

EMEP Centres Joint Report for HELCOM
EMEP/MSC-W TECHNICAL REPORT 3/2007

Atmospheric Supply of Nitrogen, Lead, Cadmium, Mercury and Dioxines/Furanes to the Baltic Sea in 2005

Jerzy Bartnicki¹, Alexey Gusev², Wenche Aas³, Hilde Fagerli¹

¹Meteorological Synthesizing Centre-West (MSC-W)

²Meteorological Synthesizing Centre-East (MSC-E)

³Chemical Coordinating Centre (CCC)

OSLO
September 2007

ISSN 0332-9879

Summary

The results presented in this EMEP Centres Joint Report for HELCOM are based on the modelling and monitoring data presented to the 31th Session of the Steering Body of EMEP in Geneva in September 2007. It includes measurements, as well as emissions and depositions calculated by the EMEP models of nitrogen compounds, heavy metals and PCDD/F for the year 2005.

The measured monthly and annual 2005 concentrations in air and precipitation for nitrogen species, heavy metals, as well as air concentrations for lindane are presented in the report. Both for nitrogen and heavy metals a significant south-east gradient can be noticed in the measured concentrations in 2005. The temporal patterns of monthly Cd and Pb concentrations show a strong winter maximum and temporal pattern of Hg monthly concentrations weaker winter maximum. During winter the atmospheric residence time is longer due to reduced vertical mixing.

Annual emissions from the HELCOM Contracting Parties in 2005 are shown below for all pollutants considered in the report. The annual nitrogen oxides emission from the international ship traffic on the Baltic Sea in 2005 is 343kt NO₂ (or 104 kt N).

Country	POLLUTANT					
	NO ₂ kt N	NH ₃ kt N	Cd tonnes	Pb tonnes	Hg tonnes	PCDD/F g TEQ
Denmark	56,6	76,2	0,6	5,6	1,3	25
Estonia	9,8	7,6	0,6	36,7	0,5	3
Finland	54,0	29,8	1,3	23,5	0,9	26
Germany	439,0	510,1	2,7	106,8	2,7	74
Latvia	12,5	11,5	0,5	16,7	0,1	19
Lithuania	17,5	32,5	0,4	5,7	0,4	11
Poland	246,8	268,9	46,0	536,5	20,1	416
Russia	941,4	511,4	59,4	355	14,0	747
Sweden	62,4	43,1	0,5	16,5	0,7	39
HELCOM	1840,1	1491,2	112	1103	41	1360

Compared to 2004 emissions, annual emissions in 2005 are slightly lower for almost all pollutants except NO₂ ship emissions on the Baltic Sea which are 2.5% higher.

Annual depositions of all considered pollutants in 2005 are shown in the Table below for 6 sub-basins of the Baltic Sea and for the entire Baltic Sea.

Basin	POLLUTANT					
	Ox-N kt N	Red-N kt N	Cd tonnes	Pb tonnes	Hg tonnes	PCDD/F g TEQ
GUB	18,3	11,7	1,24	44	0,72	38
BAP	7,9	5,0	4,11	136	1,51	86
GUF	5,4	3,9	0,50	17	0,22	21
GUR	66,0	49,4	0,34	11	0,14	16
BES	9,2	12,3	0,54	21	0,19	26
KAT	9,6	9,2	0,54	22	0,20	12
BAS	116,4	91,4	7,3	251	3,0	199

Nitrogen depositions followed the nitrogen emission changes and were lower in 2005 than in 2004 in most of sub-basins and in the entire Baltic Sea Basin. Depositions of heavy metals to the entire Baltic Sea remain on the same level in 2005 as in 2004, but there are some differences in distributions among sub-basins. Deposition of PCDD/F to the entire Baltic Sea is approximately 6% higher in 2005 than in 2004. There is also an increase of PCDD/F deposition from 2004 to 2005 for most of the sub-basins.

