UNITED NATIONS **E**

Economic and Social Council

Distr.
GENERAL

EB.AIR/WG.1/2005/10/Add.1
22 June 2005

Original: ENGLISH

ECONOMIC COMMISSION FOR EUROPE

EXECUTIVE BODY FOR THE CONVENTION ON
LONG-RANGE TRANSBOUNDARY AIR POLLUTION

Working Group on Effects
(Twenty-fourth session, Geneva, 31 August–2 September 2005)
Item 5 (vi) of the provisional agenda

DEVELOPMENT, MODELLING AND MAPPING OF CRITICAL LOADS AND THEIR INPUT DATA

Addendum

MODELLING AND MAPPING OF CRITICAL LOADS OF CADMIUM, LEAD AND MERCURY IN EUROPE: RESULTS OF A CALL FOR NATIONAL DATA CONTRIBUTIONS

Note prepared by the Coordination Center for Effects (CCE) of the International Cooperative Programme (ICP) on the Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends

Introduction

1. The Working Group on Effects, at its twenty-third session, requested the Coordination Center for Effects (CCE) of ICP Modelling and Mapping to issue a call for data on critical loads of cadmium (Cd), lead (Pb) and mercury (Hg) (see EB.AIR/WG.1/2004/2).

GE.05-31532

2. The call, which was made in October 2004 with a deadline of 31 December 2004, requested national focal centres (NFCs) to provide data for the 50x50 km^2 EMEP grid.

3. National Focal Centres (NFCs) received instructions on the database format. Respondents were encouraged to provide ecosystem information using the European Nature Information System (EUNIS, see http://eunis.eea.eu.int/habitats.jsp) to enhance cross-border comparison of ecosystems. Responses and adjustments to submissions were received by CCE up to 13 May 2005.

4. Following recommendations from a joint meeting of the Bureau of the Working Group on Effects and the Bureau of the EMEP Steering Body, collaboration between CCE and the EMEP Meteorological Synthesizing Centre - East (MSC-E) focused on establishing results of modelled depositions of cadmium, lead and mercury for 1990 and 2000 for the computation of exceedance maps.

I. RESPONSE BY THE NATIONAL FOCAL CENTRES

5. Preliminary results of the call for data were presented at the fifteenth CCE workshop and the twenty-first Task Force meeting of ICP Modelling and Mapping, which were held back to back in Berlin on 25–29 April 2005.

6. Table 1 lists the critical limit indicators (second last column) and five effects (last column) used to compute critical thresholds. Critical loads of cadmium, lead and mercury were computed to find the maximum deposition values onto different receptors at which eco-toxicological effects (effects 3 and 4) and human health effects (effects 1 and 2) did not occur. The risk for effect 5 was not related to a critical load but to a critical concentration of mercury in precipitation.

7. Altogether 17 NFCs submitted critical loads for heavy metals with 16, 16 and 9 NFCs computing values for Cd, Pb and Hg respectively. Not all NFCs addressed all effects (table 2).

8. A detailed description of the response by NFCs, preliminary European maps of critical loads of cadmium, lead, and mercury as well as preliminary exceedance maps were recorded in a collaborative report (CCE-MSCE 2005). Drafts of several chapters of this report had been made available electronically to the participants of the CCE workshop and the Task Force meeting.

II. CRITICAL LOADS MAPS FOR CADMIUM, LEAD AND MERCURY

9. The Task Force recommended that critical loads maps should indicate separately the protection against adverse health effects (effects 1 and 2) and the protection against adverse ecosystem effects (effects 3 and 4).

10. Figure I shows the maps of critical loads of cadmium (top), lead (middle) and mercury (bottom) that would protect 95% of the ecosystems with the effect endpoint on food chain mediated human health impact (right) and on ecosystem functioning (left). The submitted critical loads mainly cover ecosystem effects.

III. ECOSYSTEMS AT RISK

11. In order to provide Europe-wide effect-based information on the risk of air pollution impacts (exceedances) there is a need for representative cover of Europe by critical loads data for acidity, nutrient nitrogen and now heavy metals.

12. For this, a European background database containing relevant, available European forest soils information was used in the past for mapping countries that did not submit critical loads data on acidity and nutrient nitrogen. The Task Force on Mapping noted already in 1993 (EB.AIR/WG.1/R.85, paras. 5 and 26) that these data provided European maps of critical loads and the Working Group on Effects has approved such maps since 1994. Critical loads maps based on national contributions and background data were used to assess areas at risk during the negotiations of the 1994 Oslo Protocol and the 1999 Gothenburg Protocol.

