5. Atmospheric Supply of Cadmium to the Baltic Sea in 2013

In this chapter the results of model evaluation of cadmium atmospheric input to the Baltic Sea and its sub-basins for 2013 is presented. Modelling of cadmium atmospheric transport and deposition was carried out using MSC-E Eulerian Heavy Metal transport model MSCE-HM (*Travnikov and Ilyin*, 2005). Latest available official information on cadmium emission from HELCOM countries and other European countries was used in computations. Based on these data annual and monthly levels of cadmium deposition to the Baltic Sea region have been obtained and contributions of HELCOM countries emission sources to the deposition over the Baltic Sea are estimated. Model results were compared with observed levels of cadmium concentrations in air and precipitation measured at monitoring sites around the Baltic Sea in 2013.

5.1 Cadmium emissions

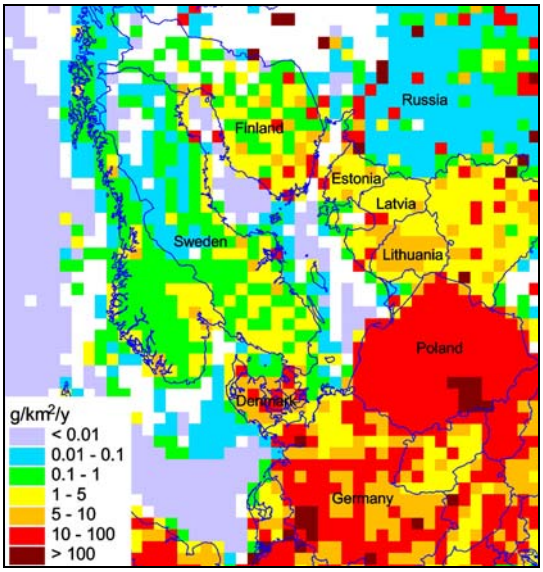


Figure 5.1. Annual total anthropogenic emissions of cadmium in the Baltic Sea region for 2013, g/km^2/y.

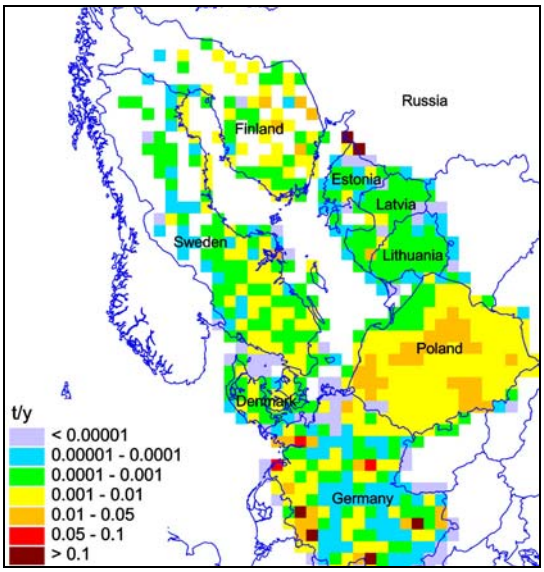


Figure 5.2. Annual cadmium emission from Public Power sector for 2013, t/grid cell/y (white color means no information).

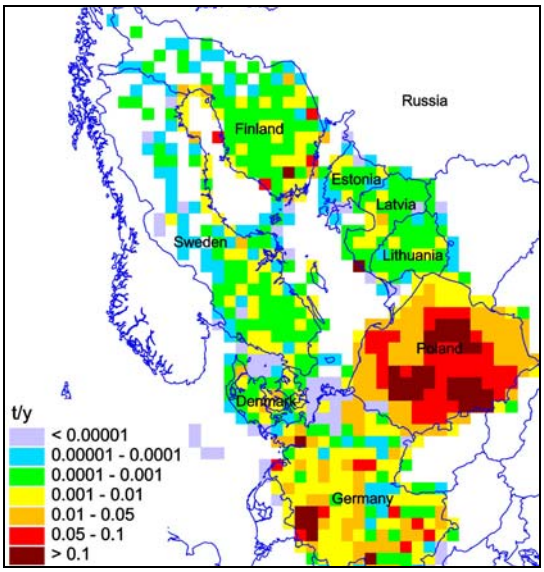


Figure 5.3. Annual cadmium emission from Industry sector for 2013, t/grid cell/y (white color means no information).

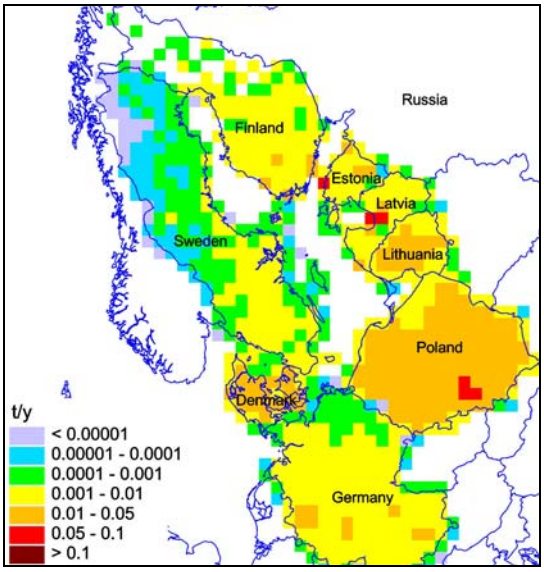


Figure 5.4. Annual cadmium emission from Other Stationary Combustion sector for 2013, t/grid cell/y (white color means no information).

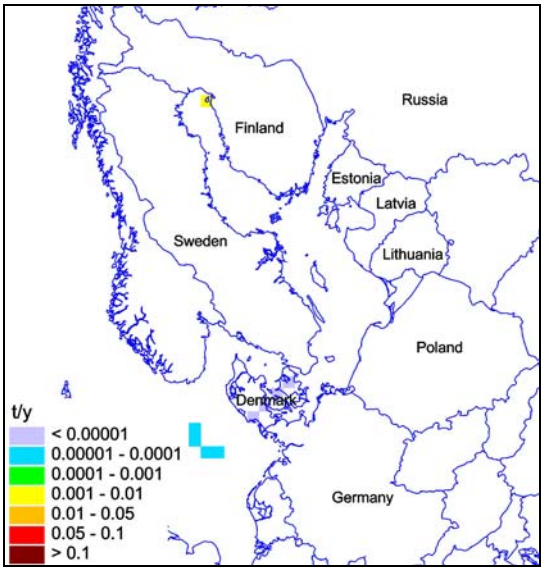


Figure 5.5. Annual cadmium emission from Fugitive Emissions sector for 2013, t/grid cell/y (white color means no information).

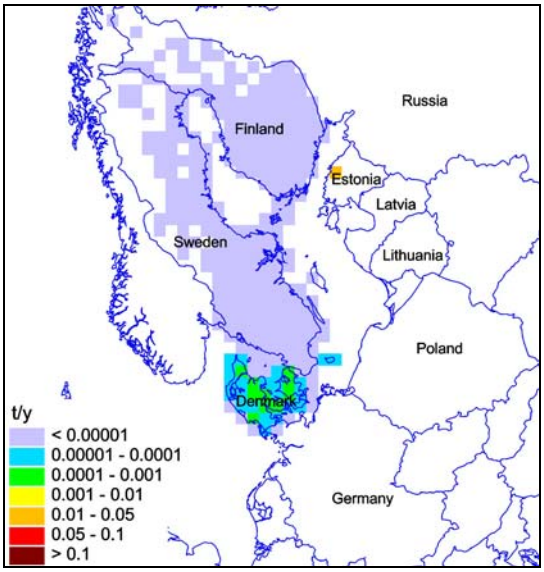


Figure 5.6. Annual cadmium emission from Solvents sector for 2013, t/grid cell/y (white color means no information).

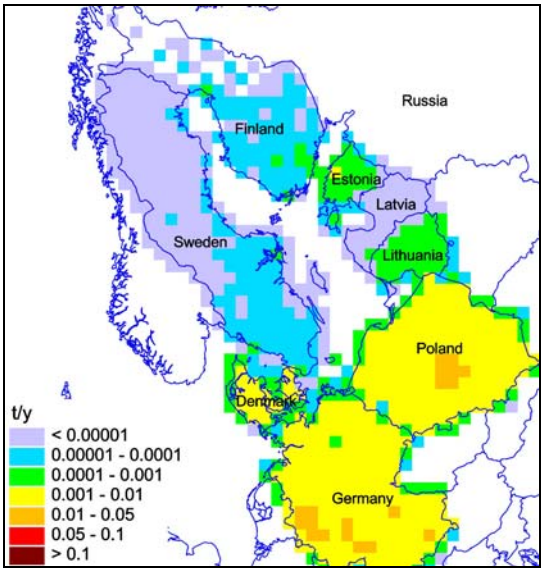


Figure 5.7. Annual cadmium emission from Road Transport sector for 2013, t/grid cell/y (white color means no information).

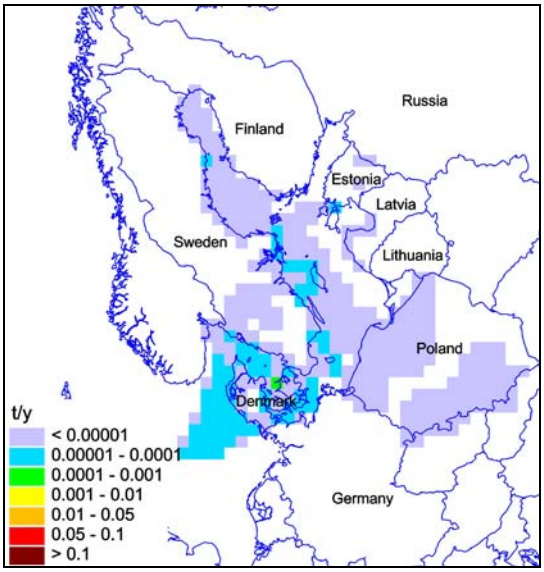


Figure 5.8. Annual cadmium emission from Shipping Emissions sector for 2013, t/grid cell/y (white color means no information).

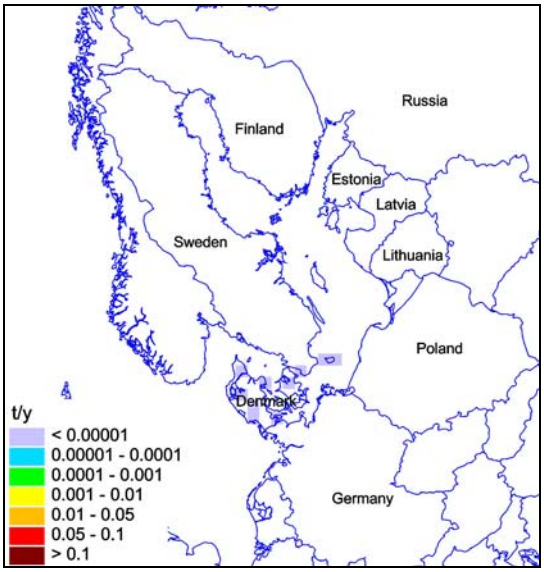


Figure 5.9. Annual cadmium emission from Aviation sector for 2013, t/grid cell/y (white color means no information).

