation between the variability of α and the OC/EC ratios and the particle morphology, independent of the type of wood used in the experiment. For instance, when particles have α values close to those generally attributed in the aethalometer model to fossil fuel activities (α<1.1) they also have low OC/EC ratios and open branched morphologies, typical of these emissions, suggesting that these parameters might be linked, independent of the source. Current investigations in our group are also considering diesel exhaust (EURO5) and atmospheric (traffic urban sites) particles in the same scenario to support this finding.

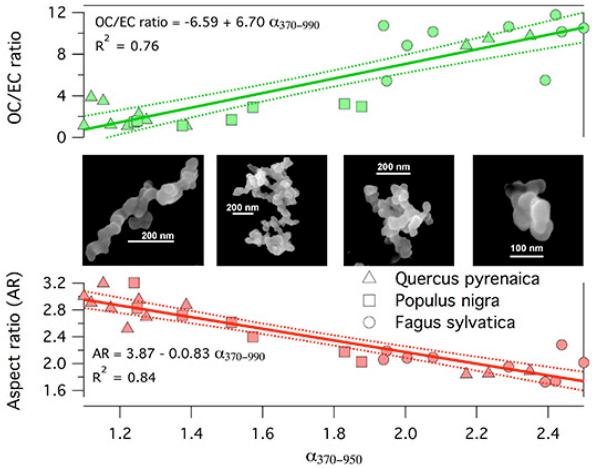


Fig. 1. $\alpha_{370\text{-}950}$, the AR and OC/EC linear correlation. The images show examples of the particle morphological evolution with the parameters.

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