13. This past practice of using the European background database was followed by CCE to compile a European background database of critical loads of heavy metals.

14. At the Task Force meeting some experts objected to the use of the European background database for calculating and mapping of critical loads of heavy metals for their countries.

15. The Task Force agreed not to use the European background database for assessing exceedances in countries that had not submitted critical loads of heavy metals. The risk of heavy metal deposition would only be computed and mapped for countries submitting data.

16. Exceedances for data submitted were computed by comparing critical loads with depositions for effects 1 to 4. The concentration in precipitation was used for effect 5. However, the computed depositions and concentrations of Cd, Pb and Hg were not considered robust due to the uncertainty of underlying reported emissions in 1990 and 2000 (see CCE-MSCE 2005, chapter 4). Therefore, the results described in Tables 3 and 4 were considered preliminary.

17. Table 3 gives an overview of the percentage of national ecosystem areas where these present risks to human health (effects 1 and 2) in countries where NFCs had submitted critical loads of cadmium, lead and/or mercury.

18. Table 4 gives an overview of the percentage of national ecosystem areas that are at risk of ecosystem effects (effect 3 and 4) in countries where NFCs had submitted critical loads of cadmium, lead and/or mercury.

19. Tables 3 and 4 showed that risks for effects of lead were more widespread than those of cadmium. The area of excess deposition of Pb in 2000 was greatly decreased in comparison to that in 1990. In Europe 33.3 % of the ecosystem area in 1990 was subject to excess deposition of Pb for human health effects, which was reduced to 8.3% in 2000 (table 3). The risk for ecosystem effects of Pb was 65.7% and 28.7% in 1990 and 2000, respectively (table 4).

20. Effect 5 was mapped by Sweden, Finland and the Wallonian part of Belgium (CCE-MSCE 2005, CCE Status Report 2005). Exceedance maps showed that in 1990 almost all grid cells over the mapped areas were at risk. The risk hardly diminished by 2000.

21. MSC-E has emphasized that official national emission reports are highly uncertain (see CCE-MSCE 2005, chapter 4). In many cases this could lead to significant underestimates of depositions, exceedances and areas at risk.

22. CCE conducted a preliminary analysis of the risks from inputs of cadmium and lead from agricultural practices. Agricultural inputs of lead and cadmium, independent of atmospheric input, did not by themselves exceed the critical loads for agricultural areas. However, when these inputs were added to the atmospheric deposition, the critical loads of cadmium were slightly exceeded locally and critical loads of lead were clearly exceeded.

23. CCE explored the relationship between critical loads of Cd and Pb with the European Community (EC) threshold levels for ambient concentrations. EC limit and guideline values of cadmium and lead, respectively, were compared to yearly average ambient concentrations in 2000 computed by MSC-E. These thresholds were not exceeded anywhere. However, the modelling and mapping of critical loads suggested that heavy metal depositions, especially of lead and mercury, were too high in many areas of Europe where critical loads data were submitted.

References

CCE-MSCE (2005), Slootweg J, Hettelingh JP, Posch M, SV Dutchak, I.Ilyin (eds.) Critical loads of cadmium, lead and mercury in Europe, Collaborative Report, Netherlands Environmental Assessment Agency at RIVM, Coordination Center for Effects, www.mnp.nl/cce, Bilthoven, The Netherlands.

CCE Status Report (2005) Posch M, Slootweg J, Hettelingh JP (eds.) Netherlands Environmental Assessment Agency at RIVM, Coordination Center for Effects, www.mnp.nl/cce, Bilthoven, The Netherlands.

Note: The references have been reproduced as received by the secretariat.

Table 1. Overview of indicators used in the computation of critical thresholds (adapted from UBA 2005, table 5.17)

Receptor ecosystem	Effect endpoints	Heavy metals of concern	Land cover types to be considered	Indicator/critical limit	Effect number
Terrestrial	Human health effects	Cd, Pb, Hg	All ecosystems	Total concentration in soil water below the rooting zone(to protect ground water)	1
		Cd, Pb, Hg	Arable	Content in food, fodder and crops	2
		Cd, Pb, Hg	Grassland	Content in grass and animal products (cows, sheep)	
	Ecosystem functions	Cd, Pb	Arable land, grassland, non-agricultural	Free ion concentration in view of effects on soil micro-organisms, plants and invertebrates	3
		Hg	Forest soils	Total concentration in humus layer in view of effects on soil micro organisms and invertebrates	
Aquatic	Ecosystem functions	Cd, Pb, Hg	Freshwaters	Total concentration in view of effects on algae, crustacea, worms, fish, top predators	4
	Human health	Hg	Freshwaters	Concentration in fish	5

