

Atmospheric emissions of Benzo(a)pyrene in the Baltic Sea region

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Key Message

Annual emissions of benzo(a)pyrene in HELCOM countries have decreased by 38% during the period from 1990 to 2016.

Results and Assessment

Relevance of the BSEFS for describing developments in the environment

This indicator shows the levels and trends in emissions of benzo(a)pyrene (B(a)P) 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 B(a)P 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 B(a)P 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

Based on officially reported inventories of POP releases, annual emissions of B(a)P in HELCOM countries have decreased during the period from 1990 to 2016 by 38% (Figure 1). The most significant drop of B(a)P emissions (see Figure 2) is noted for Germany (79%), Latvia (56%), and Lithuania (55%). At the same time emissions of Poland, Denmark and Finland in 2016 were higher than emissions for 1990, by 20%, 43% and 44% respectively.

In 2016 total annual B(a)P emissions of HELCOM countries amounted to 176 t. Among the HELCOM countries the largest contributions to total annual B(a)P emissions of HELCOM countries belong to Russia (49%), Poland (24%), and Germany (17%).

Maps with time-series of annual total B(a)P 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 belong to Denmark and Sweden (13% and 12%, respectively), and the lowest one to the Russian Federation (about 0.4%).

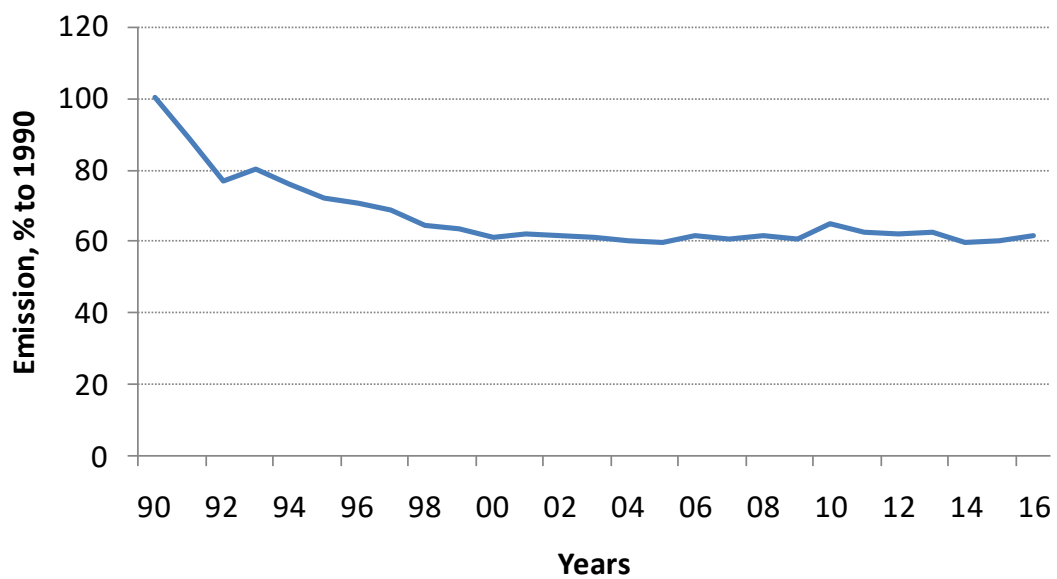


Figure 1. Total annual emissions of B(a)P to air from HELCOM countries in period 1990-2016 (% of 1990).

