Atmospheric emissions of PCB-153 in the Baltic Sea region

HELCOM Baltic Sea Environment Fact Sheet (BSEFS), 2023

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Key Message

Annual atmospheric emissions of PCB-153 in the HELCOM Contracting Parties have decreased by 83% during the period 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 polychlorinated biphenyls (PCB) 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 PCB-153 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 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

Officially reported inventories and available expert estimates of PCB-153 emissions to the atmosphere in the HELCOM Contracting Parties show decrease of releases during the period 1990-2021 by 83% (Figure 1). Spatial distributions of PCB-153 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 PCB-153 emissions of the HELCOM Contracting Parties are shown in Figure 3. The most significant decline of PCB-153 emissions is noted for Latvia (97%) followed by Russia (94%), and Estonia (90%). The lowest decline of national PCB-153 emissions was reported by Sweden (2%).

In 2021 total annual PCB-153 emissions of the HELCOM Contracting Parties amounted to 0.5 t. Among the HELCOM countries the largest contribution to total annual PCB-153 emissions of HELCOM countries was made by Germany (40%) followed by Poland (26%) and Sweden (12%).

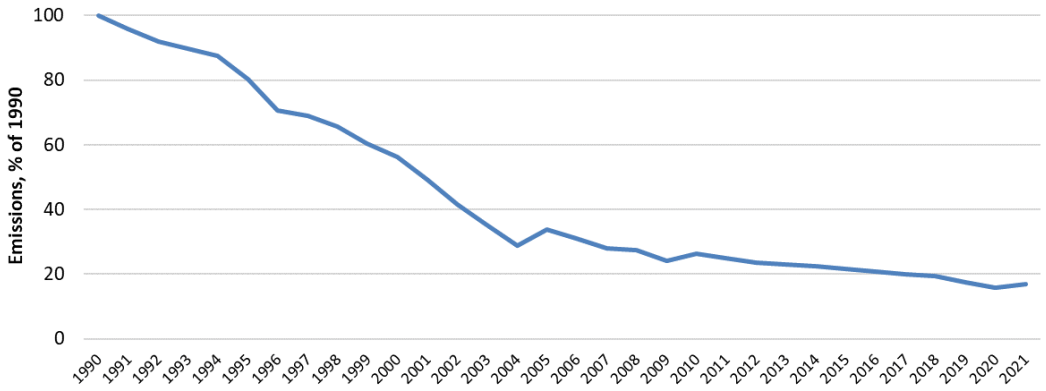

Figure 1. Relative changes of total annual emissions of PCB-153 to the atmosphere from the HELCOM Contracting Parties in period 1990-2021 (% of 1990).

