Atmospheric emissions of Mercury in the Baltic Sea region

HELCOM Baltic Sea Environment Fact Sheet (BSEFS), 2023

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Key Message

Annual atmospheric mercury emissions of the HELCOM Contracting Parties decreased by 63% from 1990 to 2021.

Results and Assessment

Relevance of the BSEFS for describing developments in the environment

This BSEFS shows the levels and trends in mercury 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 mercury 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.

The relevant policy to the control of emissions of heavy metals to the atmosphere on European scale is set in the framework of UN ECE Convention on Long-Range Transboundary Air Pollution (CLRTAP). The CLRTAP Protocol on Heavy Metals (1998) targets three particularly harmful metals: cadmium, lead and mercury. According to one of the basic obligations emissions of these three metals must be reduced below the emission levels in 1990. The Protocol entered into force in 2003 and was signed and/or ratified by 41 countries.

Assessment

Annual anthropogenic emissions of mercury to the atmosphere from the HELCOM Contracting Parties decreased by 63% from 1990 to 2021 (Figure 1). Spatial distributions of mercury anthropogenic emission fluxes in 1990 and 2021 are shown in Figure 2. The largest emission fluxes are noted for the areas along the southern and western parts of the Baltic Sea.

Time-series of annual total mercury emissions of the HELCOM Contracting Parties are shown in Figures 3. Among the HELCOM countries the largest drop of mercury emissions is noted for Denmark (93%), followed by Estonia (82%), and Germany (81%). The smallest decrease of mercury emissions is seen for Russia (42%).

In 2021 total annual mercury emissions of the HELCOM Contracting Parties amounted to 31 t. The largest contributions to these emissions were made by Russia (45%), Poland (28%) and Germany (22%).

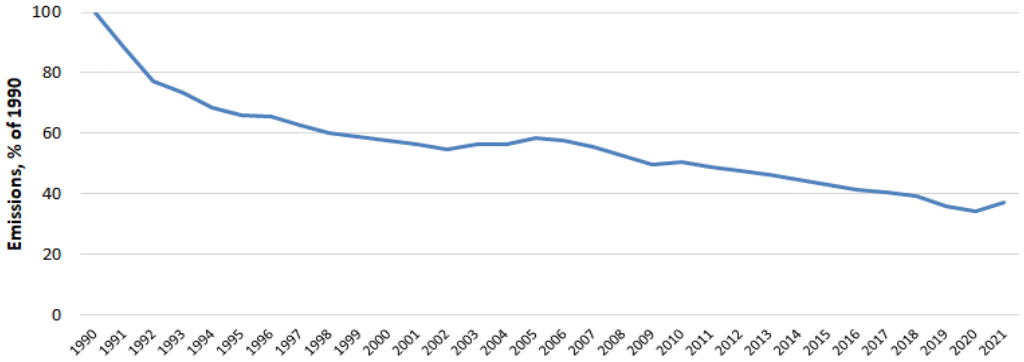

Figure 1. Relative changes of total annual emissions of mercury to the atmosphere from the HELCOM Contracting Parties in period 1990-2021 (% of 1990).

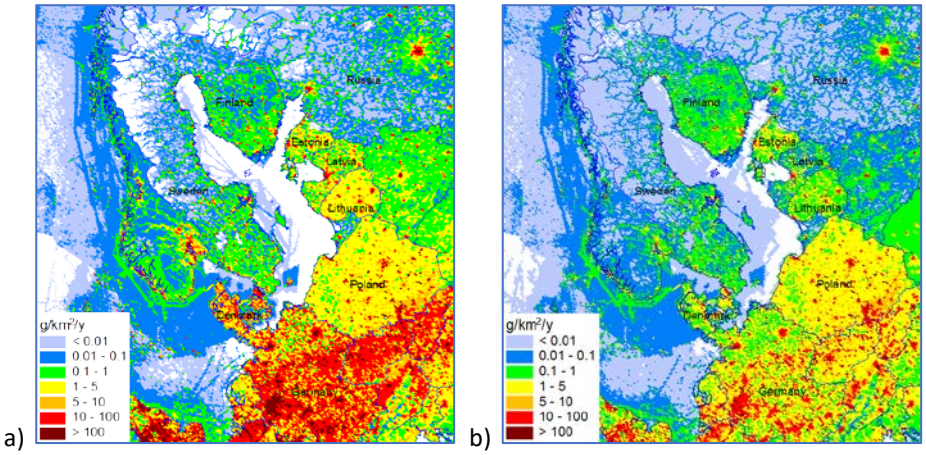

Figure 2. Spatial distribution of annual anthropogenic Hg emissions to the atmosphere in the Baltic Sea region in 1990 (a) and in 2021 (b), in g km^{-2} y^{-1}.

Figure 3. Mercury emissions of the HELCOM Contracting Parties (CP) to the atmosphere for the period 1990-2021 in t 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). Mercury emissions of the HELCOM Contracting Parties (CP) to the atmosphere for the period 1990-2021 in t y^{-1} (blue bars) and in % of 1990 (red line). The emission data of the CP refer to the total area of the CPs except for Russia, where emissions from the territory of Russia within the EMEP domain is used.

Data

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

Table 1. Mercury emissions from anthropogenic sources of the HELCOM Contracting Parties from 1990 to 2021. Units: t y^{-1}.

