Atmospheric emissions of HCB in the Baltic Sea region

HELCOM Baltic Sea Environment Fact Sheet (BSEFS), 2021

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Key Message

Annual atmospheric emissions of hexachlorobenzene in the HELCOM Contracting Parties have decreased by 98% during the period from 1990 to 2019. The most significant drop of HCB emissions is indicated for 2002. The subsequent period 2003-2019 is characterized by the absence of clear trend in emission changes.

Results and Assessment

Relevance of the BSEFS for describing developments in the environment

This BSEFS shows the levels and trends in hexachlorobenzene (HCB) emissions from anthropogenic sources of the HELCOM Contracting Parties, and other sources in the calculations of the deposition on the Baltic Sea (cf. BSEFS "Atmospheric deposition of hexachlorobenzene on the Baltic Sea").

Policy relevance and policy reference

The updated Baltic Sea Action Plan states the ecological objectives that concentrations of hazardous substances in the environment are to be close to background values for naturally occurring substances. HELCOM Recommendation 31E/1 identifies the list of regional priority substances for the Baltic Sea.

On the European level the relevant policy to the control of emissions of HCB 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 HCB 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

Analysis of officially reported national inventories of POP releases shows that annual anthropogenic emissions of HCB in the HELCOM Contracting Parties have decreased during the period 1990-2019 by 98% (Figure 1). The most significant drop of HCB emissions is indicated for 2002, while for the subsequent period 2003-2019 no clear trend in HCB emission changes can be seen. Substantial reduction of HCB from 2001 to 2002 is explained by the strong decrease in the emissions reported by Germany. Spatial distributions of anthropogenic HCB emission fluxes in 1990 and 2019 are shown in Figure 2. The most significant emission fluxes around the Baltic Sea are indicated for the areas along the southern part of the Baltic Sea.

Time-series of annual anthropogenic HCB emissions of the HELCOM Contracting Parties are shown in Figures 3. The largest decline of HCB emissions is noted for Germany (99%) followed by Lithuania (96%) and Latvia (91%). At the same time emissions of Russia and Estonia in 2019 were higher than emissions in 1990 by 23% and 37%, respectively.

In 2019 total annual HCB emissions of the HELCOM Contracting Parties amounted to 62 kg. Among the HELCOM countries the largest contributions to total annual HCB emissions of HELCOM countries belong to Finland (37%), Poland (24%), and Germany (21%).

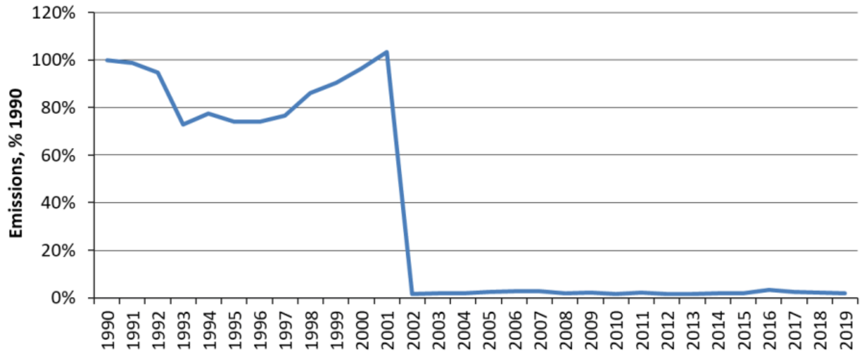

Figure 1. Relative changes of annual anthropogenic emissions of HCB to the atmosphere from the HELCOM Contracting Parties in period 1990-2019 (% of 1990).

HCB is known as a pollutant of global concern due to its long lifetime in air, significant potential to long-range transport, and persistence in the environment. HCB was widely used world-wide as a fungicide or pesticide from the beginning of 1950s until 1970s, when its application for the agricultural purposes was banned or severely restricted. Contemporary levels of HCB pollution are likely supported by unintentional releases due to industrial and combustion processes. Along with anthropogenic emissions, additional contribution to HCB pollution levels is made by the secondary emission sources (re-volatilization from surface media). Secondary sources were formed due to long-term air-surface exchange and accumulation of HCB in the terrestrial and aquatic compartments as well as direct emissions to them. It is believed that secondary emissions are considerably larger comparing to the contemporary anthropogenic emissions [*Barber et al.*, 2005]. Model estimates of HCB secondary emissions are described in the BSEFS "*Atmospheric deposition of HCB on the Baltic Sea*".

