Performance of the Chemical Mass Balance Model with Various Traffic Profiles

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Road traffic is one of the key sources of particulate matter (PM) concentrations in urban areas, and a good understanding of the contribution of traffic emissions to PM mass is imperative for policy action. Receptor models such as the Chemical Mass Balance (CMB) and Positive Matrix Factorization (PMF) are routinely used for quantitative estimation of source contributions to PM. The CMB model, based on the principle of mass balance, requires locally-relevant profiles for reliable source contribution estimates (SCEs).

The aim of this study was to assess the response of the CMB-MM model to molecular marker profiles for traffic derived using different sampling approaches, i.e. dynamometer and twin-site sampling (Schauer *et al.*, 1996). The traffic estimates thus obtained were cross-compared using other proposed methods as described in Figure 1.

24-hour samples were collected using high-volume samplers at roadside, urban background and rural sites in Birmingham and London (UK) in 2007 and 2011 respectively. Chemical analysis was carried out using GC-MS as described in Yin *et al.* (2010).

Using ambient measurement-based molecular marker data from the roadside and background sites in London, a composite traffic profile for $PM_{2.5}$ OC was created. Based on previous studies and information about key sources in the area, a total of six profiles were used including vegetative detritus, wood combustion, coal combustion, natural gas, crustal dust and traffic (diesel, gasoline and smoking engine). Ambient data was analysed using the CMB8.2 software for attribution of $PM_{2.5}$ OC mass to different sources. The marker species for the sources were monitored using the MPIN matrix and cross-compared with other published studies and the r^2 and χ^2 were observed to be between 0.96-1.00 and 0.08- 3.00 respectively. $PM_{2.5}$ estimates were obtained using OC to $PM_{2.5}$ source conversion ratios previously published in Yin *et al.* (2010).

The model resolved the CMB mass reasonably well with both composite and dynamometer profiles with 88.8-117.1% of the $PM_{2.5}$ mass resolved across all datasets. In terms of resolution of the traffic source, while there was overall agreement between the SCEs from the different profiles, the t-stat values for the composite profile were consistently lower than the dynamometer profile runs. Comparisons with mass closure and the EC-tracer calculations lead to the conclusion that the composite profiles estimates the traffic source contribution better than the dynamometer profile. However, it is important to bear in mind that the traffic profiles generated using ambient data have higher uncertainties and the chemical species can be subject to oxidation in the atmosphere, both of which can impact upon the model output.

Analysis is currently underway to prepare traffic source profiles using tunnel data which will then be compared against twin-site profile and dynamometer profiles.

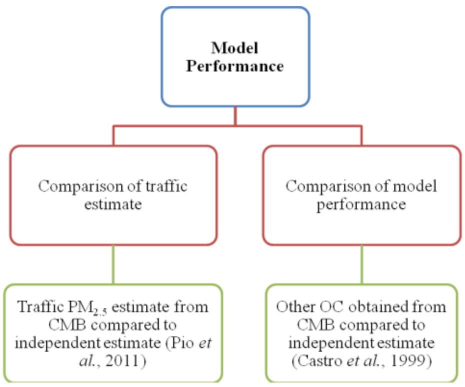

Figure 1: Assessment of model performance using independent estimates

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