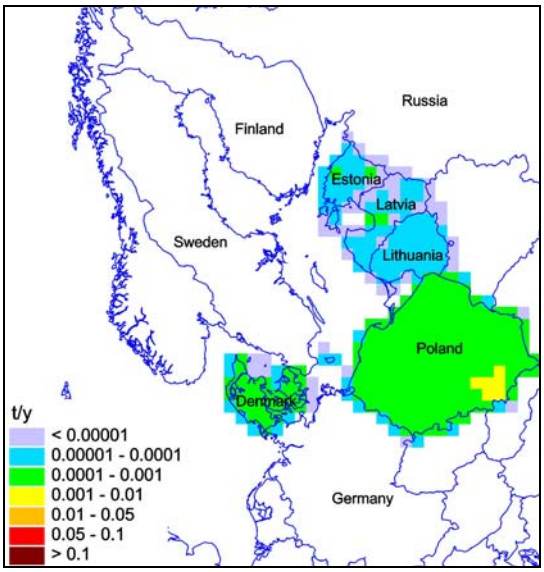


Figure 5.10. Annual lead emission from Off Road sector for 2013, t/grid cell/y (white color means no information).

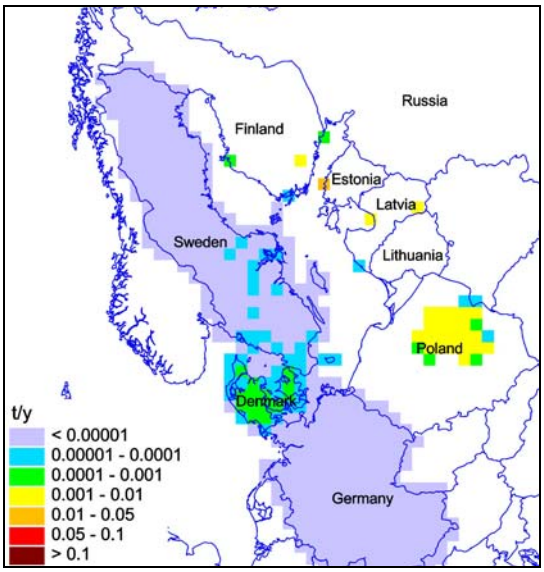


Figure 5.11. Annual cadmium emission from Waste sector for 2013, t/grid cell/y (white color means no information).

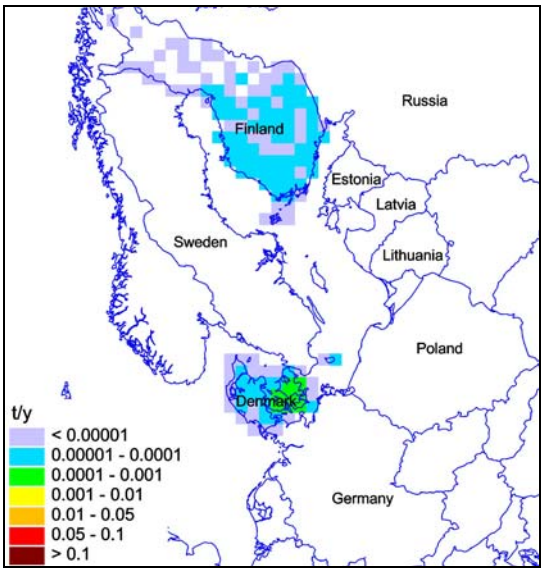


Figure 5.12. Annual cadmium emission from Agricultural Other sector for 2013, t/grid cell/y (white color means no information).

Table 5.1. Annual total anthropogenic emissions of **cadmium** of HELCOM countries from different sectors for 2013, tonnes/year

GNFR emission sector	Sector name	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden
A	Public Power	0.032	0.709	0.183	1.244	0.017	0.034	1.07	0.13	0.156
B	Industry	0.066	0.018	0.7	2.647	0.184	0.073	10.542	0.099	0.164
C	Other Stationary Combustion	0.416	0.209	0.322	0.611	0.391	0.308	2.552		0.148
D	Fugitive Emissions	0.0002		0.0012	NA			0.468		
E	Solvents	0.0036	0.011	3.8E-07	2.058		NA	4.2E-06		3.99E-07
F	Road Transport	0.045	0.008	0.0037	0.779	9.3E-06	0.013	0.426		0.0027
G	Shipping Emissions	0.0023	4.4E-05		0.0072	9.9E-07	4.5E-05	7.1E-05		0.0007
H	Aviation	1.7E-05	NA	NA	NE	NE	NE	NA		NE
I	Off Road	0.009	0.0013		0.03	0.0008	0.0012	0.093	20.4	0.0003
J	Waste	0.0048	0.011	0.0019	1.5E-06	0.0039	0.0043	0.15	0.003	0.0008
L	Agricultural Other	0.0023		0.0015				NA		NA
M	Other	NO	NO	NO	NA	NA	NO	NA	1.97	NO
Total		0.581	0.966	1.214	7.376	0.596	0.433	15.301	22.6	0.473

NO – not occurring, an activity or process does not exist within a country.
NA – not applicable, the process or activity exists but emissions are considered never to occur.
NE – not estimated, emissions occur but have not been estimated or reported in this submission.

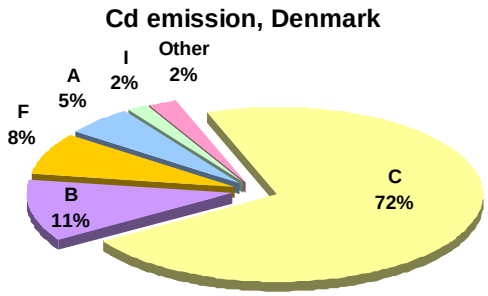


Figure 5.13. Contributions of different sectors to total annual cadmium emission of Denmark in 2013.

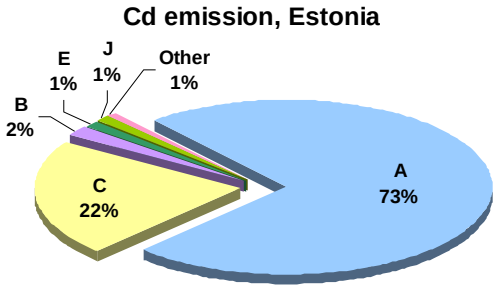


Figure 5.14. Contributions of different sectors to total annual cadmium emission of Estonia in 2013.

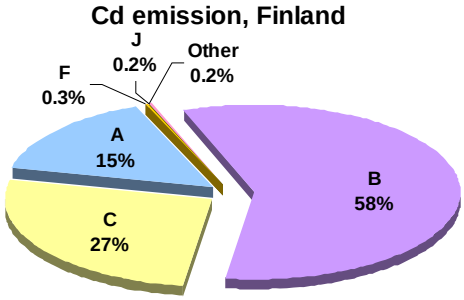


Figure 5.15. Contributions of different sectors to total annual cadmium emission of Finland in 2013.

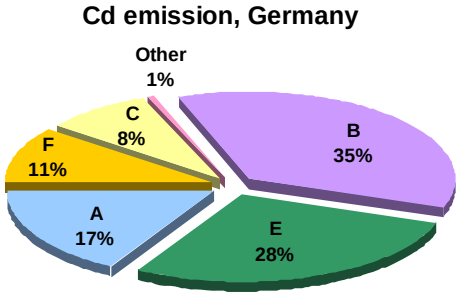


Figure 5.16. Contributions of different sectors to total annual cadmium emission of Germany in 2013.

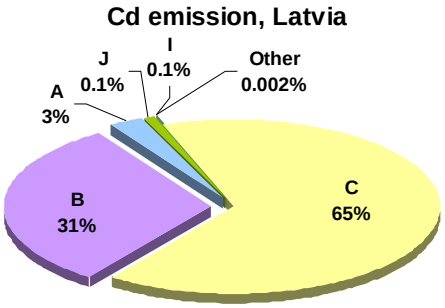


Figure 5.17. Contributions of different sectors to total annual cadmium emission of Latvia in 2013.

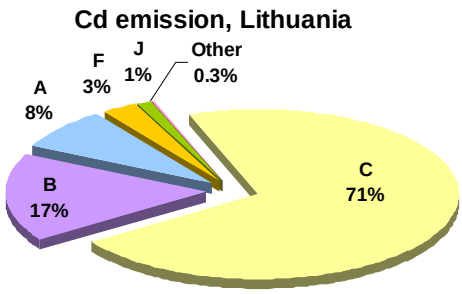


Figure 5.18. Contributions of different sectors to total annual cadmium emission of Lithuania in 2013.

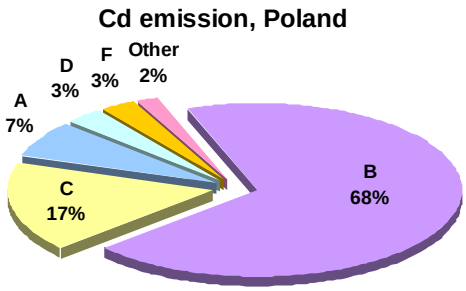


Figure 5.19. Contributions of different sectors to total annual cadmium emission of Poland in 2013.

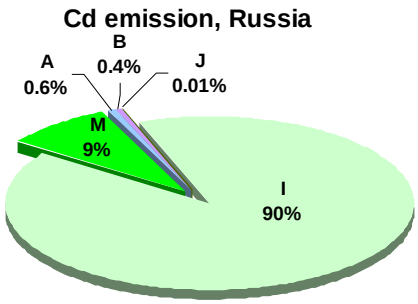


Figure 5.20. Contributions of different sectors to total annual cadmium emission of Russia in 2013.