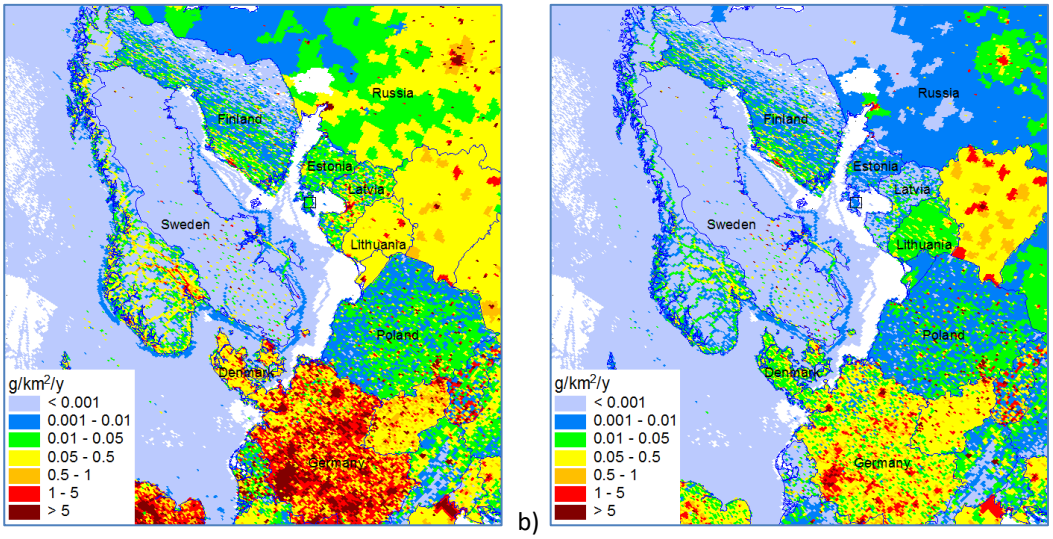

Figure 2. Spatial distribution of annual anthropogenic PCB-153 emissions to the atmosphere in the Baltic Sea region in 1990 (a) and in 2021 (b), in g km^{-2} y^{-1}.