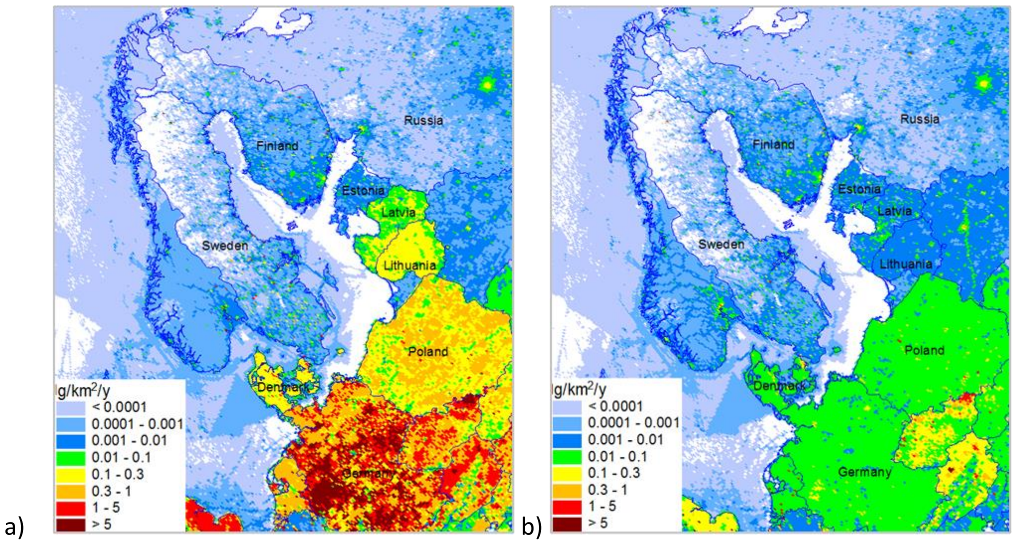

Figure 2. Spatial distribution of annual anthropogenic HCB emissions to the atmosphere in the Baltic Sea region in 1990 (a) and in 2019 (b), in g km^{-2} y^{-1}.

