Seasonal variability of volatile organic compounds (VOC) at the SIRTA station (Île-de-France region) analyzed by GC/MS

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Abstract:
Volatile organic compounds (VOC) play an important role in the atmosphere. They participate in complex reactions which favor the formation of ozone, which is a pollutant and a greenhouse gas.

The ACTRIS project is an European research infrastructure for long-term observations of clouds, aerosols and reactive gases (including VOC). ACTRIS plays an important role in the definition of quality assurance measurement protocols. These measurements will allow to follow and to better understand the long-term trends of reactive compounds, and the link with climate change, air quality and long-range transport of pollutants.

Since 2013, the SIRTA station performs measurement of VOC in the framework of this project. With regular air sampling (4/week), analyses of VOC are produced by gas chromatography/mass spectrometry (GC/MS). We present here the instrumentation, the quality approach and the results obtained since 2013 for selected VOC.

Sampling and Analysis by GC/MS:

• 2 Liters of Sampling Air on Tenax TA cartridge
• 4 samples/week (Tuesday, Thursday 11h-13h and Wednesday, Friday 01h-03h)

Repeatability tests:

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Benzene</th>
<th>Isoprene</th>
<th>Octane</th>
<th>Tolouene</th>
<th>p-xylene</th>
<th>m/xylene</th>
<th>Trimethyl-benzene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartridges doped with 200 ml NMHC</td>
<td>262 968</td>
<td>58 102</td>
<td>74 852</td>
<td>206 069</td>
<td>417 052</td>
<td>219 847</td>
<td></td>
</tr>
<tr>
<td>Area average</td>
<td>20 513</td>
<td>4 150</td>
<td>10 217</td>
<td>25 191</td>
<td>66 966</td>
<td>65 644</td>
<td></td>
</tr>
<tr>
<td>Standard deviation</td>
<td>8</td>
<td>7</td>
<td>14</td>
<td>12</td>
<td>21</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

Tests allow to calculate the uncertainties

- Good repeatability for many compounds
- Low uncertainty
- Trimethyl-benzene: compound less volatile than the other compounds
- Difficulty to analyse
- Uncertainty increases

Control quality and submission at The European data base (EBAS)

Data quality control at N-1 year

- January-March N: internal verification at each laboratory in the ACTRIS network
- 31 March N: sending raw data
- 30 April N: consistency tests carried out by ACTRIS
- May N: meeting, discussion of problems
- 31 May N: new submission of corrected data
- Publication of labeled data ACTRIS

Intercomparison between 17 laboratories in ACTRIS on 34 VOC mixed – SIRTA’s Results

- Global Atmosphere Watch quality objective
- Mixing in Dinitrogen: Achieved for 8 VOC measured out of 9
- Mixing in Air: Achieved for 7 VOC measured out of 9

Variability of selected VOC between years 2013 and 2016:

- Benzene: Maximum in winter due to enhanced source and dynamics
- Isoprene: Maximum in summer due to more intense activity of the vegetation
- α-pinene: Maximum in summer due to more intense activity of the vegetation

Conclusion:

- The objective of the rigorous measurement protocol used in SIRTA is the approval of data by the ACTRIS network. Based on this protocol, data are reliable and suitable for long-term monitoring of VOC.
- Currently, the first calculations of uncertainty are in progress
- The annual variability is marked, natural VOC are more abundant in summer, while anthropogenic VOC are more abundant in winter.