Table 2. Overview of the country response on the call for critical thresholds of cadmium, lead and mercury for the five effects listed in table 1

Country	Country code	Effect number (see table 1)									
		Cd				**Pb**			**Hg**		
		1	2	3	4	1	3	4	1	3	5
Austria	AT	x	x	x		x	x		x	x	
Belarus	BY			x			x				
Belgium	BE	x		x	x	x	x	x	x	x	x
Bulgaria	BG	x				x					
Cyprus	CY	x	x	x		x	x		x		
Finland	FI										x
France	FR			x			x				
Germany	DE	x	x	x		x	x		x	x	
Italy	IT			x			x				
Netherlands	NL	x	x	x		x	x				
Poland	PL			x			x			x	
Russia	RU	x		x		x	x				
Slovakia	SK			x			x			x	
Sweden	SE		x	x			x			x	x
Switzerland	CH	x		x		x	x			x	
Ukraine[1]	UA		x								
United Kingdom	GB			x			x				

[1] Ukraine voluntarily submitted critical loads of lead for effect number 2.

Table 3. Percentage of national ecosystem areas that were at risk of health effects in countries that submitted critical loads of cadmium, lead and/or mercury

country	Cd			Pb			Hg		
	ecosystem area (km^2)	1990 at risk (%)	2000 at risk (%)	ecosystem area (km^2)	1990 at risk (%)	2000 at risk (%)	ecosystem area (km^2)	1990 at risk (%)	2000 at risk (%)
AT	61,371	0.0	0.0	61,371	24.0	0.0	61,371	0.0	0.0
BE	5,228	0.0	0.0	5,228	62.3	18.2	5,228	22.7	6.1
BG	48,330	42.0	14.8	48,330	99.9	77.2	-	-	-
CH	2,200	0.0	0.0	2,218	72.0	2.3	-	-	-
CY	7,973	1.3	0.8	7,973	74.1	70.4	7,973	4.2	4.1
CZ	25,136	1.1	0.5	25,136	93.1	19.9	25,136	7.4	1.9
DE	290,003	1.4	0.1	290,003	79.0	7.4	290,003	17.9	4.8
NL	19,471	0.1	0.0	19,471	89.2	0.1	-	-	-
RU	425,425	0.0	0.0	650,575	3.3	2.5	-	-	-
SE	22,050	0.0	0.0	-	-	-	-	-	-
UA	18,002	0.0	0.0	18,002	91.6	41.4	-	-	-
EU25	431,232	1.1	0.1	409,182	71.8	8.1	389,711	14.2	3.9
Europe	925,190	2.7	0.8	1,128,308	33.8	8.3	389,711	14.2	3.9

Table 4. Percentage of national ecosystem areas that were at risk of ecosystem effects in countries that submitted critical loads of cadmium, lead and/or mercury

country	Cd			Pb			Hg		
	ecosystem area (km^2)	1990 at risk (%)	2000 at risk (%)	ecosystem area (km^2)	1990 at risk (%)	2000 at risk (%)	ecosystem area (km^2)	1990 at risk (%)	2000 at risk (%)
AT	61,371	0.0	0.0	61,371	48.7	11.1	32,601	39.2	11.7
BE	5,237	0.0	0.0	5,237	63.0	12.8	5,228	100.0	83.5
BY	121,128	9.1	0.1	121,128	100.0	10.2	-	-	-
CH	9,411	0.0	0.0	9,393	99.0	24.1	11,611	80.2	44.4
CY	7,973	0.0	0.0	7,973	80.9	78.4	-	-	-
DE	290,003	0.1	0.0	290,003	83.8	9.0	99,866	97.0	59.8
FR	170,638	0.1	0.0	170,638	93.7	9.8	-	-	-
GB	50,075	0.5	0.0	50,075	25.9	6.0	-	-	-
IT	278,128	0.0	0.0	278,128	0.3	0.0	-	-	-
NL	22,314	0.0	0.0	22,314	98.4	21.5	-	-	-
PL	88,383	0.5	0.0	88,383	73.5	14.7	88,383	100.0	99.9
RU	1,393,300	1.1	0.2	1,194,125	70.8	51.0	-	-	-
SE	151,432	0.0	0.0	151,432	60.5	1.9	152,074	56.0	22.9
SK	19,253	2.6	1.1	19,253	52.3	22.6	19,253	99.0	65.3
EU25	1,144,807	0.1	0.0	1,144,807	56.3	7.4	397,405	77.4	51.2
Europe	2,668,646	1.0	0.1	2,469,453	65.7	28.7	409,016	77.4	51.0

