Atmospheric emissions of PCB-153 in the Baltic Sea region

Author: Alexey Gusev, EMEP MSC-E

Key Message

Annual emissions of PCB-153 in HELCOM countries have decreased during the period from 1990 to 2016 by 78%.

Results and Assessment

Relevance of the BSEFS for describing developments in the environment

This indicator shows the levels and trends in emissions of PCBs from anthropogenic sources of HELCOM countries to the atmosphere. These emissions represent the pressure of emission sources on the atmosphere of the Baltic Sea region and subsequently on the Baltic Sea aquatic environment.

Policy relevance and policy references

HELCOM adopted a Recommendation in May 2001 for the cessation of hazardous substance discharges/emissions by 2020, with the ultimate aim of achieving concentrations in the environment near to background values for naturally occurring substances and close to zero for man-made synthetic substances.

On the European level the relevant policy to the control of emissions of PCBs to the atmosphere is being taken in the framework of UN ECE Convention on Long-Range Transboundary Air Pollution (CLRTAP). The Executive Body of CLRTAP adopted the Protocol on Persistent Organic Pollutants on 24 June 1998 in Aarhus (Denmark). According to one of the basic obligations, Parties to the Convention shall reduce their emissions of PCBs below their levels in 1990. The Protocol has been entered into force in 2003 and has been signed and/or ratified by 40 countries.

Assessment

According to officially reported data and available expert estimates annual emissions of PCB-153 in HELCOM countries have decreased during the period from 1990 to 2016 by 78% (Figure 1). The most significant drop of PCB-153 emissions (see Figure 2) can be noted for Latvia (95%), Germany (87%), and Russia (85%), while the lowest decline took place in Poland (17%). At the same time, increase of PCB-153 emissions since 1990 was estimated for Sweden and Finland by 3% and 11%, respectively.

In 2016 total annual PCB-153 emissions of HELCOM countries amounted to 0.6 t. Among the HELCOM countries the largest contributions to total annual PCB-153 emission of HELCOM countries belong to Germany (34%), Poland (23%), and Russia (18%).

Maps with time-series of annual total PCB-153 emissions of HELCOM countries are shown in Figure 2. The diagrams on the map also show the fractions of emissions deposited to the Baltic Sea. The highest fractions were characteristic of Denmark, Sweden, and Estonia (about 12%), while the lowest one of the Russian Federation (about 0.4%).

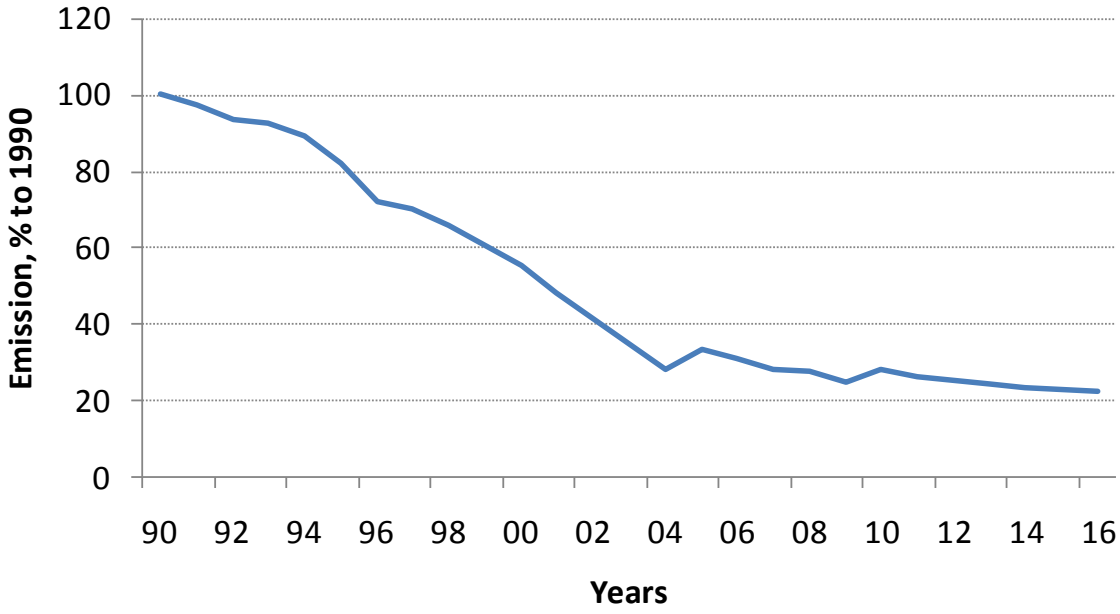

Figure 1. Total annual emissions of PCB-153 to air from HELCOM countries in period 1990-2016 (% of 1990).