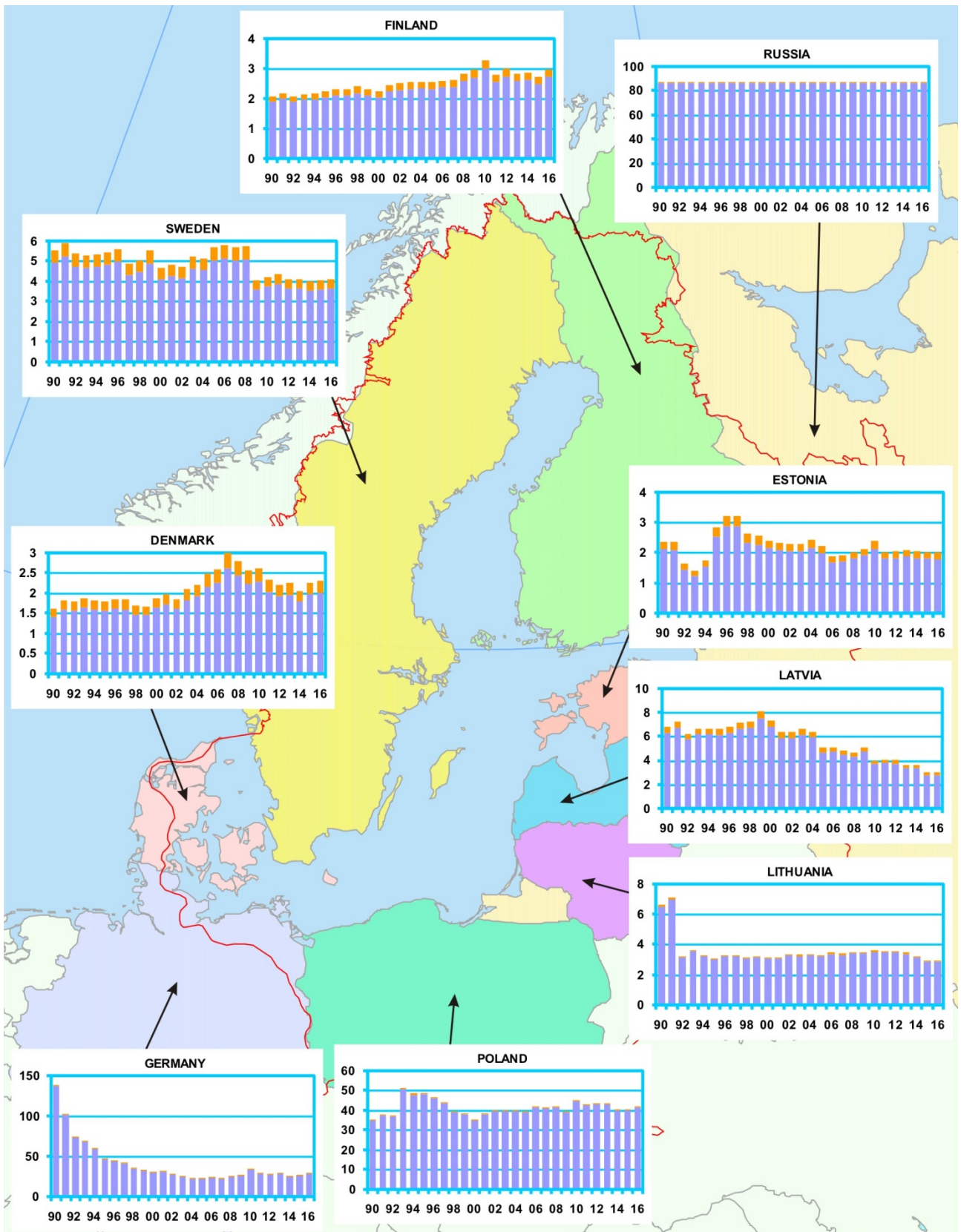


Figure 2. Map of B(a)P emissions of HELCOM Contracting Parties (CP) to air as totals in tonnes/year for the period 1990-2016. Red sections of the bars identify the fraction of emission deposited to the Baltic Sea. (The emission data of the CP refer to the total area of the CP except for Russian Federation, 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

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Tista M., Wankmueller R. and K.Mareckova [2018] Methodologies applied to the CEIP GNFR gap-filling 2018. 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. Technical report CEIP 03/2018.

(http://www.ceip.at/fileadmin/inhalte/emep/pdf/2018/POP_gap-filling_documentation_2018_v3.pdf)

Data

Numerical data on B(a)P anthropogenic emissions of HELCOM countries are given in the following table.

Table 1. Total annual B(a)P emissions from anthropogenic sources of HELCOM countries in period from 1990 to 2016. Expert estimates of emissions are shaded. Units: tonnes/year.