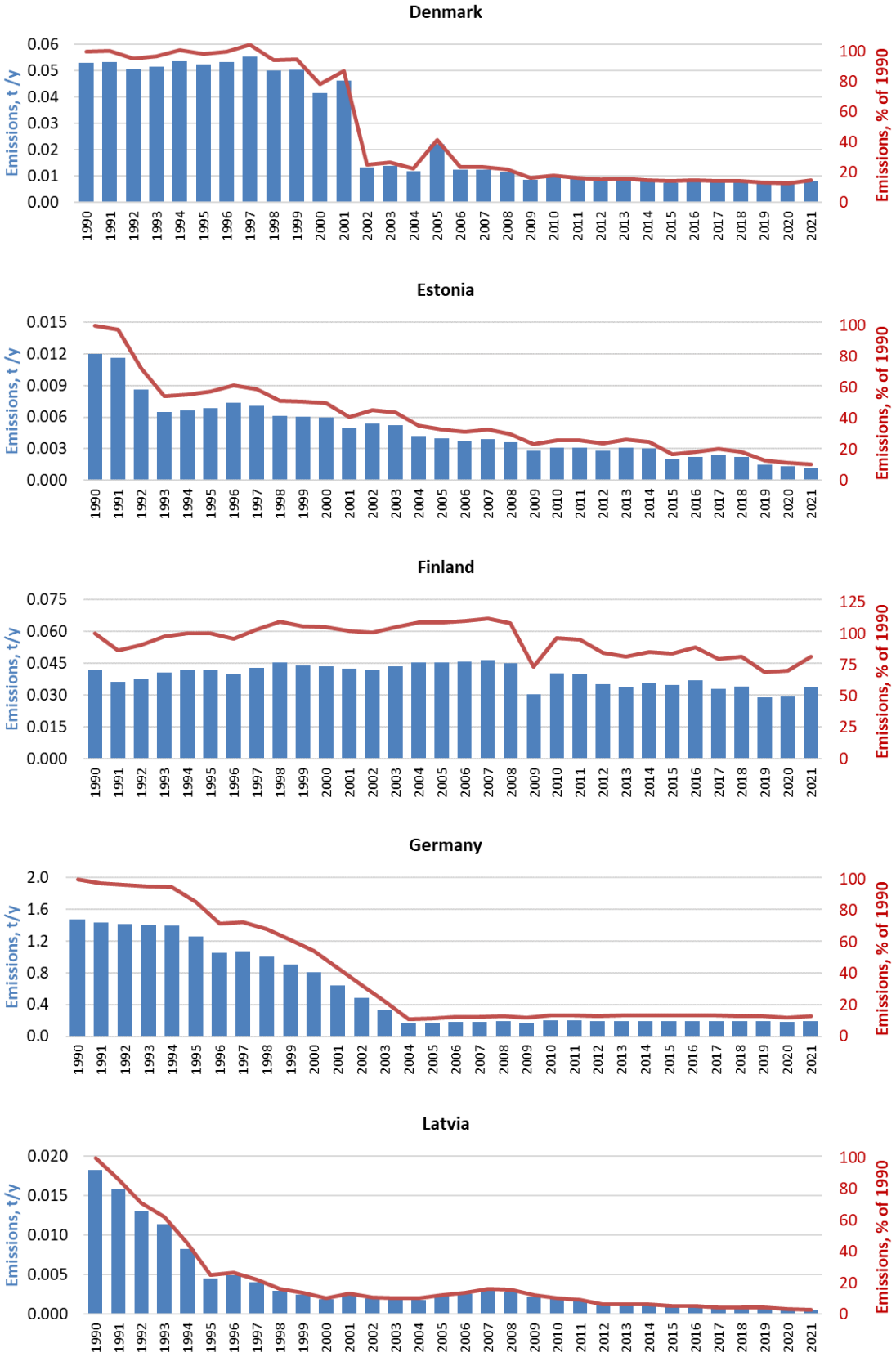

Figure 3. PCB-153 emissions of the HELCOM Contracting Parties (CP) to the atmosphere for the period 1990-2021 in t y^{-1} (blue bars) and in % of 1990 (red line). The emission data of the CP refer to the total area of the CP.

