Influence of the thermal–optical temperature protocol in the determination of OC and EC concentrations on samples collected in the surroundings of a cement plant

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Ambient organic carbon (OC) to elemental carbon (EC) ratios are strongly associated with not only the radiative forcing due to aerosols but also the extent of secondary organic aerosol (SOA) formation.

An inter-comparison study was conducted based on PM10 particulate matter samples collected over the course of a year in an industrial zone characterized by the presence of a cement plant and quarries in Alicante (Spain) to investigate the influence of the thermal–optical temperature protocol on the OC and EC concentrations. Three temperature protocols were used: the NIOSH (National Institute for Occupational Safety and Health), EUSAAR (European Supersites for Atmospheric Aerosol Research) and IMPROVE (the Interagency Monitoring of Protected Visual Environments network)-A. All the protocols were run by the Sunset carbon analyser.

The total carbon (TC) agrees well between all the protocols used (slopes:0.91-0.97; R^2:0.92-0.99). OC and EC values measured by the three protocols will be referred to as $OC_{IMPROVE-A}$ and $EC_{IMPROVE-A}$, OC_{NIOSH} and EC_{NIOSH}, OC_{EUSAAR} and EC_{EUSAAR}, respectively. Compared with IMPROVE-A, the NIOSH protocol tended to classify more carbon as OC. $OC_{IMPROVE-A}$ and OC_{NIOSH} exhibited strong correlation (slope = 0.83 ± 0.01, intercept was set as zero; R^2 = 0.95). A worse correlation is found between $EC_{IMPROVE-A}$ and EC_{NIOSH} (slope = 1.31 ± 0.03, intercept was set as zero; R^2 = 0.51). A slope closer to one is found between $OC_{IMPROVE-A}$ and OC_{EUSAAR} (slope = 0.90 ± 0.03, intercept was set as zero; R^2 = 0.95). With respect to the EC values, the correlation improves but the slope is still higher than one (slope=1,26± 0.03, R^2 = 0.75), suggesting a higher detection of EC using the IMPROVE-A protocol. In the case of the comparison between NIOSH and EUSAAR protocols, a very good correlation between the OC is found (slope=1,07± 0.02; R^2 = 0.98). The EC values do not correlate better than they do in the other comparisons but the slope is closer to one (Fig. 1).

The different concentrations obtained depending on the protocol used are related to the high concentration of metal oxides and carbonates present in the filters. These concentrations are so high that the split between OC and EC occurs in the inert mode (in 80%, 50%, 14% of the samples for NIOSH, EUSAAR and IMPROVE-A respectively). A bias in the OC and EC may be produced as it is not known if the light absorbing carbon evolving is EC or PC.

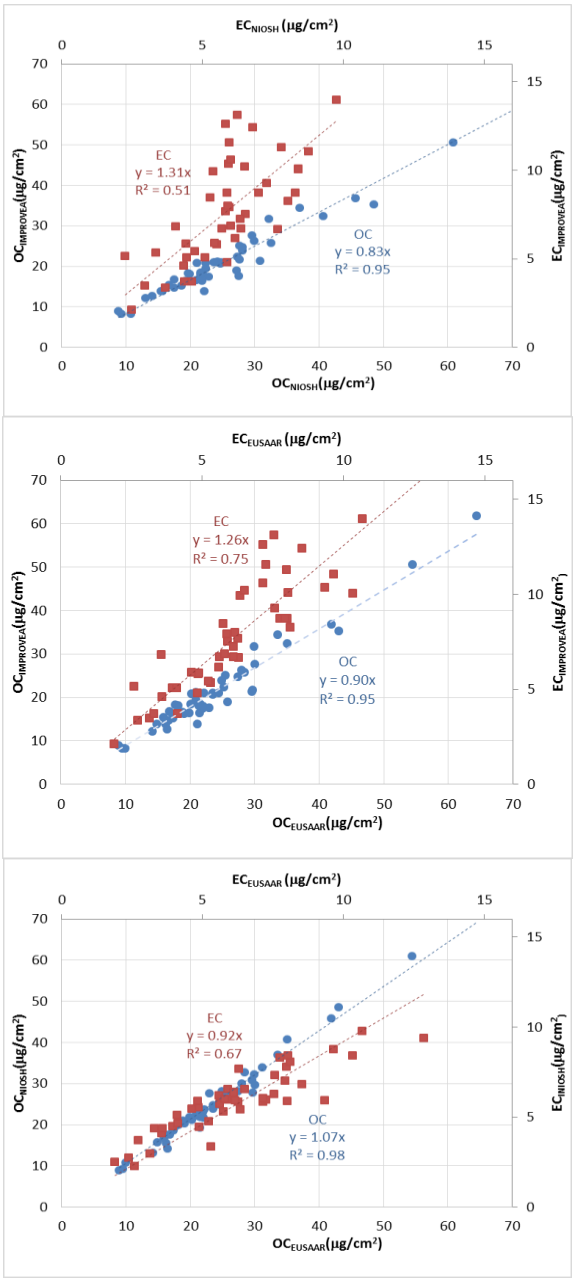

Figure 1. Comparison of the IMPROVE-A vs. NIOSH, IMPROVE-A vs. EUSAAR, NIOSH vs. EUSAAR for the OC and EC determination.

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