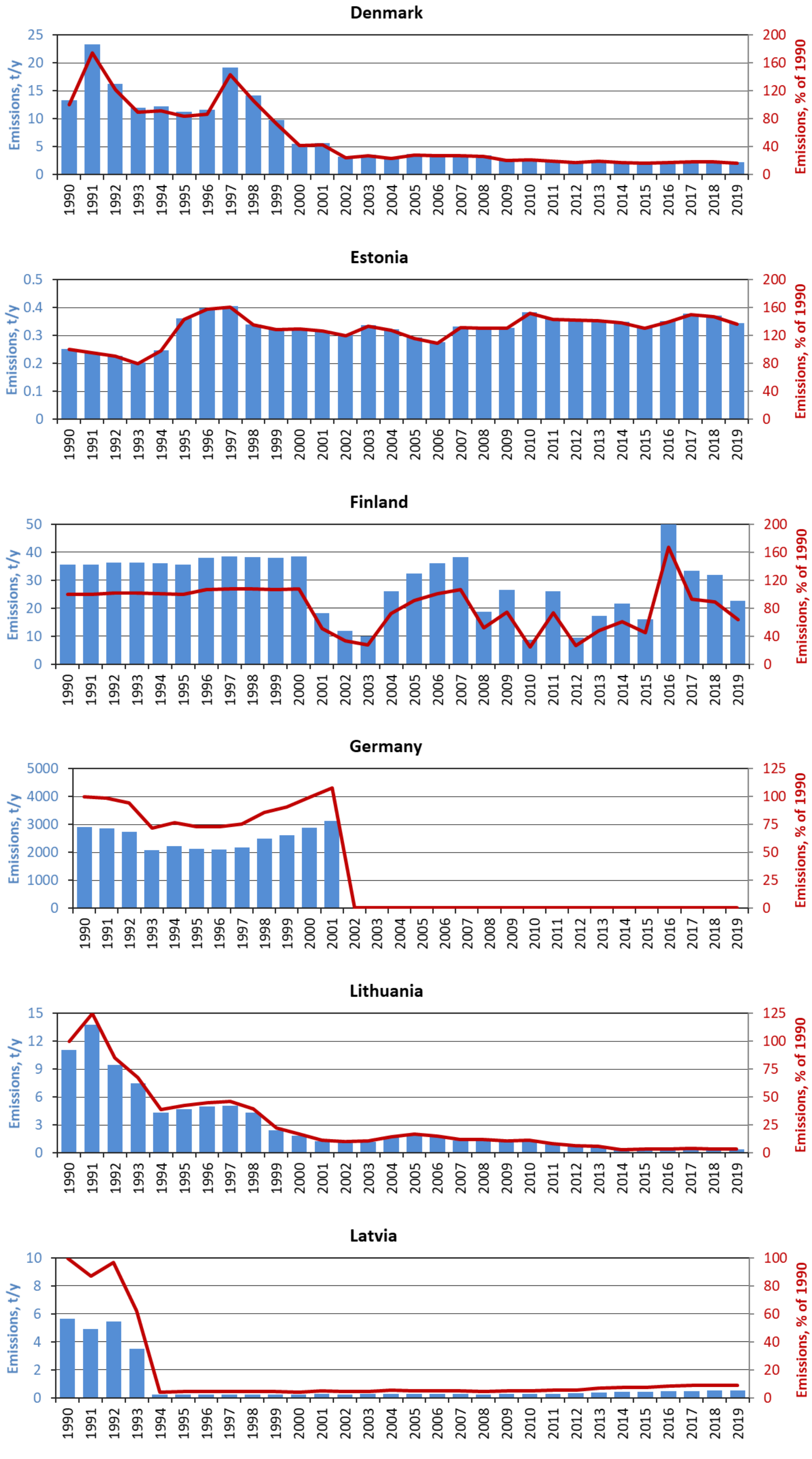

Figure 3. HCB emissions of the HELCOM Contracting Parties (CP) to the atmosphere for the period 1990-2019 in kg y^{-1} (blue bars) and in % of 1990 (red line). The emission data of the CP refer to the total area of the CP except for Russia, where emissions from the territory of Russia within the EMEP domain is used.

