Biogenic contribution to particulate matter in Northern Italy

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Introduction

Aerosol particulate matter carbonaceous fraction contains organic tracers that are characteristic of the sources, the formation and the transformation during atmospheric processes. Biogenic organic matter consists mainly of lipids, humic and fulvic acids, steroids, terpenoids, sugars, n-alkanes, n-alkanols and n-alkanoic acids (Simoneit, 1999). PM10 aerosol samples were collected during spring and summer in six sites placed in the Lombardy region (Northern Italy) having different geographical characteristics. In this study we compare some approaches in order to estimate biogenic sources contribution using different bio-aerosol tracers: n-alkanes, fatty acids, sugars (levoglucosan and arabitol) and O/C/EC ratios. GC-MS analysis is a useful tool for the identification, characterization and quantification of homologous series (like n-alkanes, fatty acids and sugars) and it provides relevant information on organic compounds in complex mixtures.

The sites object of this study are shown in figure 1, the sampling period is reported in table 1. In table 2 we report the main results of organic material chemical characterization.

Alkanes

For the urban background sites (Canti, Milano, Mantova) the CPI index increases from spring to summer samples. Considering for instance the pattern distribution of the n-alkanes (figure 2) of three months in Mantova, we note that in the summer season the samples are richer in biogenic compounds (C27, C29, C31). In the April samples (figure 3) of Sondrio (traffic site) and Milano we note that the concentrations of n-alkanes < C26 are high: this is an indication of anthropogenic contribution to organic material in the particulate matter. The WNA index (table 2) shows very high biogenic contribution (from 17% to 22%) in S.Colombano, an alpine site where the sampler is located at 2.300 m a.s.l.

Sugars

Following the results of Piazzalunga et al. (2009) demonstrating that the concentration of Levoglucosan (LG), a marker of wood burning, in Lombardy region is high during the cold season, in this poster we show (figure 4 and 5) that in the warm and hot season the concentrations of this sugar are very low; in these periods the Arabitol (AR), a marker of fungal spores, concentrations increase.

According to Bauer et al., (2008) Arabitol and Mannitol are the source tracers for quantifying the spore-OC in the atmospheric aerosol, currently no other emission sources for these compounds have been reported in literature. Here we present the first data available in Italy.

Fatty Acids

In this work we quantified only even acids (C14-C28), C16 and C18 concentration values are not reported here because of high blank value. The distribution pattern shows that, in all samples, the most abundant compounds are those with C>22.

In figure 6 we show the distribution pattern in the different sites during April. The comparison between April and June/July samples in Mantova is shown in figure 7.

Conclusion

The chemical characterization of organic material in the particulate matter samples shows that there are biogenic compounds (i.e. odd n-alkanes, arabitol). The concentration of these compounds increases from spring to summer.

The biogenic contribution of particulate matter could not be negligible so in the future we would like to quantify the contribution of these sources to PM level.

References:


Table 1

<table>
<thead>
<tr>
<th>Site</th>
<th>April '05</th>
<th>May '05</th>
<th>June/July '05</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. Colombano</td>
<td>4 - 10</td>
<td>16 - 19</td>
<td>27 - 3</td>
</tr>
<tr>
<td>Sondrio</td>
<td>4 - 10</td>
<td>16 - 22</td>
<td>27 - 3</td>
</tr>
<tr>
<td>Milano</td>
<td>4 - 10</td>
<td>16 - 23</td>
<td>27 - 3</td>
</tr>
<tr>
<td>Mantova</td>
<td>4 - 10</td>
<td>16 - 22</td>
<td>27 - 3</td>
</tr>
<tr>
<td>Bosco Fontana</td>
<td>4 - 10</td>
<td>16 - 22</td>
<td>27 - 3</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Sugar concentration</th>
<th>April</th>
<th>May</th>
<th>June/July</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levoglucosan (LG)</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
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<tr>
<td>Arabitol (AR)</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7