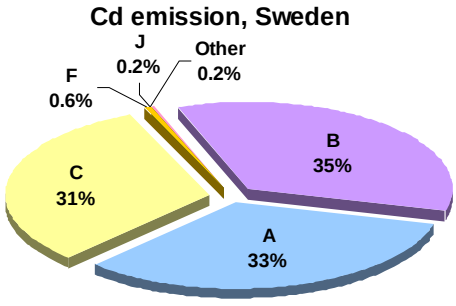
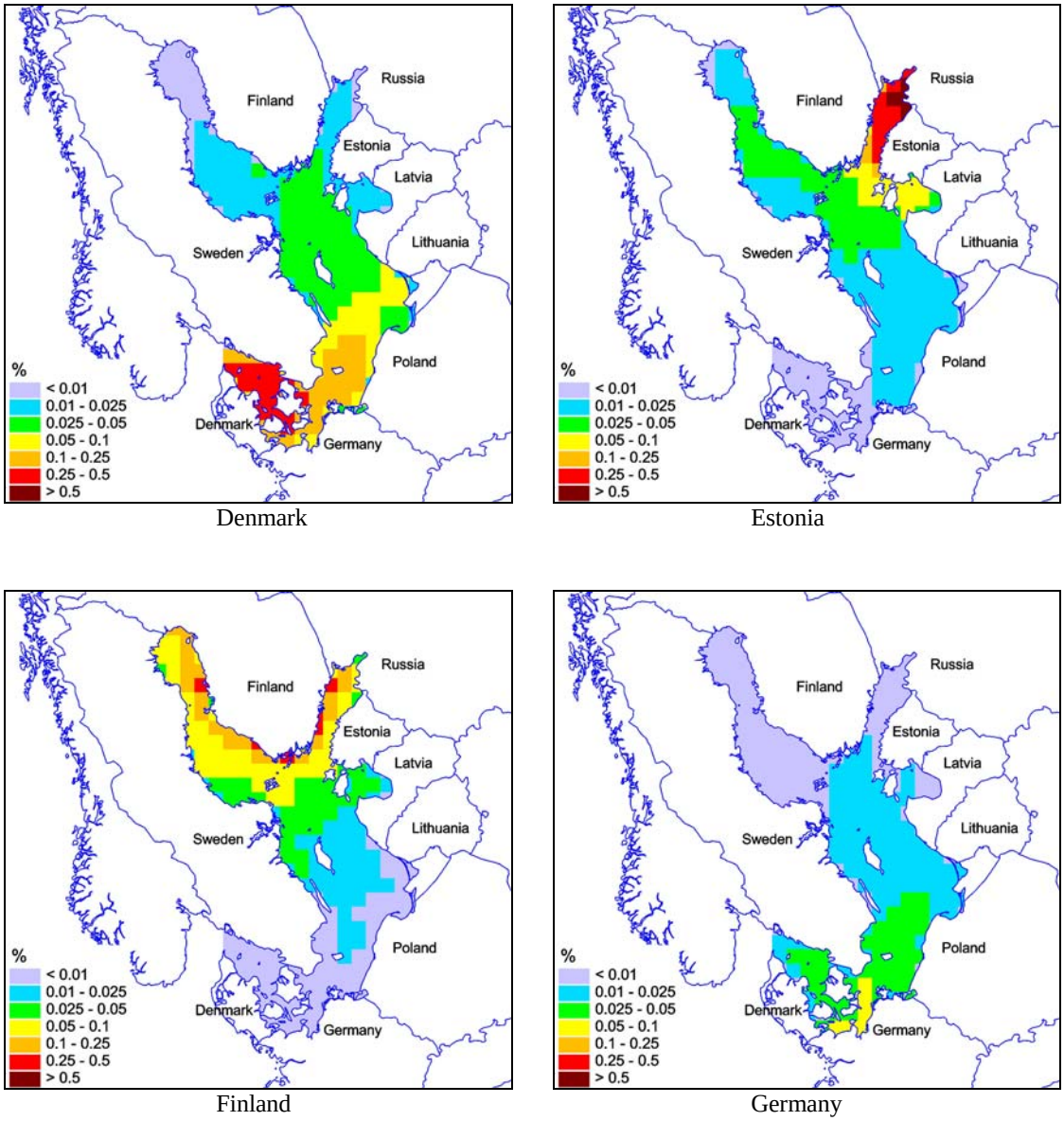


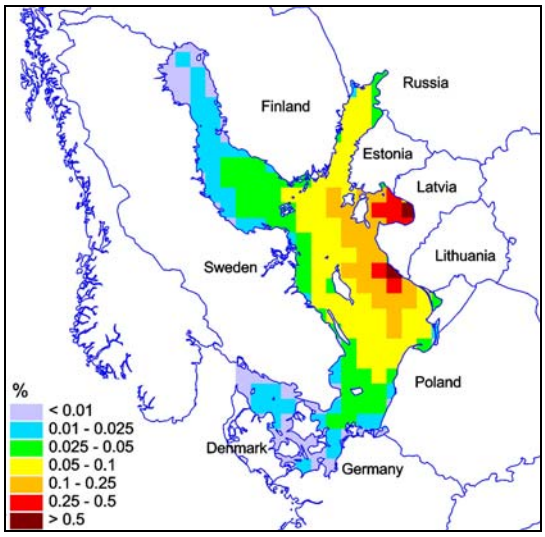
Figure 5.21. Contributions of different sectors to total annual cadmium emission of Sweden in 2013.



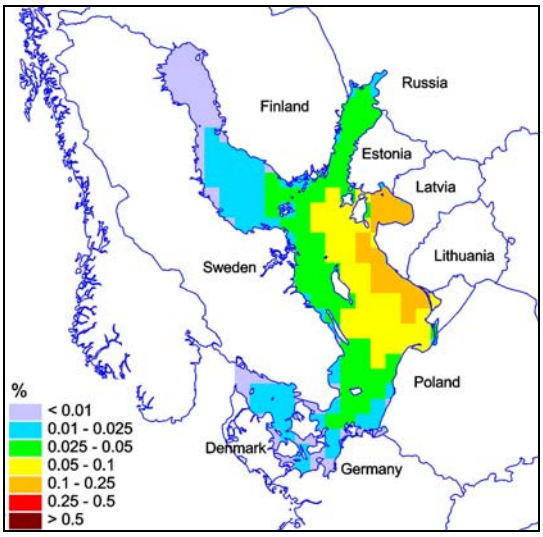
Denmark Estonia

Finland Germany

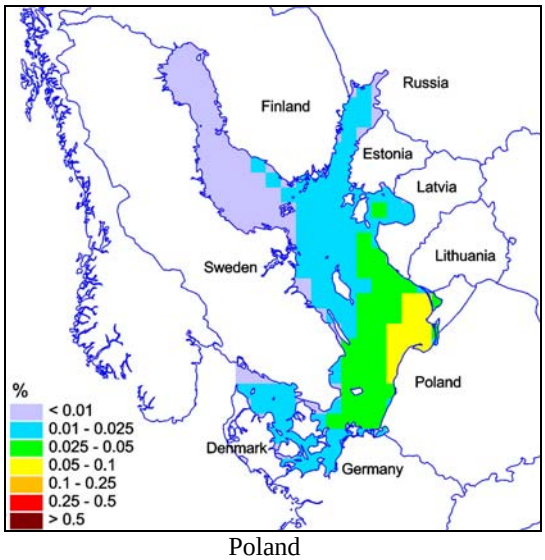
Figure 5.22. Fractions of annual anthropogenic cadmium emissions of HELCOM Parties deposited to the Baltic Sea in 2013 (expressed as a percent of national anthropogenic emission deposited to the particular grid cells).



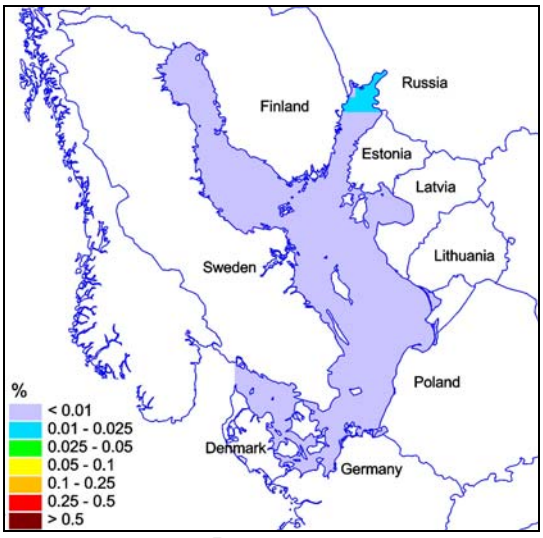
Latvia



Lithuania

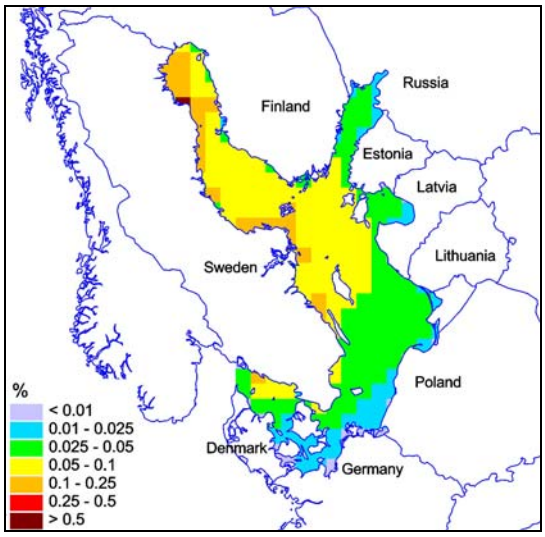


Poland



Russia

Figure 5.22. (cont.) Fractions of annual anthropogenic cadmium emissions of HELCOM Parties deposited to the Baltic Sea in 2013 (expressed as a percent of national anthropogenic emission deposited to the particular grid cells).



Sweden

Figure 5.22. (cont.) Fractions of annual anthropogenic cadmium emissions of HELCOM Parties deposited to the Baltic Sea in 2013 (expressed as a percent of national anthropogenic emission deposited to the particular grid cells).