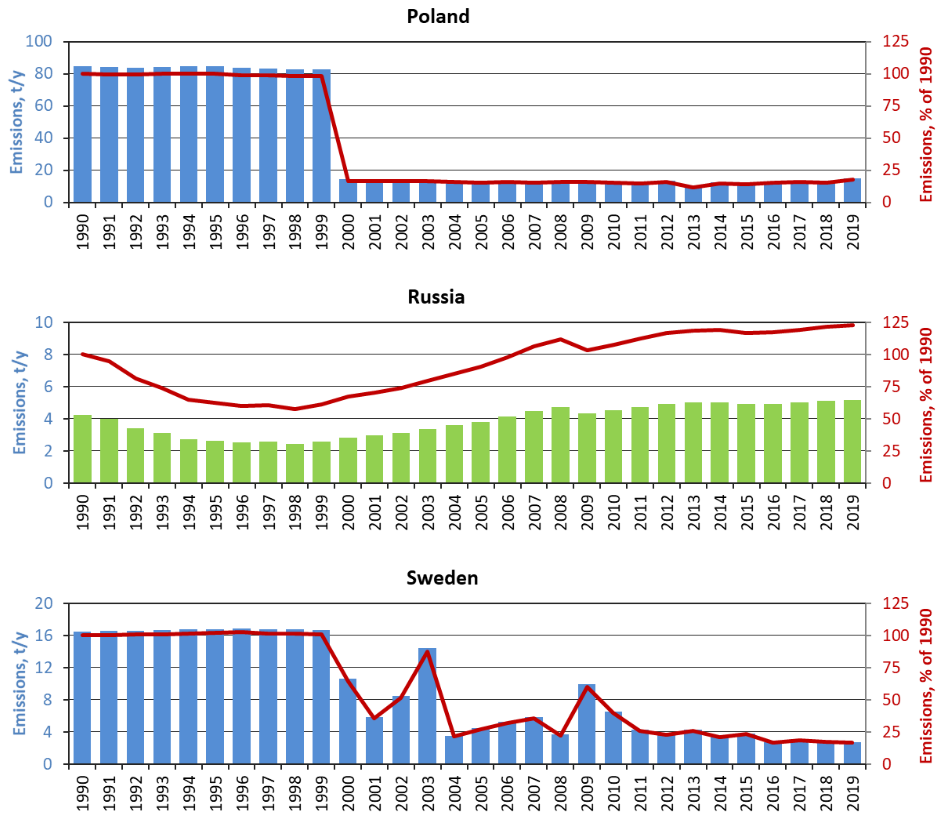

Figure 3. (continued) HCB emissions of the HELCOM Contracting Parties (CP) to the atmosphere for the period 1990-2019 in kg y^{-1} (blue bars) and in % of 1990 (red line). Green bars indicate expert estimates. The emission data of the CP refer to the total area of the CP except for Russia, where emissions from the territory of Russia within the EMEP domain is used.

Data

Numerical data on HCB anthropogenic emissions of the HELCOM Contracting Parties are given in the following table.

Table 1. HCB emissions from anthropogenic sources of the HELCOM Contracting Parties, and other EMEP countries from 1990 to 2019.
Units: kg y^{-1}.

	DK	EE	FI	DE	LV	LT	PL	RU	SE	HELCOM	Other
1990	13.4	0.252	35.7	2898	5.7	11.0	84.6	4.2	16.5	3070	6163
1991	23.4	0.240	35.6	2854	4.9	13.8	84.1	4.0	16.5	3037	5998
1992	16.2	0.227	36.4	2742	5.5	9.4	83.9	3.4	16.6	2913	6188
1993	12.0	0.202	36.4	2076	3.5	7.4	84.4	3.1	16.7	2239	5985
1994	12.3	0.248	36.1	2222	0.245	4.3	84.5	2.7	16.8	2379	5707
1995	11.2	0.362	35.6	2118	0.266	4.7	84.6	2.6	16.8	2274	5877
1996	11.6	0.397	38.0	2117	0.266	5.0	83.5	2.5	16.9	2275	5825
1997	19.2	0.405	38.5	2190	0.263	5.1	83.4	2.6	16.8	2356	5875
1998	14.2	0.340	38.4	2485	0.253	4.4	83.0	2.4	16.8	2645	6135
1999	9.7	0.324	38.1	2625	0.255	2.4	82.9	2.6	16.7	2778	1462
2000	5.6	0.327	38.6	2884	0.239	1.9	14.2	2.8	10.6	2958	1240
2001	5.7	0.318	18.2	3121	0.279	1.2	14.2	3.0	5.9	3170	1122
2002	3.2	0.303	12.0	5.6	0.259	1.1	14.0	3.1	8.5	48	919
2003	3.6	0.336	9.9	13.8	0.269	1.2	14.0	3.3	14.4	61	710
2004	3.1	0.322	26.0	5.4	0.309	1.6	13.5	3.6	3.5	57	576
2005	3.7	0.292	32.4	15.3	0.279	1.8	13.1	3.8	4.5	75	545
2006	3.6	0.275	36.1	16.2	0.292	1.7	13.5	4.1	5.3	81	427
2007	3.6	0.332	38.2	14.1	0.297	1.3	13.1	4.5	5.8	81	421
2008	3.5	0.328	18.7	14.0	0.250	1.3	13.4	4.7	3.7	60	417
2009	2.7	0.328	26.6	9.2	0.296	1.2	13.7	4.3	9.9	68	370
2010	2.8	0.382	8.8	10.7	0.292	1.3	13.1	4.5	6.6	48	369
2011	2.6	0.361	26.1	11.0	0.314	0.890	12.7	4.7	4.3	63	370
2012	2.4	0.359	9.5	9.9	0.324	0.747	13.5	4.9	3.8	45	385
2013	2.6	0.357	17.3	10.4	0.404	0.669	9.8	5.0	4.3	51	444
2014	2.4	0.348	21.6	14.5	0.438	0.310	12.3	5.0	3.4	60	462
2015	2.2	0.329	16.2	13.3	0.427	0.395	12.1	4.9	3.8	54	353
2016	2.4	0.352	59.7	15.9	0.492	0.398	12.8	4.9	2.7	100	363
2017	2.4	0.377	33.4	18.5	0.502	0.435	13.6	5.0	3.1	77	401
2018	2.4	0.372	31.9	12.8	0.515	0.391	13.2	5.1	2.8	70	354
2019	2.2	0.345	22.6	12.7	0.515	0.409	14.9	5.2	2.7	62	356

