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Working Group on Effects

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RECENT RESULTS AND UPDATING OF SCIENTIFIC AND TECHNICAL KNOWLEDGE

PROGRESS ON EUROPEAN EMPIRICAL AND MODELLED CRITICAL LOADS OF NITROGEN, EXCEEDANCES AND DYNAMIC MODELLING

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

INTRODUCTION

1. The Working Group on Effects, at its twenty-fifth session, approved the proposal of ICP Modelling and Mapping to make a voluntary call for data for the nitrogen-related parameters. It also recommended the use of the document, “Development in deriving critical limits and modelling critical nitrogen loads for terrestrial ecosystems in Europe” (Alterra/CCE, 2007), as

GE.07-23008

information for national focal centres (NFCs) for the call for data to be distributed by CCE. The results are presented here in accordance with the Convention's 2007 workplan (item 3.7).

2. CCE issued a call for voluntary data in the autumn of 2006. It was intended to give scientific and technical leeway to the NFCs for testing new knowledge in the period 2006–2007, prior to possible revisions of the 1999 Gothenburg Protocol and the thematic strategy for air pollution of the European Commission.

3. To support the call, CCE had prepared, in collaboration with the Stockholm Environment Institute (SEI), a harmonized land cover database which covered the geographic domain of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants (EMEP). It was based on CORINE (Coordination and Information on the Environment) country-specific land-cover information and, where available, complemented with SEI data. It included a translation from CORINE/SEI to EUNIS (European Nature Information System) classes. This database could assist NFCs to verify ecosystem coverage, enable CCE to verify submitted data on empirical critical loads, and provide information for Parties that have not submitted critical load data. CCE used it to update its background database, which now enables the calculation of critical loads for acidification and eutrophication in Eastern Europe, Caucasus and Central Asia (EECCA).

4. NFCs were requested to participate in:

(a) Preliminary application of a broad range of critical limits in simple mass balance calculations to address biodiversity, as proposed in Alterra/CCE (2007);

(b) Application of empirical critical loads to (i) those EUNIS classes for which NFCs provided modelled critical loads, and (ii) Natura 2000. This work could improve the robustness of the European critical loads database, and could facilitate the interpretation of exceedances in a more biological context. Existing documentation on empirical critical loads is more explicit on biological impacts than those on modelled critical load exceedance;

(c) Exploration of the possibility for dynamic modelling of eutrophication, taking into account available data, e.g. for the Very Simple Dynamic model (VSD) and complex models, as described in Alterra/CCE (2007).

I. RESULTS OF THE VOLUNTARY CALL FOR DATA

5. CCE issued a call for voluntary contributions on empirical critical loads, critical loads of acidification and eutrophication, and dynamic modelling in November 2006. The deadlines for data submission were set at 28 February and 31 March 2007, respectively. The results are presented in table 1. Note that the results for Belgium are limited to Wallonia and that Canada,

Lithuania and Slovenia submitted data for the first time. Not all Parties submitted reports to substantiate their results.

Table 1. Data submissions from countries (denoted with “x”) as a response to the call for voluntary data by March 2007.

Country code	Country	Modelled critical loads of sulphur and nitrogen	Empirical critical loads of nitrogen	Dynamic modelling data
AT	Austria	x	x	x
BE	Belgium	x	-	x
BG	Bulgaria	x	x	-
BY	Belarus	x	-	-
CA	Canada	x	-	x
CH	Switzerland	x	x	x
CZ	Czech Republic	-	x	-
DE	Germany	x	x	x
FR	France	x	x	x
GB	United Kingdom	x	x	x
IE	Ireland	x	x	-
IT	Italy	x	-	-
LT	Lithuania	x	-	-
NL	Netherlands	x	x	x
NO	Norway	x	x	x
PL	Poland	x	x	x
SE	Sweden	x	-	x
SI	Slovenia	-	x	-
UA	Ukraine	-	x	-
Total	19	16	13	11

6. The updated European critical load maps and data statistics were presented at the seventeenth CCE workshop (Sofia, 23–25 April 2007) and the twenty-third Task Force meeting (Sofia, 26–27 April 2007) of ICP Modelling and Mapping. Belarus, Canada, the Czech Republic and Ireland submitted data after the Task Force meeting within the agreed period for revisions.