Table 5.2. Annual total anthropogenic emissions of **cadmium** of HELCOM countries and other EMEP countries in period 1990-2013, tonnes/year (Expert estimates of emissions are shaded)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
DK	1.09	1.13	0.97	0.89	0.74	0.62	0.65	0.59	0.55	0.55	0.55	0.61	0.58	0.60	0.60	0.61	0.58	0.67	0.65	0.62	0.65	0.61	0.58	0.58
EE	4.51	4.30	3.09	2.31	2.98	2.18	1.31	1.34	1.22	1.16	0.77	0.75	0.77	0.84	0.79	0.76	0.73	0.90	0.83	0.71	0.90	0.86	0.79	0.97
FI	6.34	3.50	3.01	2.81	2.19	1.65	1.48	0.86	1.26	0.57	1.29	1.65	1.28	1.18	1.50	1.31	1.29	0.96	1.23	1.22	1.41	1.32	1.33	1.21
DE	19.78	16.14	13.41	11.97	11.37	13.44	12.83	13.28	12.69	13.08	12.71	12.27	11.58	11.24	10.48	9.74	9.39	9.00	7.92	7.24	7.86	7.83	7.49	7.38
LV	0.47	0.51	0.50	0.53	0.54	0.59	0.62	0.58	0.57	0.56	0.51	0.56	0.55	0.57	0.61	0.62	0.61	0.60	0.57	0.65	0.55	0.58	0.64	0.60
LT	0.56	0.56	0.35	0.30	0.38	0.40	0.40	0.42	0.47	0.41	0.40	0.44	0.45	0.44	0.48	0.51	0.48	0.47	0.46	0.45	0.45	0.47	0.46	0.43
PL	27.8	27.8	27.8	27.8	27.8	27.8	29.1	28.0	23.8	21.5	19.7	18.3	17.5	17.8	17.8	16.1	16.3	16.8	16.2	14.3	16.0	16.3	15.6	15.3
RU	79.4	68.2	68.8	59.0	56.6	57.4	51.0	50.4	49.0	50.9	50.5	51.0	51.5	57.3	55.4	59.4	59.4	47.1	34.9	22.6	22.6	22.6	22.6	22.6
SE	2.27	1.73	1.36	1.07	0.75	0.73	0.70	0.69	0.61	0.53	0.51	0.59	0.51	0.51	0.53	0.53	0.54	0.56	0.51	0.53	0.54	0.50	0.50	0.47
AL	0.31	0.15	0.08	0.08	0.06	0.08	0.06	0.03	0.05	0.05	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.08	0.12	0.12	0.12	0.12	0.12
AM	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
AT	1.58	1.53	1.25	1.16	1.07	0.98	1.00	0.97	0.90	0.95	0.92	0.95	0.96	1.00	1.01	1.09	1.10	1.15	1.17	1.09	1.21	1.18	1.22	1.23
AZ	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.12	0.17	0.28	0.28	0.35	0.37	0.36	0.36	0.35
BY	2.11	2.22	1.97	1.66	1.31	1.11	1.20	1.25	1.45	1.42	1.38	1.78	1.90	1.79	1.84	2.07	2.49	2.58	2.75	3.02	3.23	3.00	2.87	2.87
BE	6.17	6.43	7.13	5.88	4.43	5.04	4.53	4.64	3.11	2.75	2.77	2.93	2.88	2.99	3.45	2.45	3.00	2.77	3.07	2.36	2.65	2.45	2.19	2.32
BA	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.66	1.65	1.64	1.63	1.62	1.61	1.60	1.59	1.58	1.57	1.56	1.55	1.54
BG	5.23	4.06	3.33	3.56	3.62	3.65	3.81	3.64	3.44	2.95	3.47	3.41	3.08	3.38	3.45	2.94	2.82	2.51	2.42	1.59	1.12	1.22	1.13	1.16
HR	0.98	0.68	0.55	0.54	0.66	0.78	0.73	0.65	0.69	0.68	0.60	0.54	0.54	0.61	0.61	0.61	0.63	0.53	0.51	0.51	0.53	0.52	0.51	0.48
CY	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.07	0.06	0.07	0.07	0.05
CZ	4.34	3.92	3.61	3.48	3.52	3.55	2.94	3.00	2.65	2.72	2.85	2.61	2.74	2.24	2.37	3.11	3.18	2.91	3.76	3.37	0.88	0.81	0.95	0.70
FR	20.0	19.9	19.4	18.4	18.3	17.3	16.7	15.8	14.8	13.4	13.5	12.4	11.7	8.55	6.02	5.40	4.19	3.83	3.84	2.73	2.70	2.52	2.37	2.50
GE	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.004	0.009	0.01	0.01	0.01	0.012
GR	4.47	4.23	3.98	3.74	3.49	3.25	3.00	2.96	2.92	2.88	2.84	2.80	2.75	2.70	2.66	2.61	2.56	2.52	2.47	2.42	2.38	2.33	2.28	2.24
HU	3.77	3.44	3.10	3.18	3.09	2.94	2.80	2.72	2.62	2.54	2.51	2.53	2.38	2.31	2.17	1.17	1.27	1.26	1.05	1.02	1.06	1.09	1.04	1.00
IS	0.17	0.16	0.15	0.14	0.13	0.12	0.12	0.11	0.10	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09
IE	0.46	0.52	0.50	0.50	0.49	0.52	0.55	0.55	0.59	0.53	0.55	0.44	0.32	0.30	0.33	0.37	0.36	0.34	0.32	0.29	0.30	0.28	0.30	0.29
IT	10.11	10.78	10.20	9.80	9.41	9.41	9.14	9.16	8.63	8.51	8.84	8.70	7.06	7.28	7.86	8.16	8.29	8.93	8.75	6.99	6.85	6.78	6.75	6.47
KZ	12.00	12.00	12.00	12.00	12.00	13.00	12.00	12.00	12.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	23.33
KY	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.70	2.70	2.80	2.80	2.80	2.80	2.80	2.80	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70
LI	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002
LU	0.60	0.58	0.55	0.53	0.50	0.40	0.40	0.30	0.20	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
MT	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.53	0.52	0.57	0.57	0.59	0.60	0.62	0.56	0.56	0.05	0.02	0.02	0.02
MC	0.056	0.058	0.063	0.069	0.006	0.006	0.007	0.008	0.007	0.007	0.008	0.008	0.007	0.006	0.005	0.005	0.004	0.005	0.005	0.005	0.004	0.005	0.005	0.005
NL	2.09	1.79	1.61	1.43	1.24	1.07	0.95	1.04	1.14	0.95	0.94	1.62	2.19	2.34	1.75	1.69	1.95	1.72	1.89	1.79	2.52	1.12	0.81	0.62
NO	1.51	1.38	1.24	1.37	1.35	1.22	1.32	1.26	1.32	1.24	0.92	0.89	0.86	0.82	0.76	0.70	0.74	0.68	0.66	0.52	0.63	0.62	0.51	0.47
PT	6.25	6.66	6.80	6.03	6.31	6.49	5.68	6.13	6.83	6.79	6.18	6.09	6.79	5.99	5.80	6.73	5.72	5.97	5.60	3.94	4.25	3.02	2.65	4.25
MD	0.45	0.38	0.28	0.19	0.14	0.13	0.13	0.14	0.13	0.11	0.12	0.13	0.11	0.13	0.14	0.15	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.37
RO	21.60	20.38	19.15	17.93	16.70	15.48	14.25	13.03	11.80	11.84	8.73	7.43	6.53	5.63	4.74	3.84	3.74	3.81	3.94	3.20	3.30	3.23	3.17	2.89
RUA	74.00	68.00	61.00	54.00	48.00	41.00	37.00	33.00	29.00	25.00	21.00	21.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
ME	0.08	0.08	0.06	0.05	0.04	0.02	0.06	0.06	0.07	0.06	0.06	0.05	0.06	0.06	0.07	0.06	0.07	0.07	0.09	0.05	0.06	0.07	0.07	0.07
RS	3.87	3.63	3.51	1.96	2.19	2.39	2.95	3.18	2.81	1.82	1.93	1.75	1.78	1.51	1.57	1.77	2.04	1.89	1.89	1.84	1.78	1.89	1.82	1.87
SK	9.71	10.27	10.83	8.73	6.63	10.37	9.03	10.07	7.59	6.53	9.06	7.36	5.03	5.81	6.82	6.24	6.07	1.44	1.40	1.10	1.45	1.28	1.31	1.33
SI	0.58	0.46	0.46	0.43	0.34	0.37	0.37	0.36	0.36	0.36	0.38	0.39	0.39	0.39	0.40	0.40	0.42	0.43	0.45	0.39	0.41	0.40	0.37	0.38
ES	24.1	23.3	21.8	19.4	20.5	21.7	19.9	19.6	19.5	19.6	17.0	15.9	16.7	15.2	14.2	13.8	11.8	10.1	9.70	8.44	8.36	7.93	7.77	6.90
CH	3.75	3.58	3.45	3.26	3.02	2.68	2.58	2.45	2.40	1.99	1.85	1.71	1.51	1.38	1.39	1.39	1.43	1.36	1.39	1.36	1.40	1.31	1.29	1.31
TJ	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.30	1.30	1.30	1.30	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
MK	0.50	0.42	0.38	0.33	0.29	0.38	0.44	0.38	0.38	0.36	0.40	0.25	0.25	0.22	0.15	0.15	0.16	0.14	0.17	0.17	0.18	0.19	0.16	0.22
TR	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.8	16.9	17.0	17.1	17.3	17.4	17.5	17.7	17.8	17.9	18.0	18.2	18.3
TM	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
UA	54.2	50.2	46.2	42.3	38.3	34.3	30.3	26.4	22.4	18.4	14.4	10.5	2.01	28.18	3.09	6.84	5.10	8.95	8.32	4.44	2.81	2.81	2.81	2.81
UK	22.6	22.3	21.9	13.6	12.8	11.0	9.2	7.8	6.1	5.9	5.9	4.5	4.5	3.3	3.4	3.6	3.5	2.8	2.5	2.2	2.3	2.5	2.0	2.2
UZ	3.4	3.5	3.6	3.7	3.7	3.8	3.9	3.9	3.9	3.9	3.9	3.8	3.7	3.5	3.4	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3

Expert estimates:

Denier van der Gon D. H.A.C., van het Bolscher M., Visschedijk A.J.H. and Zandveld P.Y.J. [2005] Study to the effectiveness of the UNECE Heavy Metals Protocol and costs of possible additional measures. Phase I: Estimation of emission reduction resulting from the implementation of the HM Protocol. TNO-report B&O-A R 2005/193.

Berdowski J.J.M., Baas J., Bloos J.P.J., Visschedijk A.J.H., Zandveld P.Y.J. [1997] The European Emission Inventory of Heavy Metals and Persistent Organic Pollutants for 1990. TNO Institute of Environmental Sciences, Energy Research and Process Innovation, UBA-FB report 104 02 672/03

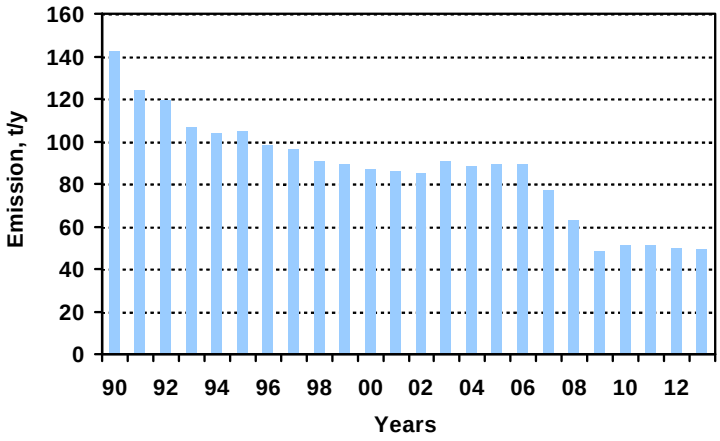


Figure 5.23. Time-series of annual **cadmium** emissions of HELCOM countries in 1990-2013, tonnes/year.

5.2 Annual total deposition of cadmium

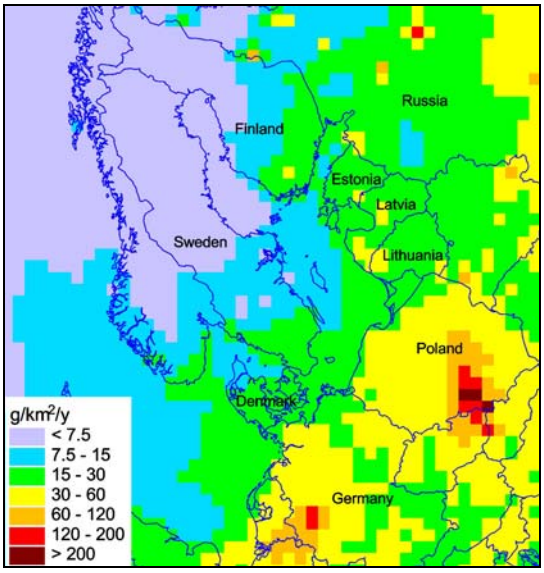


Figure 5.24. Annual total deposition fluxes of **cadmium** over the Baltic Sea region for 2013, g/km^2/y.

5.3 Monthly total deposition of cadmium

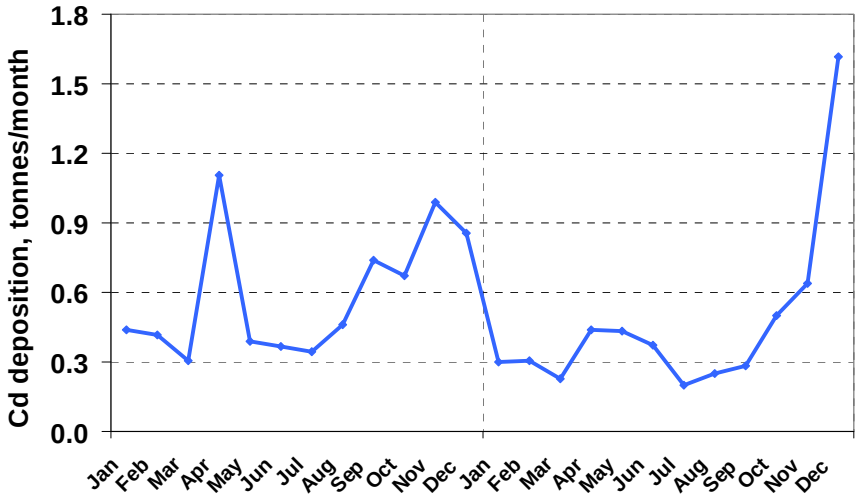


Figure 5.25. Monthly total deposition of **cadmium** to the Baltic Sea for 2012 and 2013, tonnes/month.