Meta data

Technical information:

1. Source:

Meteorological Synthesizing Centre East (MSC-E) of EMEP, Centre on Emission Inventories and Projections (CEIP) of EMEP.

2. Description of data:

Annual total emissions of HCB were officially reported to the UN ECE Secretariat by the HELCOM Contracting Parties. These data are available on the web site of the EMEP Centre on Emission Inventories and Projections (CEIP) (http://www.ceip.at/).

3. Geographical coverage:

EMEP region

4. Temporal coverage:

Data on annual emissions of HCB for the period 1990 – 2019 were reported by all HELCOM Contracting Parties with the exception of Russia. For Russia, expert estimates of emissions were used elaborated on the basis of methodology developed by CEIP [*Tista and Wankmueller*, 2019].

5. Methodology and frequency of data collection:

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

Quality information:

6. Strength and weakness:

Strength: data on HCB emissions are annually submitted, checked and stored in the database.

Weakness: gaps in time series and uncertainties in HCB national emissions, lack of gridded emissions, and incompleteness of sectoral distribution.

7. Uncertainty:

Officially reported emission data represent the best available information on temporal variations of HCB emissions in the EMEP region. It is believed that reported inventories cover the most significant anthropogenic sources of HCB emissions to the atmosphere. At the same time, for some of the countries significant uncertainties and incomplete information on sector distribution still exist.

Evaluation of emission uncertainties is made by the HELCOM contracting parties on the base of methodology presented in EMEP/EEA guidebook [*EEA*, 2019]. The methodology considers uncertainties of both the activity data and the emission factors applied for each emission sector. It is important to note that the uncertainties of emission factors are much higher than those for the activity data. For POPs the default value of emission factor uncertainty suggested by the guidebook exceeds 100%.

Among the HELCOM countries the level of uncertainty of official data on HCB emission was reported by Denmark, Estonia, Finland, Latvia and Poland. From other EMEP countries the information on uncertainties of HCB official emissions is available for Austria, Belarus, Belgium, Croatia, Cyprus, France, Republic of Moldova, Monaco, Switzerland and the United Kingdom. The uncertainty of reported data on HCB emissions, expressed as percentage relative to mean value of emission, is as follows:

Denmark:	474%
Estonia:	107%
Finland:	261%
Latvia:	28%
Poland:	84%
Austria:	88%
Belarus:	65%
Belgium:	160%
Croatia:	141%
Cyprus:	9%
France:	29%
Republic of Moldova:	224%
Monaco:	14%
Switzerland:	>100%
UK:	±>50%

8. Further work required:

Further work to refine national inventories of emissions of HCB is required to fill the gaps in the emission time-series, sector distribution, and spatial distribution and to reduce their uncertainties.

References

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EEA [2019]. EMEP/EEA air pollutant emission inventory guidebook 2019. Technical guidance to prepare national emission inventories. EEA Report No 13/2019. 21 p.

Tista M. and R.Wankmueller [2019] Methodologies applied to the CEIP GNFR gap-filling 2019. Part III: Persistent organic pollutants (Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total polycyclic aromatic hydrocarbons, Dioxin and Furan, Hexachlorobenzene, Polychlorinated biphenyls) of the year 2017. Technical report CEIP 3/2019 (https://www.ceip.at/ceip-reports).