7. The availability of both empirical and modelled critical loads can contribute to the analysis of robustness of critical loads and exceedances. CCE proposed an outline of a methodology preliminarily entitled “ensemble assessment of impacts” (EAI). EAI aims to improve the robustness of impact assessments in a 50 km × 50 km grid cell using different methods (including dynamic models), critical indicators and data. Its proposed outcome is (i) a

improved robustness of distinguishing between protected and non-protected ecosystems (avoiding the risk of a "false positive"), and (ii) a tentative application of the uncertainty concept developed and applied by the working groups of the United Nations Framework Convention on Climate Change and the International Panel on Climate Change. The Task Force encouraged CCE to explore such a methodology.

8. The Task Force noted the current European dataset on empirical critical loads covered a large part of Central and Western Europe and that differences between empirical and modelled critical loads existed. It recommended using both the modelled critical load for eutrophication and appropriate ranges of empirical critical loads, provided by Achermann and Bobbink (2003), and results from the Workshop on effects of low-level nitrogen deposition (Stockholm, 28–30 March 2007) as measures of risk of nitrogen deposition to biodiversity. It also noted that values for critical leaching for modelled critical loads could be obtained using Swedish and Dutch findings, as provided in Alterra/CCE (2007). The values should be used with caution, for instance in regions with extreme precipitation.

9. The Task Force recommended proposing to the twenty-sixth session of the Working Group on Effects to request CCE to issue a call for data on empirical and modelled critical loads and dynamic modelling data to Parties towards the end of 2007. The data format would be similar to the previous call. Results would be made available to the Task Force on Integrated Assessment Modelling in 2008.

10. The Task Force encouraged NFCs and representatives of EECCA to review the background land-cover maps available at CCE.

II. PRELIMINARY UPDATED EXCEEDANCE OF CRITICAL LOADS

11. Preliminary results on exceedance of empirical critical loads and critical loads for eutrophication are provided in annex I. Exceedance of the critical loads for acidification is provided in annex II.

12. Annexes I and II show two statistical indicators that are relevant for the interpretation of exceedance. The first one is the percentage of the ecosystem area that is protected ("Protected %") and the second is the average accumulated exceedance (AAE in eq ha^{-1} $year^{-1}$). Acidifying and eutrophying depositions were calculated by EMEP with emissions for the current legislation scenario in 2010 and 2020 (CLE-2010 and CLE-2020, respectively) and for the maximum technically feasible reductions in 2020 (MFR-2020).

13. The exceedance of empirical critical loads can be considered as a risk indicator of nitrogen deposition for vegetation, and, for countries that did not submit these data, calculation

employed the CCE background database (including the new harmonized land-cover map). The exceedance of the modelled critical loads of nutrient nitrogen is considered as risk for eutrophication. Both critical loads contribute to the robustness of the exceedance and their geographical distribution.

14. The Russian background database was still under development. Therefore, comparisons for the EMEP domain between the exceedance of empirical critical loads and the exceedance of modelled critical loads exclude the Russian Federation at this stage.

15. Annex I shows that the country percentages of the area that is protected with CLE-2010, CLE-2020 and MFR-2020 varies greatly, as does AAE, depending on whether critical loads are empirical or modelled. Note, that that the country-specific coverage of ecosystems is different for empirical and modelled data. NFCs would need to review the implications of these differences.

16. For the 25 European Union member States (EU25), the area protection using empirical and modelled critical loads with CLE-2010 deposition is 58% and 47%, respectively, and 56% and 44% for EU27, respectively. AAE with CLE-2010 is 139 and 202 eq ha^{-1} $year^{-1}$ for EU25, respectively, and 147 and 230 eq ha^{-1} $year^{-1}$ for EU27, respectively.

17. The area in the geographical domain of EMEP ("EU") protected from acidification is 92%, 94% and 99% with CLE-2010, CLE-2020 and MFR-2020, respectively (annex II).

III. STATUS OF DYNAMIC MODELLING

18. Dynamic modelling is an important part of the effects-based work. It can improve the understanding of the delayed response of natural systems to changes in exceedance. It is key to the understanding of the effects for biodiversity caused by dynamic interactions between climate change and air pollution.

19. The call for voluntary contributions on dynamic modelling focused on the application of the VSD model to acidification and eutrophication. It also explored national input data requirements for dynamic soil-vegetation models (Alterra/CCE 2007).