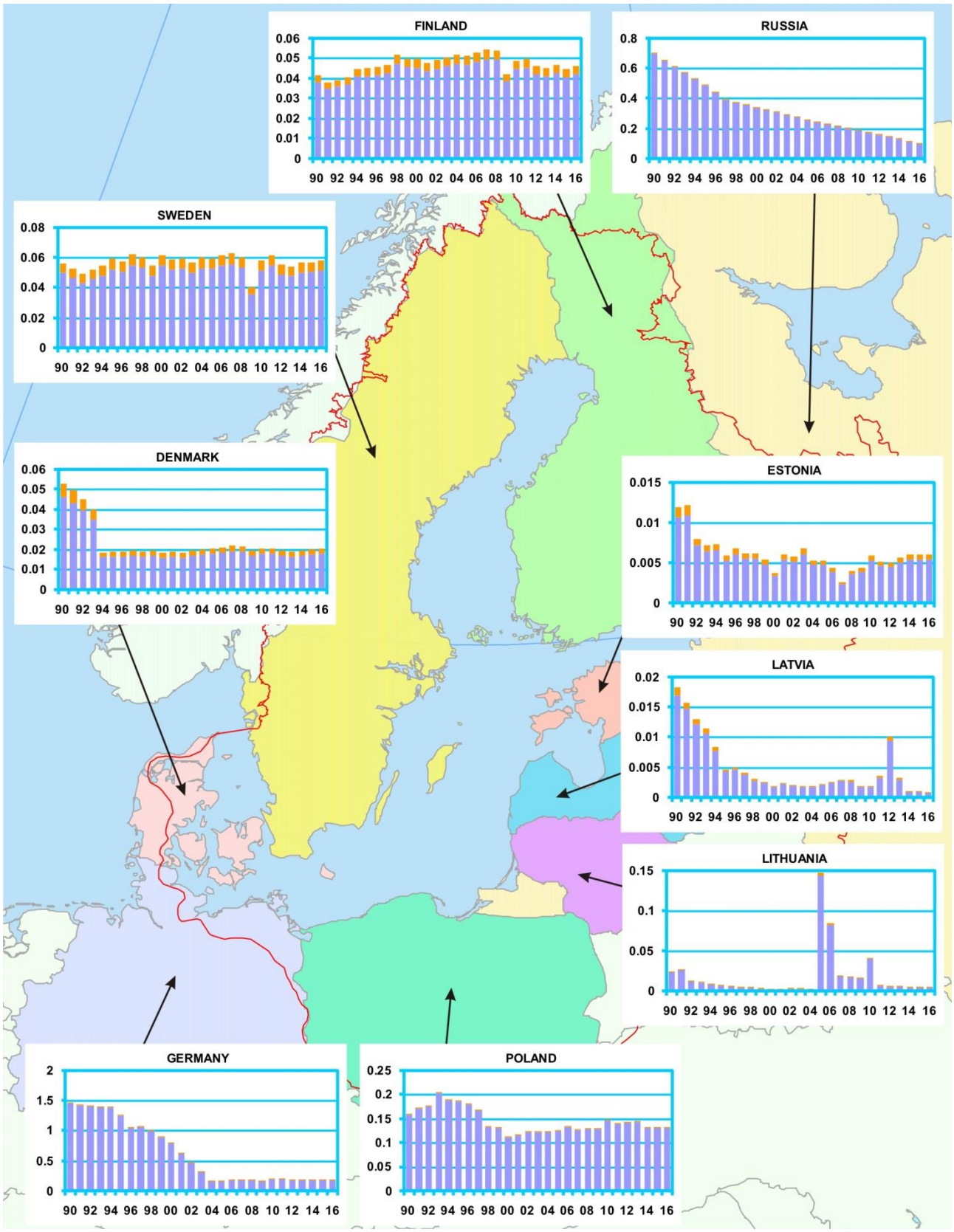

Figure 2: Map of **PCB-153** emissions of HELCOM Contracting Parties (CP) to air as totals in tonnes/year for the period 1990-2016. Red sections of the bars identify the fraction of emission deposited to the Baltic Sea. *(The emission data of the CP refer to the total area of the CP except for Russian Federation, for which emissions from the territory of Russian Federation within the EMEP domain is used).* **Note:** different scales have been used for different countries!

