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Source-apportionment and model evaluation: experiences with the EMEP SOA model

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The EMEP MSC-W chemical transport model (Simpson et al., 2003) has been successfully used for the prediction of photochemical oxidants and various inorganic aerosol components (sulphate, nitrate, ammonium) for many years. The model generally performs well for such species, as should be expected for compounds whose emission sources and chemistry are fairly well know. For carbonaceous particulate matter (PCM) however the model has been found to give very different results in different parts of Europe, with typically poor performance in southern Europe, but rather good results in Northern Europe (Simpson et al., 2007). Earlier comparison with the results of source-apportionment studies from the CARBOSOL project (Gelencser et al., 2007, Simpson et al., 2007) has shown that the poor performance in southern Europe can partly be ascribed to difficulties with emissions from residential wood-burning, and partly due to an underestimate of the secondary organic aerosol (SOA) component. Such difficulties are expected for organic aerosols, a subject where the basic science is only partially understood, and where new experimental results continually lead to revisions in existing ideas concerning sources and formation mechanisms (e.g. Hallquist et al., 2009). In such a situation, it is essential that model results are evaluated as thoroughly as possible, and that where possible the various components of organic aerosol can be evaluated separately.

A number of source-apportionment (SA) studies have recently become available in Europe, in which data on elemental carbon (EC), organic carbon (OC), 14C, levoglucosan, and various markers of primary organic carbon (cellulose, sugars/sugar-alcohols) have allowed estimates of various sources of carbonaceous particulate matter (PCM). As well as CARBOSOL, these studies include various sites in Switzerland (e.g. Lanz et al., 2008, Szidat et al., 2006), data are available from Gothenburg in Sweden (Szidat et al., 2008) and from southern Norway (Yttri et al., 2009).

Here we present comparisons of the EMEP model against the source-apportionment results of all of the above studies, comparing the model's estimates of primary, secondary, biogenic and anthropogenic PCM against those estimated from the SA data. We also discuss the uncertainties inherent in such SA data resulting from difficulties associated with measurements of PCM and with the assumptions necessary to perform the source-apportionment. Such difficulties include positive and negative artifacts due to filter sampling, and assumptions concerning EC/OC ratios, levoglucosan/OC ratios, etc.

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