Table 5.3. Monthly total deposition of **cadmium** to the Baltic Sea for 2012 and 2013, tonnes/month.

Month	Cd deposition 2012	Cd deposition 2013
Jan	0.44	0.30
Feb	0.42	0.31
Mar	0.31	0.23
Apr	1.11	0.44
May	0.39	0.43
Jun	0.37	0.37
Jul	0.34	0.20
Aug	0.46	0.25
Sep	0.74	0.28
Oct	0.67	0.50
Nov	0.99	0.64
Dec	0.86	1.62

5.4 Source allocation of cadmium deposition

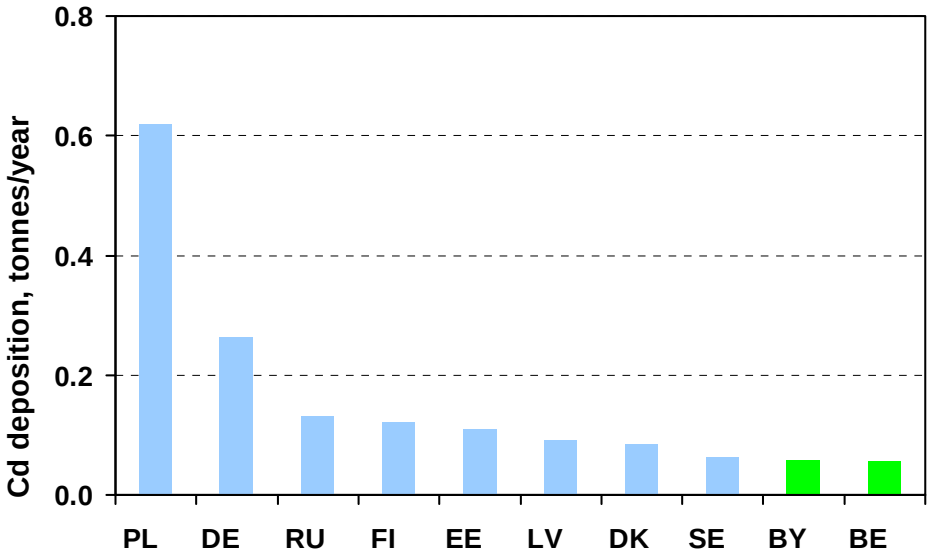


Figure 5.26. Top ten countries with the highest contribution to annual total deposition of **cadmium** over the Baltic Sea for 2013, tonnes/year.

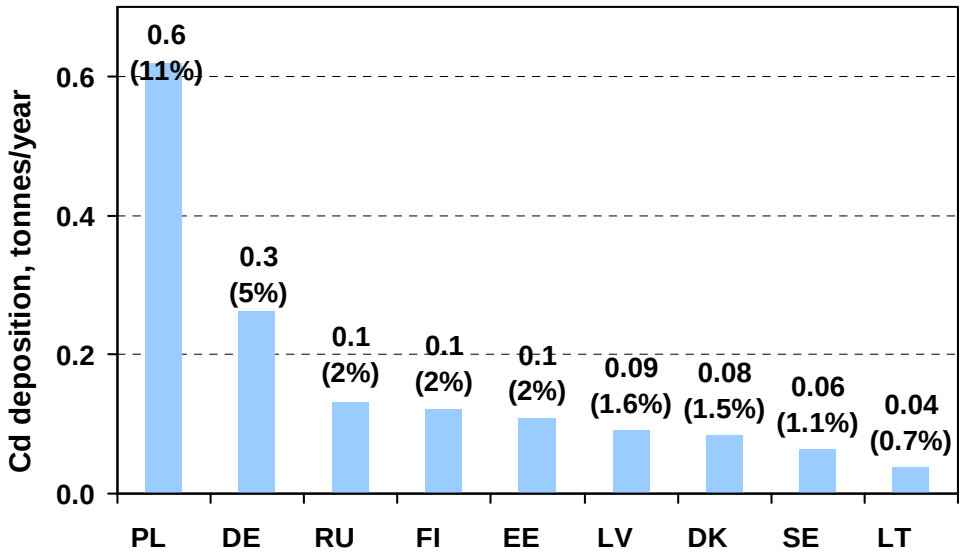


Figure 5.27. Sorted contributions (in tonnes/year and in %) of HELCOM countries to total **cadmium** deposition over the Baltic Sea for 2013. HELCOM countries emissions of **cadmium** contributed about 27% to the total annual cadmium deposition over the Baltic Sea. Contribution of other EMEP countries accounted for 7%. Significant contribution was made by other emission sources, in particular, remote

emissions sources, natural emissions and wind re-suspension of cadmium (66%).

Table 5.4. Two most significant contributors to the annual total deposition of **cadmium** to the nine Baltic Sea sub-basins for 2013.

Sub-basin	Country(1)	%	Country(1)	%	*, %
ARC	Poland	10	Finland	7	65
BOB	Finland	16	Russia	12	51
BOS	Finland	8	Poland	6	63
BAP	Poland	14	Germany	5	66
GUF	Estonia	12	Russia	6	62
GUR	Poland	9	Latvia	7	69
KAT	Poland	7	Germany	7	68
SOU	Germany	9	Poland	8	66
WEB	Germany	10	Poland	7	69
BAS	Poland	11	Germany	5	66

* - contribution of re-emission, natural and remote sources (NSR).

5.5 Comparison of model results with measurements

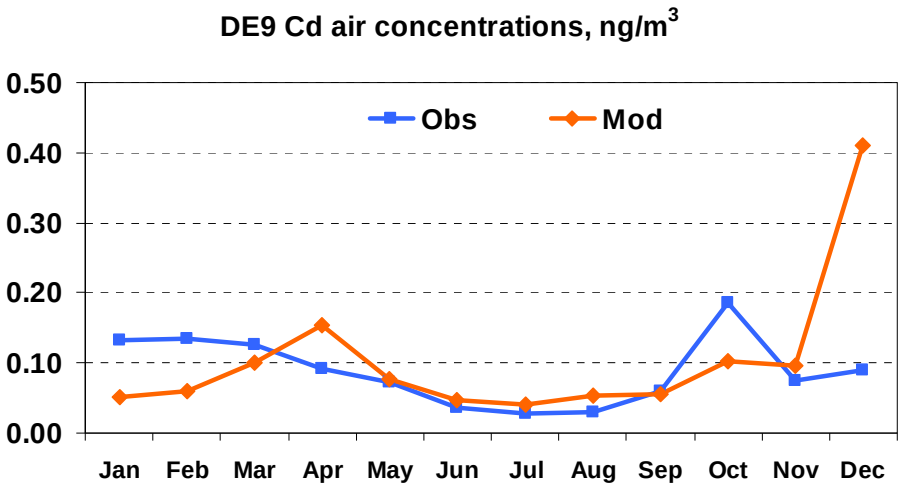


Figure 5.28. Comparison of calculated mean monthly cadmium concentrations in air for 2013 with measurements of the station Zingst (DE9). Units: ng / m^3.

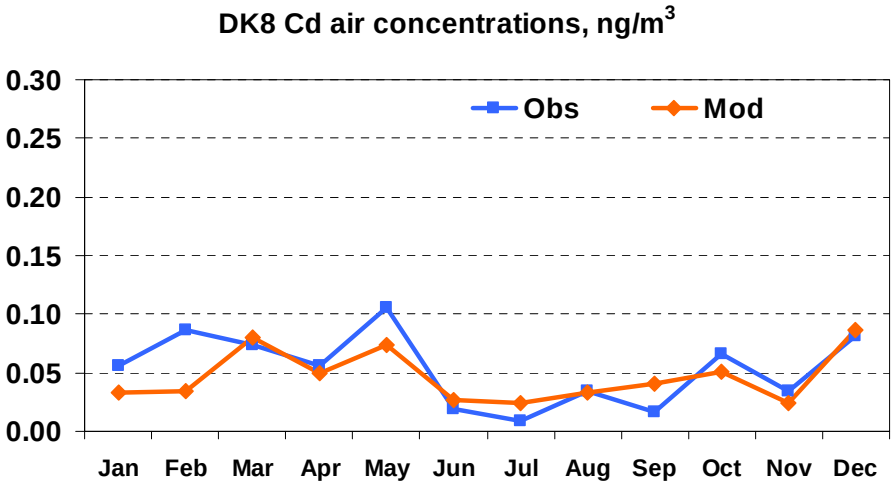


Figure 5.29. Comparison of calculated mean monthly cadmium concentrations in air for 2013 with measurements of the station Anholt (DK8). Units: ng / m^3.

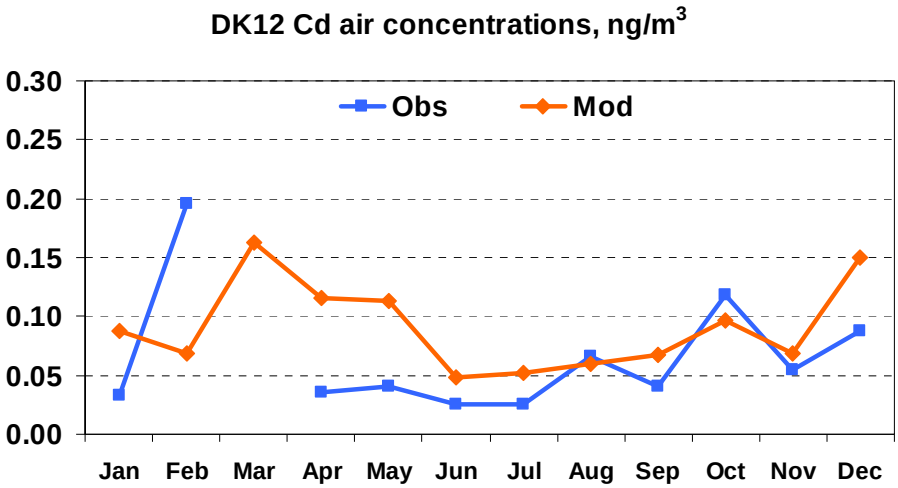


Figure 5.30. Comparison of calculated mean monthly cadmium concentrations in air for 2013 with measurements of the station Risoe (DK12). Units: ng / m^3.

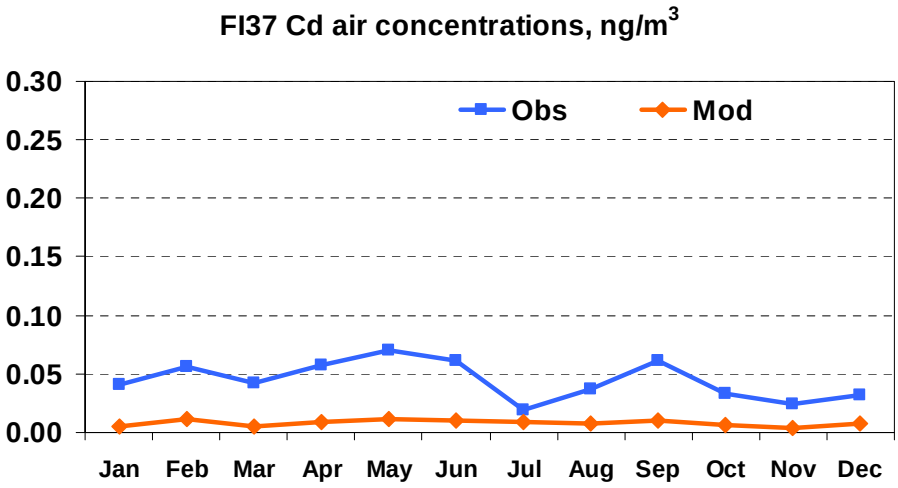


Figure 5.31. Comparison of calculated mean monthly cadmium concentrations in air for 2013 with measurements of the station Ähtäri II (FI37). Units: ng / m^3.