References

Breivik K., Sweetman A., Pacyna J.M., Jones K.C. [2007] Towards a global historical emission inventory for selected PCB congeners - A mass balance approach-3. An update. Science of the Total Environment, vol. 377, pp. 296-307.

Denier van der Gon H.A.C., van het Bolscher M., Visschedijk A.J.H. and P.Y.J.Zandveld [2005]. Study to the effectiveness of the UNECE Persistent Organic Pollutants Protocol and costs of possible additional measures. Phase I: Estimation of emission reduction resulting from the implementation of the POP Protocol. TNO-report B&O-A R 2005/194.

Data

Numerical data on PCB-153 anthropogenic emissions of HELCOM countries are given in the following table.

Table 1. Total annual PCB-153 emissions from anthropogenic sources of HELCOM countries in period from 1990 to 2016. Units: tonnes/year.

	DK	EE	FI	DE	LV	LT	PL	RU	SE	HELCOM
1990	0.0529	0.0120	0.0416	1.4712	0.0183	0.0249	0.1593	0.7038	0.0562	**2.540**
1991	0.0496	0.0122	0.0381	1.4355	0.0158	0.0273	0.1739	0.6566	0.0525	**2.462**
1992	0.0451	0.0080	0.0392	1.4152	0.0130	0.0127	0.1764	0.6143	0.0491	**2.373**
1993	0.0401	0.0072	0.0407	1.4028	0.0114	0.0109	0.2045	0.5742	0.0517	**2.344**
1994	0.0187	0.0074	0.0448	1.3937	0.0083	0.0091	0.1900	0.5324	0.0544	**2.259**
1995	0.0191	0.0059	0.0453	1.2574	0.0046	0.0072	0.1873	0.4908	0.0592	**2.077**
1996	0.0191	0.0067	0.0458	1.0533	0.0049	0.0067	0.1808	0.4456	0.0574	**1.820**
1997	0.0194	0.0062	0.0468	1.0709	0.0041	0.0056	0.1686	0.3944	0.0620	**1.778**
1998	0.0191	0.0062	0.0518	1.0067	0.0030	0.0051	0.1342	0.3769	0.0605	**1.663**
1999	0.0192	0.0054	0.0498	0.9019	0.0025	0.0043	0.1324	0.3598	0.0546	**1.530**
2000	0.0185	0.0037	0.0496	0.8038	0.0019	0.0030	0.1129	0.3436	0.0619	**1.399**
2001	0.0190	0.0060	0.0476	0.6374	0.0025	0.0027	0.1167	0.3293	0.0591	**1.220**
2002	0.0183	0.0057	0.0490	0.4809	0.0020	0.0041	0.1246	0.3119	0.0595	**1.056**
2003	0.0192	0.0068	0.0504	0.3288	0.0019	0.0032	0.1237	0.2952	0.0567	**0.886**
2004	0.0199	0.0053	0.0520	0.1644	0.0018	0.0032	0.1247	0.2790	0.0598	**0.710**
2005	0.0207	0.0053	0.0512	0.1675	0.0023	0.1477	0.1251	0.2630	0.0594	**0.842**
2006	0.0210	0.0043	0.0531	0.1813	0.0025	0.0841	0.1345	0.2475	0.0617	**0.790**
2007	0.0220	0.0026	0.0541	0.1819	0.0030	0.0193	0.1282	0.2324	0.0627	**0.706**
2008	0.0216	0.0040	0.0539	0.1857	0.0029	0.0182	0.1308	0.2176	0.0601	**0.695**
2009	0.0195	0.0044	0.0421	0.1674	0.0018	0.0162	0.1293	0.2032	0.0403	**0.624**
2010	0.0203	0.0060	0.0488	0.1970	0.0019	0.0416	0.1480	0.1890	0.0578	**0.710**
2011	0.0206	0.0052	0.0497	0.1990	0.0035	0.0072	0.1410	0.1750	0.0617	**0.663**
2012	0.0195	0.0050	0.0463	0.1892	0.0101	0.0058	0.1440	0.1612	0.0551	**0.636**
2013	0.0190	0.0056	0.0450	0.1915	0.0032	0.0064	0.1451	0.1475	0.0539	**0.617**
2014	0.0195	0.0060	0.0465	0.1934	0.0011	0.0057	0.1330	0.1334	0.0567	**0.595**
2015	0.0199	0.0060	0.0445	0.1941	0.0010	0.0052	0.1314	0.1190	0.0571	**0.578**
2016	0.0206	0.0060	0.0461	0.1929	0.0009	0.0055	0.1329	0.1035	0.0578	**0.566**