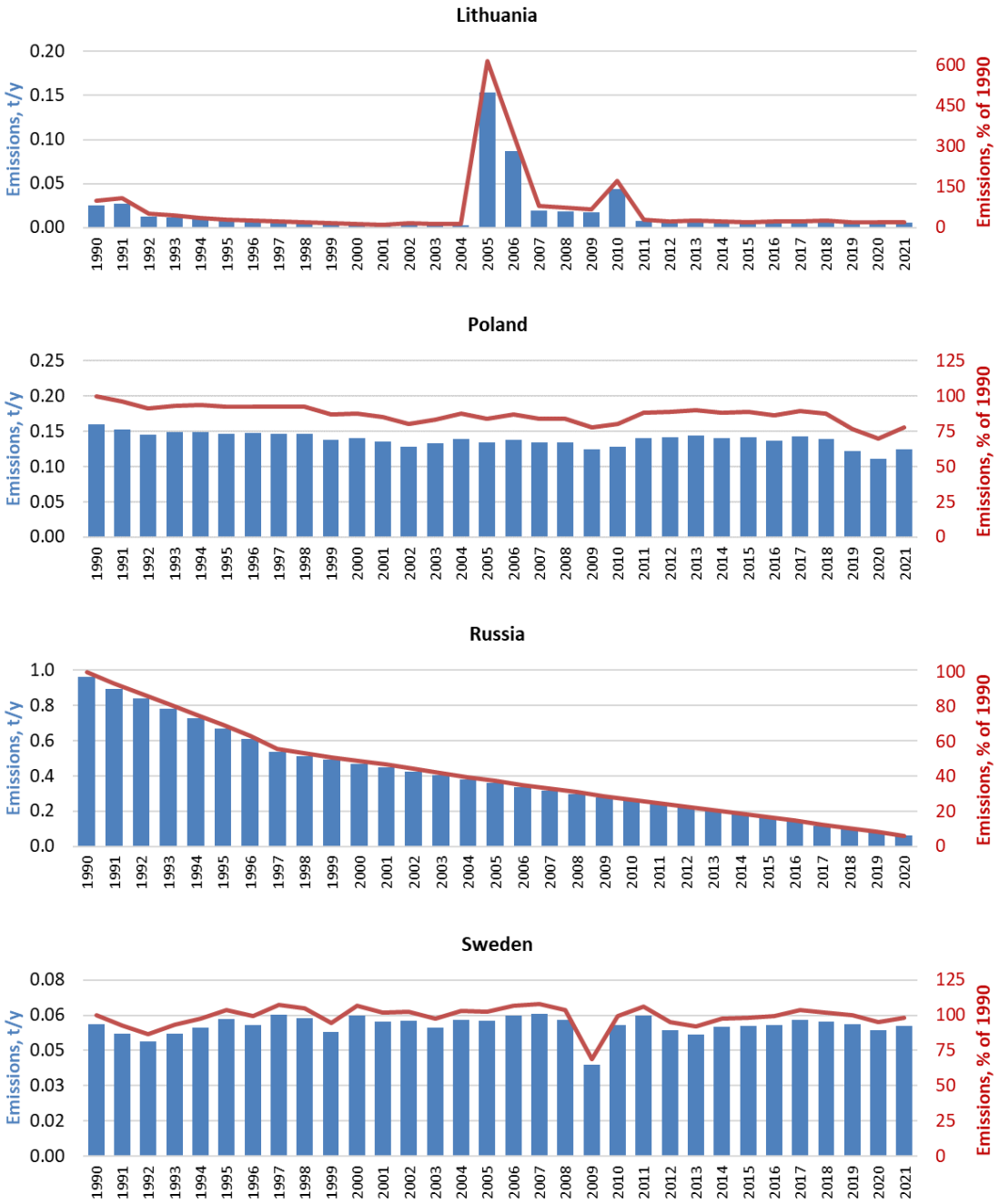

Figure 3 (continued). PCB-153 emissions of the HELCOM Contracting Parties (CP) to the atmosphere for the period 1990-2021 in t y^{-1} (blue bars) and in % of 1990 (red line). The emission data of the CP refer to the total area of the CP except for Russian Federation, for which emissions from its territory within the EMEP domain is used.

Data

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

Table 1. PCB-153 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	0.053	0.012	0.042	1.47	0.018	0.025	0.16	0.96	0.056	2.80	6.97
1991	0.053	0.012	0.036	1.44	0.016	0.027	0.15	0.90	0.052	2.68	6.67
1992	0.050	0.009	0.038	1.42	0.013	0.013	0.15	0.84	0.049	2.57	6.37
1993	0.051	0.006	0.041	1.40	0.011	0.011	0.15	0.78	0.052	2.51	6.34
1994	0.054	0.007	0.042	1.39	0.008	0.009	0.15	0.73	0.055	2.44	5.79
1995	0.052	0.007	0.042	1.26	0.005	0.007	0.15	0.67	0.058	2.24	5.84
1996	0.053	0.007	0.040	1.05	0.005	0.007	0.15	0.61	0.056	1.98	5.48
1997	0.055	0.007	0.043	1.07	0.004	0.006	0.15	0.54	0.060	1.93	5.29
1998	0.050	0.006	0.046	1.01	0.003	0.005	0.15	0.51	0.059	1.84	5.01
1999	0.050	0.006	0.044	0.90	0.002	0.004	0.14	0.49	0.053	1.69	4.77
2000	0.042	0.006	0.044	0.80	0.002	0.003	0.14	0.47	0.060	1.57	4.29
2001	0.046	0.005	0.042	0.64	0.002	0.003	0.14	0.45	0.057	1.38	4.14
2002	0.013	0.005	0.042	0.48	0.002	0.004	0.13	0.43	0.058	1.16	3.86
2003	0.014	0.005	0.044	0.33	0.002	0.003	0.13	0.40	0.055	0.99	3.90
2004	0.012	0.004	0.045	0.16	0.002	0.003	0.14	0.38	0.058	0.81	3.97
2005	0.022	0.004	0.045	0.17	0.002	0.153	0.13	0.36	0.058	0.94	4.34
2006	0.012	0.004	0.046	0.18	0.003	0.087	0.14	0.34	0.060	0.87	4.39
2007	0.012	0.004	0.047	0.18	0.003	0.020	0.13	0.32	0.061	0.78	4.57
2008	0.012	0.004	0.045	0.19	0.003	0.019	0.13	0.30	0.058	0.76	4.00
2009	0.009	0.003	0.031	0.17	0.002	0.017	0.12	0.28	0.039	0.68	3.03
2010	0.010	0.003	0.040	0.20	0.002	0.043	0.13	0.26	0.056	0.74	4.10
2011	0.009	0.003	0.040	0.20	0.002	0.007	0.14	0.24	0.060	0.70	4.23
2012	0.008	0.003	0.035	0.19	0.001	0.006	0.14	0.22	0.053	0.66	4.73
2013	0.008	0.003	0.034	0.20	0.001	0.007	0.14	0.20	0.052	0.64	5.30
2014	0.008	0.003	0.035	0.20	0.001	0.006	0.14	0.18	0.055	0.63	5.18
2015	0.008	0.002	0.035	0.20	0.001	0.005	0.14	0.16	0.055	0.61	3.09
2016	0.008	0.002	0.037	0.20	0.001	0.006	0.14	0.14	0.056	0.58	3.19
2017	0.008	0.002	0.033	0.19	0.001	0.006	0.14	0.12	0.058	0.56	3.25
2018	0.008	0.002	0.034	0.19	0.001	0.006	0.14	0.10	0.057	0.54	3.21
2019	0.007	0.002	0.029	0.19	0.001	0.005	0.12	0.08	0.056	0.49	3.50
2020	0.007	0.001	0.029	0.18	0.001	0.005	0.11	0.06	0.054	0.44	3.26
2021	0.008	0.001	0.034	0.19	0.001	0.005	0.12	0.06	0.055	0.47	6.91