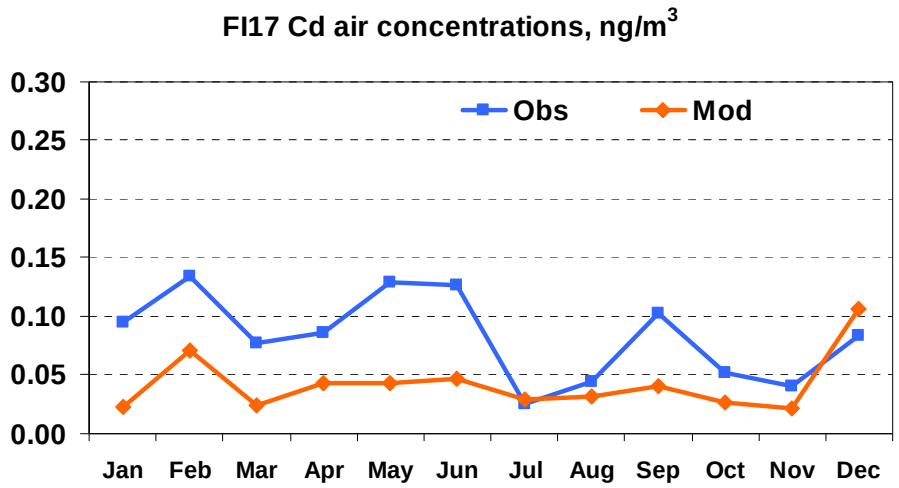


Figure 5.32. Comparison of calculated mean monthly cadmium concentrations in air for 2013 with measurements of the station Virolahty II (FI17). Units: ng / m^3.

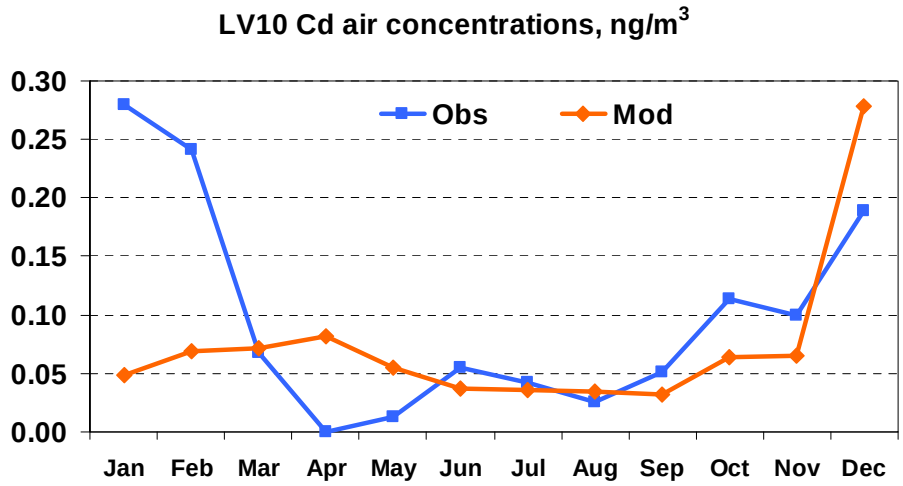


Figure 5.33. Comparison of calculated mean monthly cadmium concentrations in air for 2013 with measurements of the station Rucava (LV10). Units: ng / m^3.

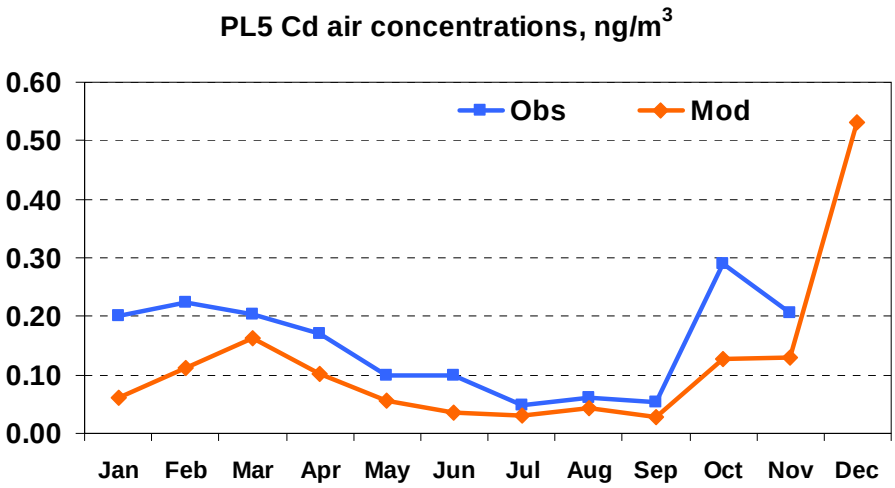


Figure 5.34. Comparison of calculated mean monthly cadmium concentrations in air for 2013 with measurements of the station Diabla Gora (PL5). Units: ng / m^3.

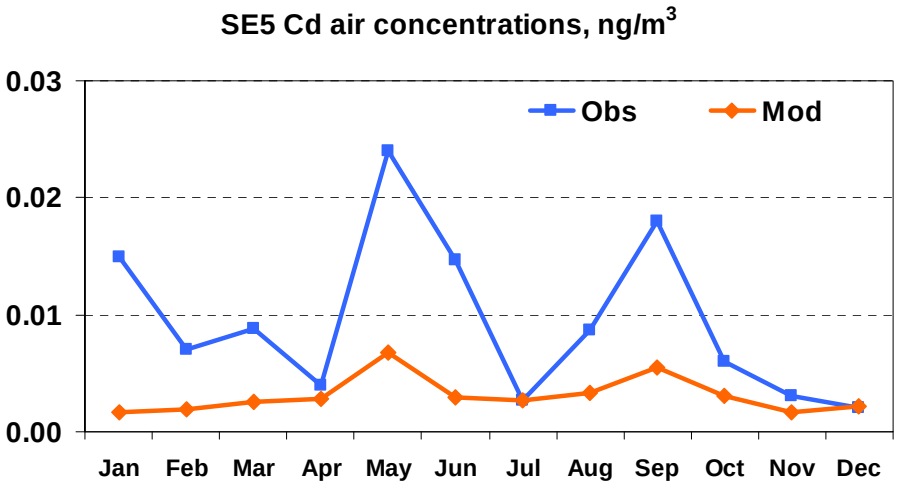


Figure 5.35. Comparison of calculated mean monthly cadmium concentrations in air for 2013 with measurements of the station Bredkälen (SE5). Units: ng / m^3.

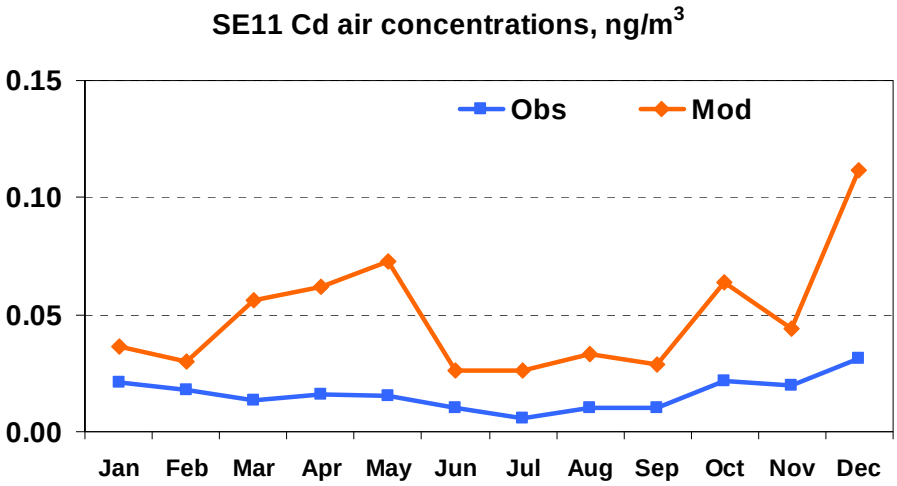


Figure 5.36. Comparison of calculated mean monthly cadmium concentrations in air for 2013 with measurements of the station Vavihill (SE11). Units: ng / m^3.

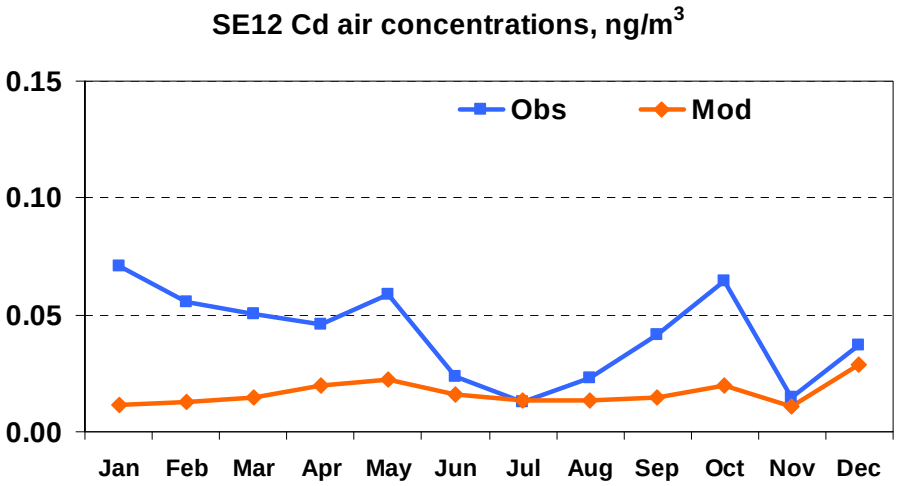


Figure 5.37. Comparison of calculated mean monthly cadmium concentrations in air for 2013 with measurements of the station Aspvreten (SE12). Units: ng / m^3.

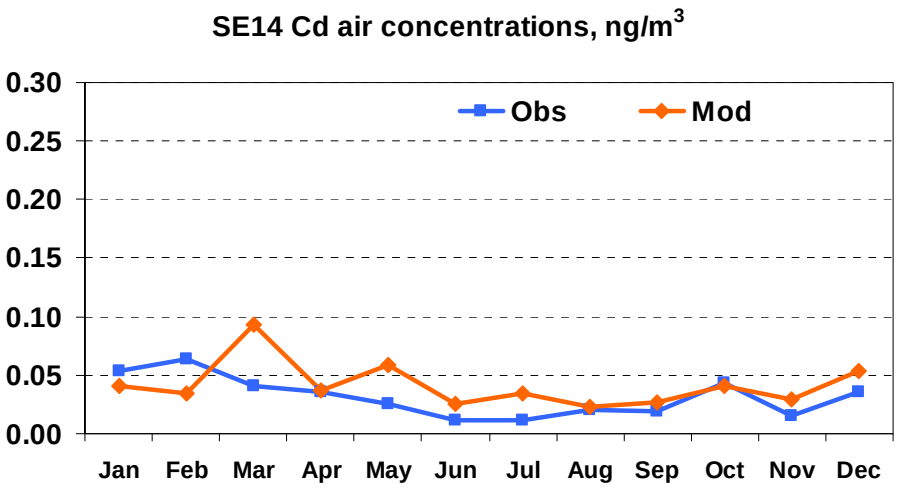


Figure 5.38. Comparison of calculated mean monthly cadmium concentrations in air for 2013 with measurements of the station Räo (SE14). Units: ng / m^3.