Preface

The Co-operative Program for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP) and the Baltic Marine Environment Protection Commission (HELCOM) are both conducting work on air monitoring, modelling and compilation of emission inventories. In 1995, HELCOM decided to rationalize its current programs by avoiding duplication of efforts with specialised international organizations. At the request of HELCOM, the steering Body of EMEP at its nineteenth session agreed to assume the management of atmospheric monitoring data, the preparation of air emission inventories and the modelling of air pollution in the Baltic region.

Following the coordination meeting held in Potsdam in Germany and the Pollution Load Input meeting held in Klajpeda-Joudkrante in Lithuania, both 1996, it was agreed that EMEP Centres should be responsible for regular evaluation of the state of the atmosphere in the Baltic Sea region and should produce an annual joint summary report which includes updated emissions of selected air pollution, modelled deposition fields, allocation budgets and measurement data.

This report was prepared for the HELCOM, based on model estimates and monitoring results presented to the thirtieth session of the Steering Body of EMEP. Following decision of the HELCOM /MONAS-9 Meeting, it presents the results for the year 2005.

Acknowledgements

The authors are indebted to the scientific teams at MSC-E, MSC-W and CCC for providing the results included in this.

We are most grateful to Marina Varygina, Iliia Ilyin and Victor Shatalov from MSC-E, and to Heiko Klein, Vigdis Vestreng and Per Helmer Skaali from MSC-W for their help in preparation of this report.

Contents

Summary.....	iii
Preface.....	v
Acknowledgements.....	v
Contents	v
1. Introduction.....	1
2. Observed Concentrations of Nitrogen, Cadmium, Lead, Mercury and Lindane at HELCOM Stations in 2005	3
2.1 HELCOM measurement stations.....	3
2.2 Nitrogen concentrations in air	5
2.3 Nitrogen in precipitation.....	7
2.4 Heavy metals in the air	10
2.5 Heavy metals in precipitation	12
2.6 Lindane (γ -HCH)	13
2.7 Laboratory and field intercomparisons.....	14
2.7.1 Nitrogen	14
2.7.2 Heavy metals	13
3. Atmospheric Supply of Nitrogen to the Baltic Sea in 2005	17
3.1 Nitrogen emissions	17
3.2 Annual deposition of nitrogen	24
3.3 Monthly depositions of nitrogen	27
3.4 Source allocation of nitrogen deposition	28
4. Atmospheric Supply of Lead to the Baltic Sea in 2005	31
4.1 Lead emissions	31
4.2 Annual deposition of lead.....	40
4.3 Monthly depositions of lead	41
4.4 Source allocation of lead deposition.....	42
4.5 Comparison of model results with measurements.....	43

5. Atmospheric Supply of Cadmium to the Baltic Sea in 2005	53
5.1 Cadmium emissions.....	53
5.2 Annual deposition of cadmium.....	65
5.3 Monthly depositions of cadmium.....	63
5.4 Source allocation of cadmium deposition	64
5.5 Comparison of model results with measurements.....	65
6. Atmospheric Supply of Mercury to the Baltic Sea in 2005	75
6.1 Mercury emissions.....	75
6.2 Annual deposition of mercury	84
6.3 Monthly depositions of mercury	85
6.4 Source allocation of mercury deposition.....	86
6.5 Comparison of model results with measurements.....	87
7. Atmospheric Supply of PCDD/Fs to the Baltic Sea in 2005	91
7.1 PCDD/Fs emissions.....	91
7.2 Annual deposition of PCDD/F	100
7.3 Monthly depositions of PCDD/F.....	101
7.4 Source allocation of PCDD/Fs deposition.....	102
7.5 Comparison of model results with measurements.....	103
References	105
Appendix A: Tables with measurements available at HELCOM stations for 2005	109
Appendix B: Monitoring methods, accuracy, detection limits and precision (updated for 2005).....	117
Appendix C: Indicator Fact Sheet on nitrogen emissions	121
Appendix D: Indicator Fact Sheet on nitrogen depositions.....	129
Appendix E: Indicator Fact Sheet on HM emissions	135
Appendix F: Indicator Fact Sheet on HM depositions	147
Appendix G: Indicator Fact Sheet on PCDD/F emissions	157
Appendix H: Indicator Fact Sheet on PCDD/F depositions.....	163