20. Eleven NFCs provided results using selected deposition scenarios from CCE. These included ecosystem-specific deposition (forest, (semi-)natural vegetation and grid average) for the period 1880–2010 for each grid cell. Deposition with CLE, MFR and natural background from 2020 onwards were made available.

21. Output was requested for the the deposition scenarios. It comprised the temporal development of critical indicators for acidification (e.g. base cation to aluminium ratio) and eutrophication.

22. The temporal development of nitrogen concentration in soil solution under different deposition scenarios was analysed. Nitrogen dynamics are complex and slow. It was possible to compute damage delay times due to the exceedance of the critical load of nitrogen. However, it was more difficult, with simple biogeochemical models, to model the mechanisms behind recovery delay times which bear relevance to air pollution policy.

23. CCE and the Centre for Integrated Assessment Modelling (CIAM) will collaborate in testing to extend the current critical loads database in the RAINS model with dynamic modelling data. The new national data on dynamic modelling form the basis for dynamic modelling of deposition scenarios, which would address recovery targets and which would be discussed by the Task Force on Integrated Assessment Modelling.

IV. NITROGEN CRITICAL LOADS IN NATURA 2000 AREAS

24. The seventeenth CCE workshop included a session focusing on methods of ICP Modelling and Mapping on Natura 2000 areas. This would further strengthen the implementation of critical load exceedance as an indicator for biodiversity loss. Specifically, the work under the EU project “Streamlining European biodiversity indicators for 2010” (SEBI2010), which determines the indicator for monitoring “threats on biodiversity” caused by nitrogen deposition, was presented.

25. With links to biodiversity policies in mind, the Task Force meeting of ICP Modelling and Mapping:

(a) Proposed further strengthening of the implementation of critical loads exceedance as an indicator for biodiversity loss (with SEBI2010) to underline the threat for biodiversity through nitrogen deposition;

(b) Sought the support of SEBI2010 in providing geographical and background information on Natura 2000 areas in Europe to CCE and NFCs for use in the effects-based activities, and would propose to the Working Group on Effects to consider raising this issue with the European Environment Agency (EEA) and/or Commission bodies, if necessary;

(c) Recommended the application of (empirical) critical loads on Natura 2000 sites to improve the relationship between exceedance and biological endpoints of the European Union nature legislation (the Habitats and Birds directives, http://ec.europa.eu/environment/nature);

(d) Encouraged NFCs to explore – together with counterparts in the national scientific/technical community affiliated with Natura 2000 areas – relationships between critical load exceedance, nitrogen impacts, and objectives set according to the Birds and/or Habitats directives;

(e) Would assist SEBI 2010 in delivering time trends on critical load exceedance both in the European nature conservation areas and Natura 2000 areas, using information from the proposed call for data in 2007;

(f) Would ask NFCs to submit national critical load data for the range of (protected) natural and semi-natural ecosystems and inform which critical loads could be regarded most relevant for the protection of biodiversity;

(g) Would explore possible ways to start quantifying the “amount of critical load exceedance” in terms of “risks of effects on biodiversity'”, i.e. to calculate the percentage of (protected) habitat types where critical loads are exceeded. The Task Force asked SEBI2010 for cooperation on this topic, since the research depended on how biodiversity itself was defined;

(h) Would asked SEBI 2010 to inform CCE about those national representatives who work with Natura 2000 and could be contacted by NFCs to obtain information on biodiversity targets in Natura 2000 areas;

(i) Would aim at more intensive collaboration with other ICPs and encouraged them to include Natura 2000 areas in their monitoring networks.

REFERENCES

Alterra/CCE (2007) De Vries W et al., Development in deriving critical limits and modelling critical loads of nitrogen for terrestrial ecosystems in Europe, Alterra-MNP/CCE report, Alterra report 1382 (available from CCE).

Achermann and Bobbink (2003) Empirical critical loads for nitrogen, Proceedings of an expert workshop. 11–13 November 2002 in Bern, Switzerland. SAEFL, Env. Doc.164.