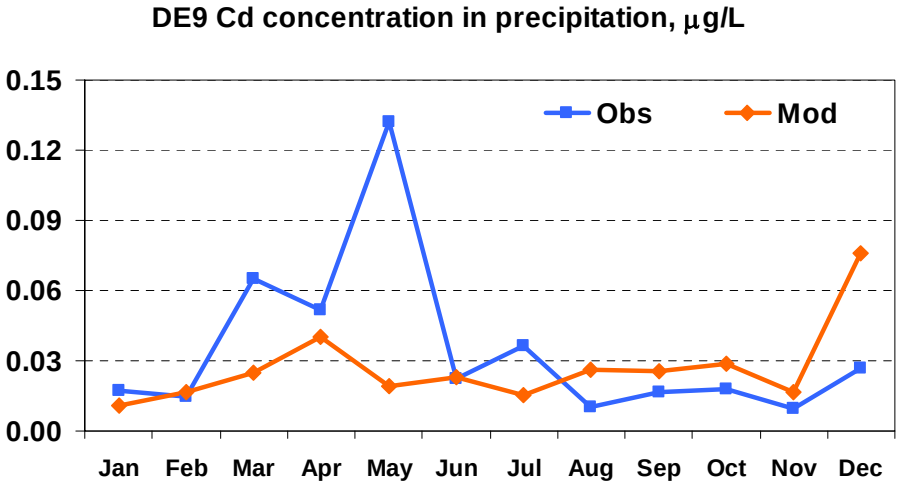


Figure 5.39. Comparison of calculated mean monthly cadmium concentrations in precipitation for 2013 with measurements of the station Zingst (DE9). Units: µg / L.

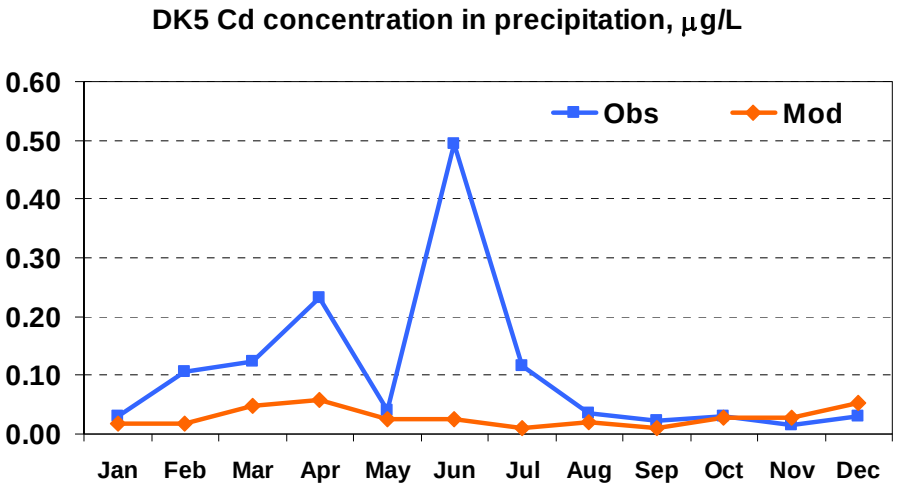


Figure 5.40. Comparison of calculated mean monthly cadmium concentrations in precipitation for 2013 with measurements of the station Keldsnor (DK5). Units: µg / L.

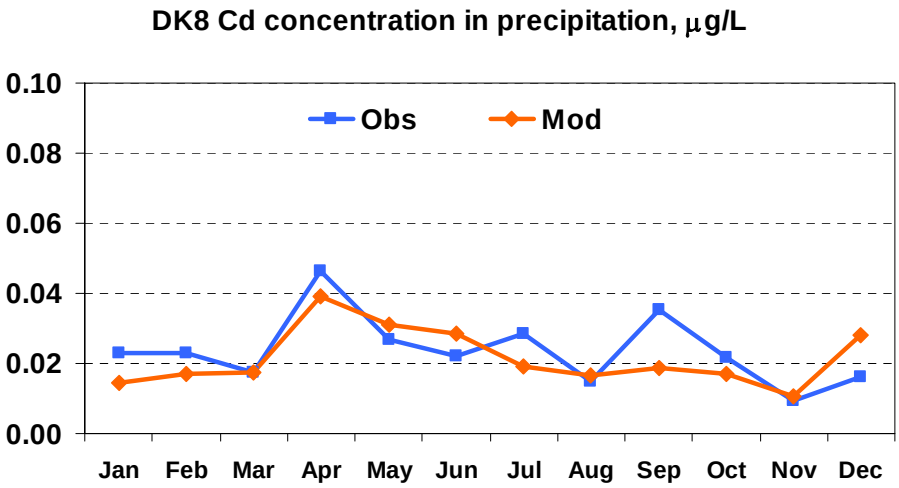


Figure 5.41. Comparison of calculated mean monthly cadmium concentrations in precipitation for 2013 with measurements of the station Anholt (DK8). Units: µg / L.

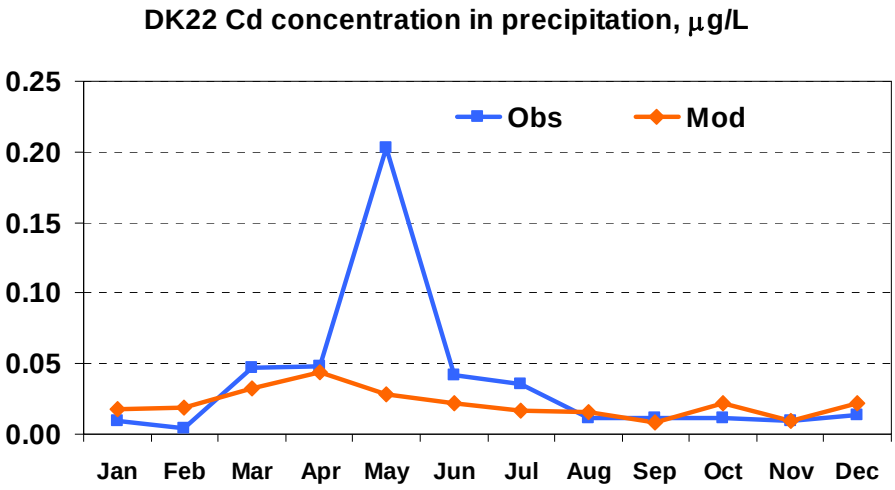


Figure 5.42. Comparison of calculated mean monthly cadmium concentrations in precipitation for 2013 with measurements of the station Storebaelt (DK22). Units: µg / L.

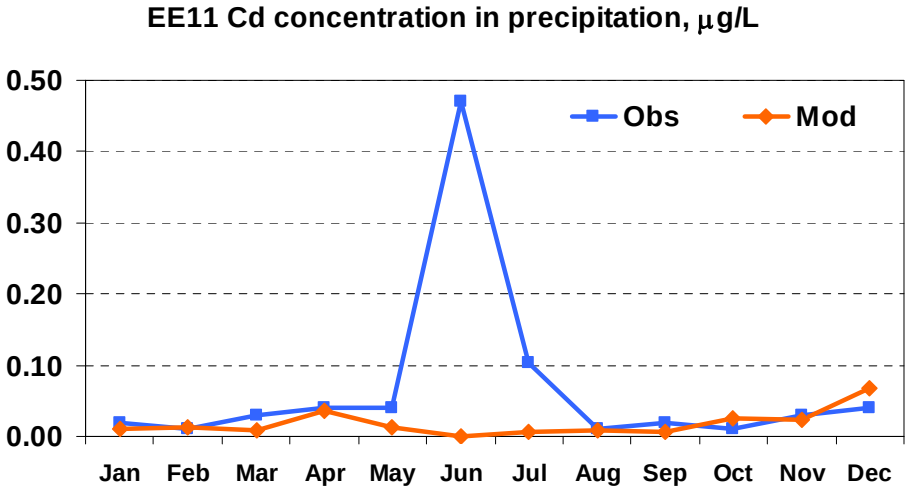


Figure 5.43. Comparison of calculated mean monthly cadmium concentrations in precipitation for 2013 with measurements of the station Vilsandi (EE11). Units: µg / L.

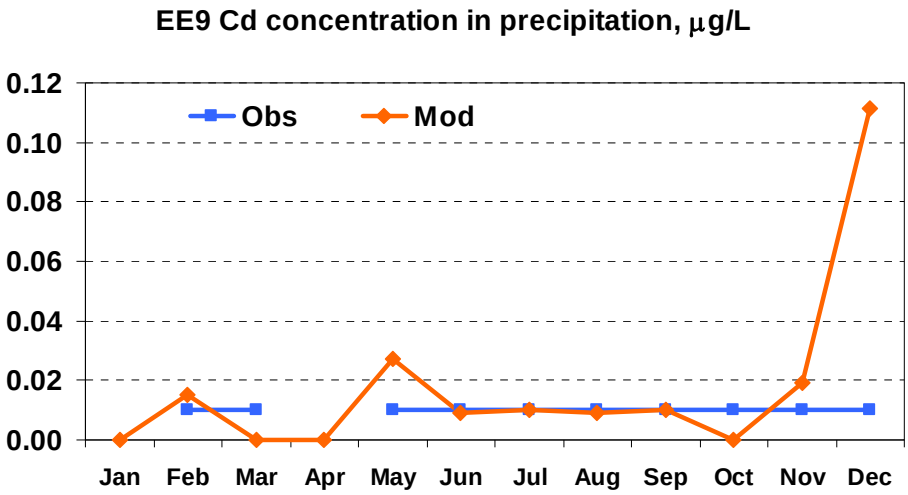


Figure 5.44. Comparison of calculated mean monthly cadmium concentrations in precipitation for 2013 with measurements of the station Vilsandi (EE9). Units: µg / L.

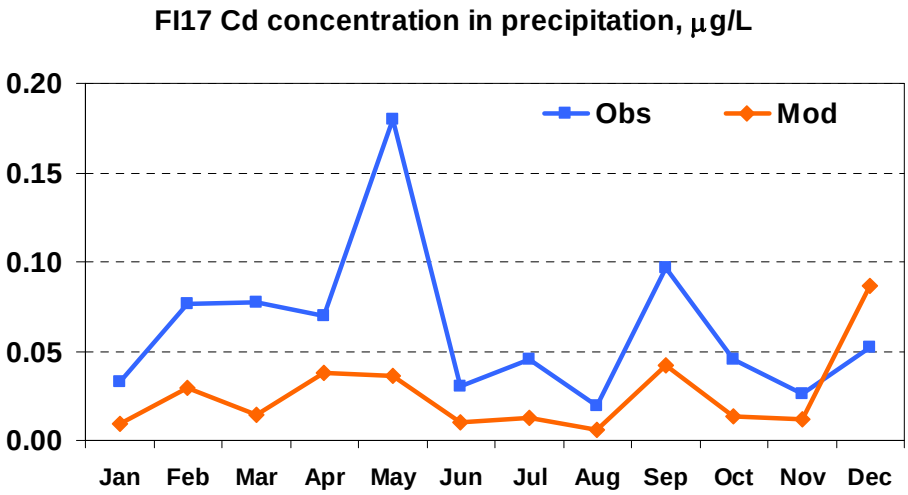


Figure 5.45. Comparison of calculated mean monthly cadmium concentrations in precipitation for 2013 with measurements of the station Virolahty II (FI17). Units: µg / L.