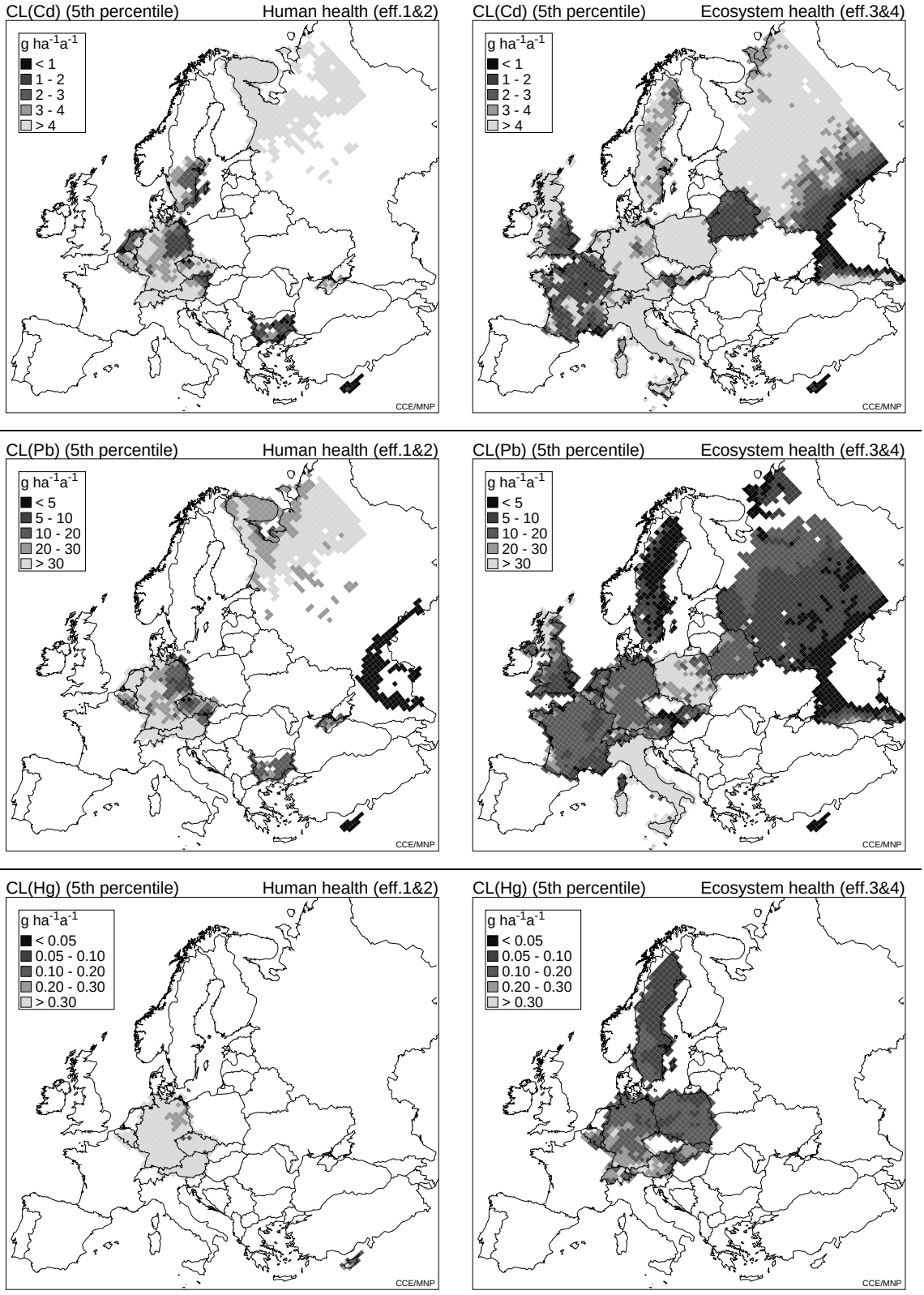

Figure I. Maps of critical loads of cadmium (top), lead (middle) and mercury (bottom) that would protect 95% of the ecosystems against adverse effects on human health (left) and on ecosystems (right). Dark shaded areas indicate the occurrence of sensitive ecosystems