Meta data

Technical information:

1. Source:

Meteorological Synthesizing Centre East (MSC-E) of EMEP, Centre on Emission Inventories and Projections (CEIP) of EMEP, inventory of global PCB emissions [*Breivik et al.*, 2007] (https://www.nilu.no/projects/globalpcb/globalpcb2.htm).

2. Description of data:

Assessment of transport and fate of PCBs in the EMEP region was made on the basis of the inventory of global PCB emissions [*Breivik et al., 2007*] and emissions officially reported by the EMEP countries. Officially reported inventories of PCB emissions do not provide congener composition of emissions. Therefore, expert estimates of PCB emissions with information on particular congeners were applied [*Breivik et al.*, 2007]. The inventory provides 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. 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 were carried out for the indicator congener PCB-153.

The spatial distribution of PCB-153 emissions within the EMEP region was prepared using gridded PCB emissions officially submitted by 24 EMEP countries, including some HELCOM Contracting Parties, namely Denmark, Finland, Latvia, Lithuania, Poland, and Sweden. For other countries spatial distribution of PCB-153 emission was made on the basis of gridded population density. Temporal variations of PCB-153 emissions in the period 1990-2021 were derived from the PCB emissions officially reported by the HELCOM and EMEP countries to the UN ECE Secretariat in 2023. 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:

1990 – 2021

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

Weakness: gaps in time series and uncertainties in PCB national emissions, lack of total and gridded emissions for some EMEP countries, and incompleteness of sectoral distribution.

7. Uncertainty:

Among the HELCOM countries the level of uncertainty of official data of PCB emission was reported by Denmark, Estonia, Finland, Latvia, and Poland. From other EMEP countries the information on uncertainties of PCB 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 PCB emissions, expressed as percentage relative to the mean value of the emission, is as follows:

Denmark:	580%
Estonia:	121%
Finland:	269%
Latvia:	32%
Poland:	19%
Austria:	94%
Belarus:	360%
Belgium:	279%
Croatia:	400%
Cyprus:	4%
France:	44%
Monaco:	14%
Republic of Moldova:	185%
Slovakia:	54%
Switzerland:	>100%
UK:	+/-50%

8. Further work required:

Further work to refine national inventories of PCB emissions is required to reduce their uncertainties, to fill the gaps in sector distribution and improve spatial distribution of emissions. Besides, the information on congener composition of officially reported PCB emission data is important for modeling.

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.