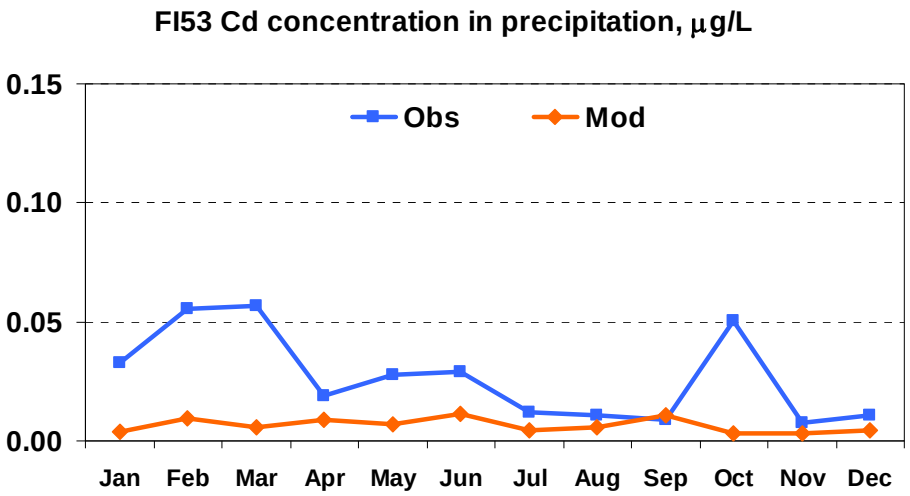


Figure 5.46. Comparison of calculated mean monthly cadmium concentrations in precipitation 2013 with measurements of the station Hailuoto (FI53). Units: µg / L.

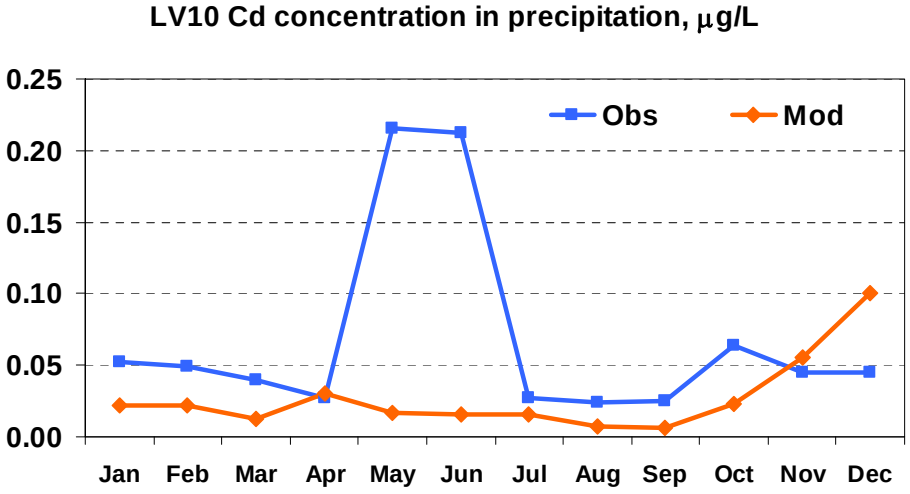


Figure 5.47. Comparison of calculated mean monthly cadmium concentrations in precipitation for 2013 with measurements of the station Rucava (LV10). Units: µg / L.

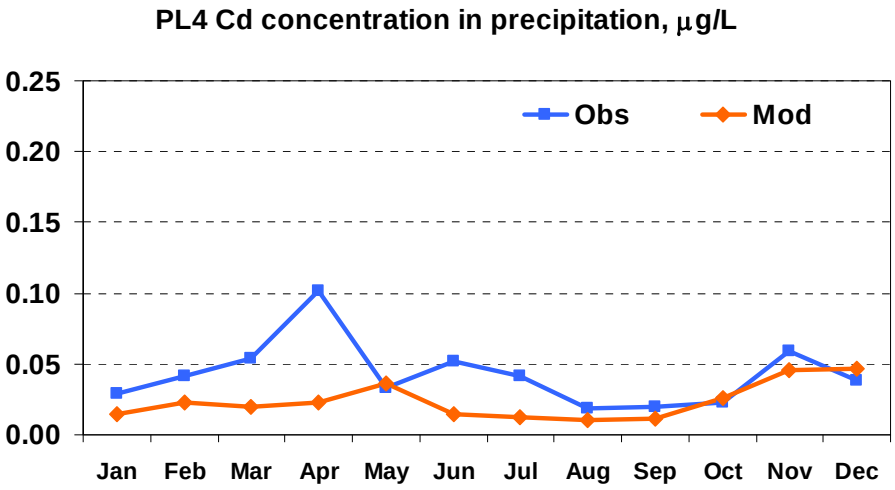


Figure 5.48. Comparison of calculated mean monthly cadmium concentrations in precipitation for 2013 with measurements of the station Leba (PL4). Units: µg / L.

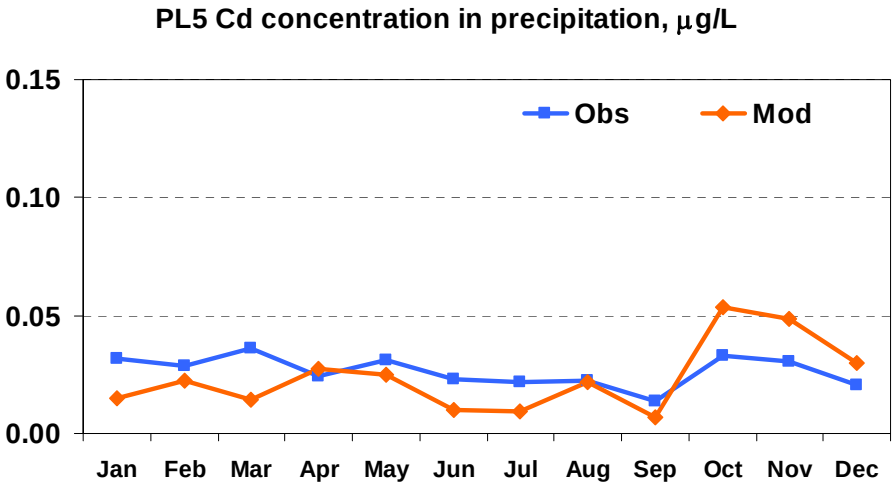


Figure 5.49. Comparison of calculated mean monthly cadmium concentrations in precipitation for 2013 with measurements of the station Diabla Gora (PL5). Units: µg / L.

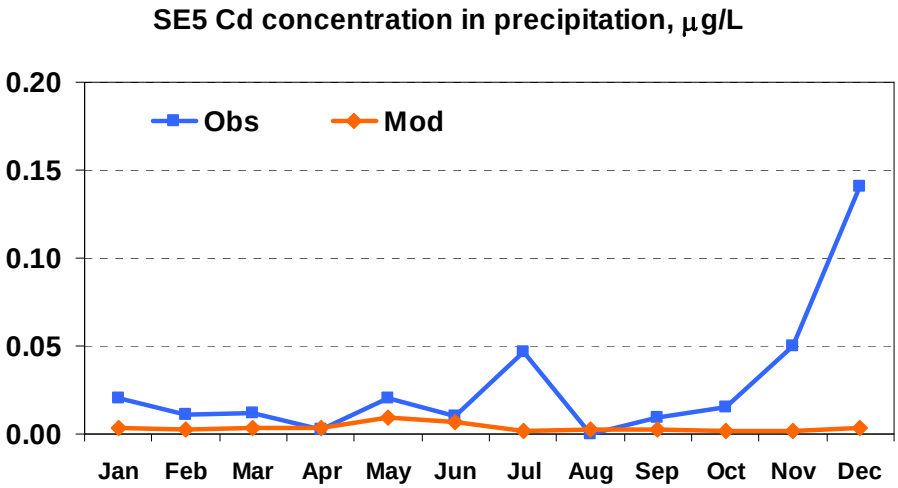


Figure 5.50. Comparison of calculated mean monthly cadmium concentrations in precipitation for 2013 with measurements of the station Bredkälen (SE5). Units: µg / L.

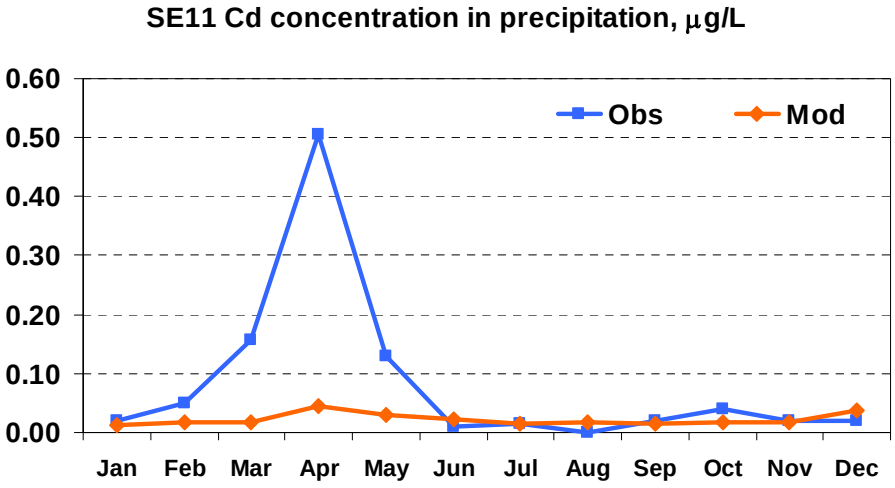


Figure 5.51. Comparison of calculated mean monthly cadmium concentrations in precipitation for 2013 with measurements of the station Vavihill (SE11). Units: µg / L.

Reasonable level of agreement between the computed concentrations of cadmium in air and in precipitation is obtained for the selected monitoring sites around the Baltic Sea. Comparing to lead more significant deviations between simulated and observed monthly mean concentrations of cadmium are found. The reason of deviations is connected with the uncertainties in seasonal variation of cadmium emission, differences between measured precipitation amount and the one used in the model, and difficulties in measurements of heavy metals.

5.6 Concluding remarks

- Emissions of cadmium from HELCOM countries have decreased from 1990 to 2013 by 65%. From 2012 to 2013 emission reduction was accounted for about 1%.

- Annual deposition of cadmium to the Baltic Sea has decreased from 1990 to 2013 by 68%. Level of cadmium deposition has slightly decreased from 2012 to 2013 by 21%.

- The contribution of anthropogenic sources of HELCOM countries to total cadmium deposition over the Baltic Sea for 2013 was estimated to approximately 27%. Essential contribution belongs to the anthropogenic sources of other EMEP countries (7%) and natural sources and wind re-suspension (66%).

- Among the HELCOM countries the most significant contribution to cadmium deposition over the Baltic Sea was made by Poland (11%) and Germany (5%).

- Modelling results for cadmium were in general within a factor of two in comparison with measurements made around the Baltic Sea in 2013.