	DK	EE	FI	DE	LV	LT	PL	RU	SE	HELCOM	Other
1990	3.16	1.20	1.09	35.53	0.27	0.45	15.45	23.64	1.57	82	192
1991	3.28	1.09	0.93	29.96	0.24	0.51	15.20	20.30	1.25	73	188
1992	3.00	0.89	0.89	25.42	0.21	0.25	14.48	17.27	1.18	64	185
1993	2.93	0.69	0.77	22.64	0.18	0.23	14.18	17.88	1.04	61	161
1994	2.55	0.69	0.81	21.36	0.15	0.20	13.86	15.76	1.06	56	157
1995	2.32	0.64	0.80	20.43	0.11	0.18	13.12	15.76	0.99	54	155
1996	2.46	0.65	0.86	19.84	0.12	0.17	13.54	15.30	1.05	54	143
1997	1.98	0.60	0.81	19.53	0.11	0.17	12.97	14.55	0.86	52	135
1998	1.68	0.54	0.69	19.15	0.10	0.19	12.17	14.24	0.87	50	126
1999	1.48	0.46	0.64	18.30	0.09	0.15	11.54	15.00	0.87	49	120
2000	1.00	0.46	0.60	18.32	0.08	0.13	10.88	15.15	0.75	47	118
2001	0.87	0.40	0.68	17.70	0.09	0.15	10.74	15.30	0.59	47	112
2002	0.84	0.37	0.67	16.73	0.08	0.17	10.29	15.45	0.63	45	113
2003	0.87	0.30	0.82	16.03	0.08	0.16	10.37	17.27	0.71	47	109
2004	0.73	0.25	0.75	15.32	0.08	0.18	10.33	18.03	0.73	46	110
2005	0.69	0.18	0.89	14.01	0.08	0.23	10.19	21.21	0.68	48	108
2006	0.62	0.15	1.03	13.44	0.09	0.22	10.32	21.21	0.53	48	107
2007	0.60	0.21	0.87	12.66	0.10	0.20	10.08	20.57	0.57	46	103
2008	0.60	0.17	0.82	11.15	0.08	0.24	9.86	19.92	0.52	43	101
2009	0.45	0.15	0.76	10.36	0.08	0.24	9.20	19.27	0.55	41	89
2010	0.43	0.21	0.89	11.15	0.08	0.25	9.46	18.63	0.54	42	90
2011	0.39	0.25	0.75	10.55	0.08	0.23	9.42	17.98	0.52	40	92
2012	0.31	0.17	0.74	10.24	0.16	0.21	9.73	17.33	0.49	39	87
2013	0.33	0.23	0.76	9.84	0.10	0.22	9.62	16.69	0.52	38	83
2014	0.33	0.23	0.71	9.69	0.08	0.19	9.07	16.04	0.45	37	81
2015	0.28	0.21	0.62	9.50	0.08	0.20	8.93	15.39	0.42	36	78
2016	0.33	0.22	0.59	8.69	0.10	0.22	8.83	14.75	0.45	34	80
2017	0.28	0.23	0.58	8.58	0.10	0.22	8.86	14.10	0.44	33	79
2018	0.27	0.23	0.68	8.32	0.09	0.23	8.70	13.45	0.42	32	84
2019	0.23	0.21	0.59	7.10	0.08	0.22	7.92	12.81	0.42	30	114
2020	0.23	0.21	0.54	6.00	0.08	0.19	7.59	12.89	0.40	28	113
2021	0.24	0.22	0.52	6.66	0.09	0.21	8.49	13.76	0.41	31	80

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 mercury were officially reported by the HELCOM Contracting Parties to the UN ECE Secretariat in 2023. 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 mercury annual emission totals are available for the period 1990 – 2021 for all HELCOM Contracting Parties with the exception of Russia. For Russia, expert estimates of emissions were elaborated on the basis of methodology developed by CEIP [*Poupa*, 2022].

5. Methodology and frequency of data collection:

National data on mercury 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 emissions are annually submitted, checked and stored in the database

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

7. Uncertainty:

Among the HELCOM countries the level of uncertainty of official data on Hg emission was reported by Denmark, Estonia, Finland, Latvia, Poland and Sweden. From other EMEP countries the information on uncertainties of Hg official emissions is available for Austria, Belarus, Belgium, Croatia, Cyprus, France, Monaco, Republic of Moldova, Slovakia, Switzerland and the United

Kingdom. The uncertainty of reported data on Hg emissions expressed as percentage relative to the mean value of emission is as follows:

Denmark:	114%
Estonia:	42%
Finland:	47%
Latvia:	23%
Poland:	35%
Sweden:	72%
Austria:	32%
Belarus:	186%
Belgium:	43%
Croatia:	82%
Cyprus:	15%
France:	31%
Monaco:	12%
Republic of Moldova:	130%
Slovakia:	107%
Switzerland:	50-100%
UK:	-30 to +50%

8. Further work required:

Further work to refine national inventories of mercury emissions is required to reduce their uncertainties, to fill the gaps in sector distribution and improve spatial distribution of emissions. Besides, further studies to evaluate mercury releases to the atmosphere from natural and secondary emission sources are of importance for the assessment of mercury pollution levels.

References

Poupa S. [2022] Methodologies applied to the CEIP GNFR gap-filling 2022. Part II: Heavy Metals (Cd, Hg, Pb) and 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 2020. Technical Report CEIP 04/2022 (https://www.ceip.at/ceip-reports).