Metadata

Technical information

1. Source:

EMEP/MSC-E, EMEP/CEIP;

PCB emission inventory [Breivik et al., 2007]
(https://www.nilu.no/projects/globalpcb/globalpcb2.htm).

2. Description of data:

Assessment of global scale transport and fate of PCBs was made on the basis of the inventory of global PCB emissions [Breivik et al., 2007] and emissions officially reported by the EMEP countries. The inventory of Breivik et al. [2007] provided consistent set of historical and future emissions of 22 individual PCB congeners from 1930 up to 2100. It included three scenarios of emissions, namely, minimum, average, and maximum, which represented the range of emission variations. Global inventory of PCB emissions developed by Breivik et al. [2007] is available in the internet at the web site https://www.nilu.no/projects/globalpcb/globalpcb2.htm.

For the evaluation of pollution levels maximum scenario of emissions was chosen since it permitted to obtain modelling results with more reasonable agreement with measurements comparing to average and minimum scenarios. Model simulations for the period 1990 and 2016 were carried out for indicator congener PCB-153. The spatial distribution of PCB-153 emissions within the EMEP region was prepared using gridded PCB emissions officially submitted by 20 EMEP countries, including HELCOM countries except Denmark and Russia, and the emission expert estimates worked out by TNO [Denier van der Gon et al., 2005]. Temporal variation of emissions was derived from the officially reported PCB emissions.

3. Geographical coverage:

EMEP region

4. Temporal coverage:

1990-2016

5. Methodology and frequency of data collection:

The methodology applied to elaborate global inventory of PCB emission is described in [Breivik et al., 2007]

National data on PCB emissions are annually submitted by countries Parties to CLRTAP Convention to the UN ECE Secretariat. The methodology is based on combination of emission measurements and estimation of emission on the basis of activity data and emission factors. Submitted data are processed using quality assurance and quality control procedure and stored in the UN ECE/EMEP emission database at EMEP/CEIP Centre. Currently, national PCB emissions

are reported by countries as total emissions without speciation for individual congeners. Thus, to evaluate transport and fate of particular PCB congeners, available expert estimates complemented by officially reported data are applied.

Quality information

6. Strength and weakness:

Strength: gridded information on PCB emissions

Weakness: gaps in time series of national emissions, uncertainties in national emissions, lack of gridded emissions, and information on congener composition of emissions

7. Uncertainty:

Among the HELCOM countries the level of uncertainties of official data on PCB emissions were reported by Denmark, Estonia, Finland and Latvia. From the EMEP countries the information on uncertainties of officially reported PCB emissions is available for Belarus, Belgium, Croatia, Cyprus, France, Switzerland and the United Kingdom. The uncertainty of reported data on PCB-153 emissions expressed as percentage relative to mean value of emission is as follows:

Denmark:	734%
Estonia:	103%
Finland:	-64% to 102%
Latvia:	27%
Belarus:	261%
Belgium:	302%
Croatia:	399%
Cyprus:	5%
France:	44%
Switzerland:	>50%
UK:	±>50%

8. Further work required:

Further work of national experts on emissions of PCBs is required to fill the gaps in the emission time-series and to reduce their uncertainties. The information on congener composition of officially reported emission data is essential for modeling.