	DK	EE	FI	DE	LV	LT	PL	RU	SE	HELCOM
1990	1.612	2.369	2.067	138.701	6.788	6.635	35.323	86.9	5.554	286
1991	1.818	2.349	2.176	102.031	7.233	7.133	38.163	86.9	5.899	254
1992	1.790	1.629	2.077	74.640	6.207	3.237	37.641	86.9	5.368	219
1993	1.884	1.385	2.152	69.497	6.681	3.649	51.519	86.9	5.293	229
1994	1.833	1.744	2.173	60.116	6.666	3.275	48.529	86.9	5.349	217
1995	1.809	2.821	2.230	47.900	6.639	3.079	48.725	86.9	5.454	206
1996	1.860	3.226	2.313	44.545	6.821	3.306	46.644	86.9	5.606	201
1997	1.844	3.224	2.325	41.833	7.145	3.281	44.211	86.9	4.891	196
1998	1.690	2.620	2.397	35.378	7.228	3.149	39.610	86.9	5.047	184
1999	1.672	2.549	2.322	33.001	8.073	3.203	38.622	86.9	5.532	182
2000	1.885	2.398	2.230	30.548	7.362	3.137	35.304	86.9	4.645	174
2001	1.986	2.337	2.452	31.530	6.362	3.171	38.353	86.9	4.810	178
2002	1.860	2.301	2.513	27.976	6.373	3.337	39.816	86.9	4.693	176
2003	2.109	2.307	2.541	26.061	6.627	3.317	39.995	86.9	5.231	175
2004	2.213	2.416	2.555	23.479	6.410	3.331	40.002	86.9	5.144	172
2005	2.493	2.207	2.543	23.373	5.046	3.298	39.372	86.9	5.668	171
2006	2.603	1.895	2.597	24.558	5.128	3.467	42.288	86.9	5.819	175
2007	3.008	1.898	2.627	23.234	4.809	3.386	41.429	86.9	5.684	173
2008	2.808	2.014	2.831	25.738	4.633	3.503	41.866	86.9	5.747	176
2009	2.580	2.136	2.952	27.284	5.079	3.513	39.355	86.9	4.044	174
2010	2.619	2.386	3.281	34.034	3.962	3.610	44.935	86.9	4.217	186
2011	2.327	2.022	2.791	29.683	4.058	3.558	43.111	86.9	4.341	179
2012	2.204	2.039	3.000	27.762	4.039	3.541	43.636	86.9	4.123	177
2013	2.252	2.090	2.827	29.784	3.647	3.456	43.628	86.9	4.114	179

2014	2.057	2.049	2.870	25.297	3.608	3.191	40.494	86.9	3.988	170
2015	2.265	2.029	2.728	27.327	2.995	2.952	40.430	86.9	4.046	172
2016	2.301	2.008	2.978	29.494	2.991	2.965	42.258	86.9	4.125	176

Metadata

Technical information

1. Source:

EMEP/MS-C-E, EMEP/CEIP.

2. Description of data:

Annual total emissions of 4 PAHs including benzo(a)pyrene are officially reported to the UN ECE Secretariat by HELCOM countries. These data are available from 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 benzo(a)pyrene for the period 1990 – 2016 were reported by all HELCOM countries with the exception of Finland, Russia and Sweden. For these three countries emissions of B(a)P were prepared by CEIP (*Tista et al.*, 2018). In particular, expert estimates, worked out by *Shen et al.* (2013), were applied to estimated B(a)P emissions in Russia. Finland submitted emission data on 4 PAHs without splitting for individual congeners. Thus, average fraction of B(a)P in the emissions of 4 PAHs was used, calculated on the basis of emissions of other EMEP countries. Sweden submitted speciated PAH emission data, however the sum of 4 PAH emissions did not match reported total PAH emission. Therefore, the reported emissions of individual PAHs were replaced by splitting up the total PAHs in accordance with the distribution reported by Sweden.

5. Methodology and frequency of data collection:

National data on emissions of 4 PAHs including benzo(a)pyrene are annually submitted by countries Parties to LRTAP Convention to the UN ECE Secretariat. The methodology is based on 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: gridded information on PAH 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 PAH emissions were reported by Denmark, Estonia, Finland, Latvia, Poland and Sweden. From other EMEP countries the information on uncertainties of officially reported B(a)P emissions is available for Belarus, Belgium, Croatia, Cyprus, France, Switzerland and the United Kingdom. The uncertainty of reported data on PAH emissions expressed as percentage relative to mean value of emission is as follows:

Denmark:	727%
Estonia:	92%
Finland:	-81% to 196%
Latvia:	43%
Poland:	74%
Sweden:	660%
Belarus:	237%
Belgium:	272%
Croatia:	367%
Cyprus:	202%
France:	66%
Switzerland:	>50%
UK:	390%

8. Further work required:

Further work of national experts on emissions of B(a)P is required to fill the gaps in the emission time-series and to reduce their uncertainties. The information on seasonal variations of B(a)P emissions and its congener composition is essential for modeling.