REGIONAL TRENDS OF POPs IN EUROPEAN AMBIENT AIR

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Introduction

Air is an important transport medium for persistent chemicals in general. Heavy metals and persistent organic pollutants (POPs) were included in EMEP’s monitoring programme in 1999. However, by 1995, co-operation concerning heavy metals and POPs between EMEP and other international programs was extended. This co-operation included the establishment of a database and collection of already available data on POPs among the participants. A number of countries have been reporting POPs within the EMEP area in connection with different national and international programmes such as HELCOM, AMAP, OSPARCOM, MEDPOP.

Methods and Materials

Few of the sites have reported data for POPs to date (Table 1). The stations are generally located distant from local emission sources in order to be representative for a larger region (Figure 1).

Table 1: List of monitoring stations included in the POP data base

<table>
<thead>
<tr>
<th>Country</th>
<th>Station codes</th>
<th>Station name</th>
<th>Location</th>
<th>Height above sea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>BE0004R</td>
<td>Knokke</td>
<td>51°21'N</td>
<td>3°20'E 0</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>CZ0003R</td>
<td>Kosetice</td>
<td>49°35'N</td>
<td>15°05'E 534</td>
</tr>
<tr>
<td>Iceland</td>
<td>IS0091R</td>
<td>Stórholfs</td>
<td>63°24'N</td>
<td>20°17'W 118</td>
</tr>
<tr>
<td>Ireland</td>
<td>IE0002R</td>
<td>Turlough Hill</td>
<td>53°02'N</td>
<td>6°24W 420</td>
</tr>
<tr>
<td>Netherlands</td>
<td>NL0009R</td>
<td>Kollumerwaard</td>
<td>53°20'N</td>
<td>6°17'E 0</td>
</tr>
<tr>
<td>Norway</td>
<td>NO0042G</td>
<td>Spitsbergen, Zeppelinfjell</td>
<td>78°54'N</td>
<td>11°53'E 474</td>
</tr>
<tr>
<td></td>
<td>NO0099R</td>
<td>Lista</td>
<td>58°06'N</td>
<td>6°34'E 13</td>
</tr>
</tbody>
</table>

Table 2: General information about sampling and analysis of POPs in air (1999)

<table>
<thead>
<tr>
<th>Country</th>
<th>Sites</th>
<th>POPs</th>
<th>Sampling period</th>
<th>Sampler</th>
<th>Analytical methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Czech. Rep</td>
<td>CZ0003R</td>
<td>PAHs, PCBs, DDTs, HCHs, HCB</td>
<td>24 hrs every week</td>
<td>High volume</td>
<td>GC-MS</td>
</tr>
<tr>
<td>Iceland</td>
<td>IS0091R</td>
<td>PCBs, pesticides</td>
<td>15d</td>
<td>High volume</td>
<td>GC-MS</td>
</tr>
<tr>
<td>Norway</td>
<td>NO0042G</td>
<td>PAH, pesticides, HCHs, HCB, PCBs</td>
<td>48h</td>
<td>High volume</td>
<td>GC-MS</td>
</tr>
<tr>
<td></td>
<td>NO0099R</td>
<td>α-HCH, γ-HCH, HCB</td>
<td>48h</td>
<td>High volume</td>
<td>GC-MS</td>
</tr>
</tbody>
</table>

GC-MS: Gas chromatography with mass spectrometry
Results and Discussion

Data of POP concentrations measured at European remote or background sites within regional monitoring programs (EMEP) and various other research programs have been included in the MEPOP-program. Regional concentrations and deposition fluxes of selected POPs and the spatial and temporal variation across Europe have been investigated.

The sites included were Košetice in the Czech Republic in central Europe, Rörvik, which is a coastal station at the Swedish West Coast, Pallas, a sub-arctic area in northern Finland and Preila in Lithuania at the Baltic Sea. In the Netherlands, measurements of selected POPs in air and precipitation have also been carried out for a period of two years at 18 stations including one at the sea.

A seasonal variation in the atmospheric concentrations of POPs was found at all the sampling sites, but the concentrations also varied as a result of the origin of the air masses. The highest PAH levels occurred during the winter periods, while the levels of PCBs and pesticides were higher during warmer periods. Figures 2 and 3 show temporal trends for $\alpha$-HCH and $\gamma$-HCH in air at 6 stations. The concentration level of $\alpha$-HCH at the Norwegian stations is relatively high compared to the other stations, but decreasing. This is probably due to higher input of technical HCH at high latitudes (Breivik et al., 1999).

Benzo(a)pyrene (also other PAHs) is rapidly destroyed by UV. In the absence of local sources, therefore, a pronounced seasonal trend is to be expected, which is seen especially for CZ03 (Figure 4). Data for PTS have been reported only from countries around the North and Baltic Seas, in the Arctic and from the Czech Republic.

Significant regional differences in the atmospheric concentrations of POPs over Europe were identified. The annual average atmospheric concentrations of PCB (sum of seven) and PAH (sum of 12), from measurements carried out between 1996 – 2001 are given in Figure 5. The levels from the Netherlands represent average values from 18 stations.
The highest concentrations of PCBs occurred at Košetice in the Czech Republic while lower concentrations were found in Scandinavia, declining from Rörvik at the Swedish West Coast to Pallas in northern Finland. The average concentrations found in the Netherlands were in the same level or somewhat higher compared to the Swedish west coast.

The highest concentrations of PAHs were measured at Košetice while lower concentrations were found in Scandinavia, declining from Rörvik at the Swedish West Coast to Pallas in northern Finland. Benzo(a)pyrene was also measured at the Baltic station Preila, where the concentrations were significantly higher compared to the Košetice levels. The PAHs concentrations in the Netherlands were in the same level as in the Czech Republic during 2000-2001 indicating the short distance to source areas at these sites.

No significant time trend was observed in the annual averages for PCB and PAH but there were indications of slightly declining levels, especially for individual components, which is demonstrated for PCB –153 at the two sampling sites Rörvik and Pallas in Figure 6.

The temporal trends in Central Europe are measured at Košetice observatory and are shown in Figures 7-10. The decreasing tendency during last years is possible to recognize.

Acknowledgements
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Reference
1. Holoubek I., Alcock R., Brorström-Lundén, E., Kočan A., Petrosjan V., Roots O., Shatalov V. et al. (2003): Regionally Based Assessment of Persistent Toxic Substance - Region III -
Europe Report, Number of project: GF/CP/4030-00-20, Number of subproject: GF/XG/4030-00-86, for UNEP Chemicals: Masaryk University, Brno, Czech Republic, 180 pp.


**Figure 7:** The time trends of regional background concentrations of PAHs, observatory Košetice (median, 1996-2001)

**Figure 8:** The time trends of regional background concentrations of PCBs, observatory Košetice (median, 1996-2001)
Figure 9: The time trends of regional background concentrations of HCHs, observatory Košetice (median, 1996-2001)

Figure 10: The time trends of regional background concentrations of DDTs and HCB, observatory Košetice (median, 1996-2001)