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

Annex I

Provisional risk of N for vegetation and eutrophication (see explanations in text)

Country code	Empirical						Modelled					
	CLE-2010		CLE-2020		MFR-2020		CLE 2010		CLE 2020		MFR 2020	
	Protected area %	AAE eq ha^{-1} a^{-1}	Protected area %	AAE eq ha^{-1} a^{-1}	Protected area %	AAE eq ha^{-1} a^{-1}	Protected area %	AAE eq ha^{-1} a^{-1}	Protected area %	AAE eq ha^{-1} a^{-1}	Protected area %	AAE eq ha^{-1} a^{-1}
AL	27	152	27	156	100	0	6	315	8	243	67	19
AT	**65**	**49**	**87**	**20**	**99**	**1**	**4**	**272**	**20**	**158**	**95**	**8**
BA	43	75	52	49	100	0	0	647	0	545	18	62
BE	49	481	49	408	51	126	**57**	**78**	**77**	**32**	**100**	**0**
BG	**56**	**108**	**65**	**89**	**100**	**0**	**2**	**391**	**4**	**340**	**83**	**12**
BY	10	179	11	148	100	0	**38**	**261**	**41**	**240**	**78**	**49**
CH	**32**	**157**	**49**	**100**	**97**	**1**	**1**	**608**	**3**	**488**	**47**	**72**
CY	96	3	79	16	100	0	**39**	**88**	**24**	**139**	**80**	**9**
CZ	**7**	**262**	**33**	**126**	**93**	**6**	**1**	**553**	**4**	**390**	**55**	**63**
DE	**5**	**483**	**17**	**338**	**73**	**71**	**24**	**455**	**33**	**341**	**63**	**99**
DK	32	501	32	473	41	88	**13**	**618**	**14**	**576**	**42**	**120**
EE	98	1	97	1	100	0	**54**	**58**	**57**	**60**	**98**	**3**
ES	64	68	72	43	99	2	**19**	**259**	**27**	**207**	**65**	**28**
FI	92	11	95	4	100	0	**56**	**42**	**59**	**37**	**97**	**1**
FR	**37**	**180**	**48**	**122**	**93**	**5**	**3**	**453**	**5**	**363**	**58**	**63**
GB	**91**	**32**	**92**	**25**	**97**	**2**	**21**	**334**	**28**	**261**	**75**	**36**
GR	71	41	71	41	100	0	0	482	0	491	51	38
HR	33	197	34	149	100	0	**59**	**161**	**61**	**125**	**93**	**8**
HU	35	208	35	141	100	0	**9**	**262**	**25**	**178**	**90**	**10**
IE	**65**	**124**	**70**	**89**	**97**	**2**	**16**	**528**	**19**	**444**	**33**	**167**
IT	19	452	19	369	68	73	**99**	**2**	**99**	**2**	**100**	**0**
LT	22	174	22	148	100	0	**0**	**521**	**0**	**487**	**27**	**93**
LU	31	572	31	457	31	122	0	517	0	416	57	36
LV	82	12	86	9	100	0	**5**	**317**	**5**	**298**	**59**	**38**
MD	39	274	39	252	100	0	**100**	**0**	**100**	**0**	**100**	**0**
MK	46	99	48	85	100	0	0	645	0	572	20	74
NL	**8**	**1217**	**10**	**1095**	**25**	**488**	**11**	**1170**	**12**	**1049**	**28**	**460**
NO	**99**	**1**	**99**	**1**	**100**	**0**	**98**	**2**	**98**	**1**	**100**	**0**
PL	**1**	**255**	**3**	**149**	**100**	**0**	**12**	**504**	**17**	**410**	**55**	**73**
PT	85	16	93	7	100	0	67	68	68	62	94	3
RO	22	270	22	216	96	1	0	784	0	744	5	137
RU[1]							**65**	**51**	**65**	**54**	**99**	**2**
SE	88	15	92	9	100	0	**88**	**14**	**89**	**12**	**96**	**2**
SI	**71**	**42**	**88**	**17**	**100**	**0**	0	818	0	800	5	85
SK	12	218	19	114	97	0	**1**	**380**	**6**	**257**	**85**	**15**
TR	98	2	96	6	100	0						
UA	1	373	1	328	100	0	27	93	28	89	99	0
YU	60	40	74	26	100	0	78	14	83	12	100	0
EU25	58	139	63	98	94	13	47	202	50	163	81	28
EU27	56	147	61	106	94	12	44	230	47	190	79	31
EU	67	102	70	77	96	8	58	131	59	114	89	15

Numbers in bold are based on data submissions from NFCs.

[1] Russian background land cover database in preparation.

Annex II

Provisional risk of acidification (see explanations in text)

Country code	CLE-2010		CLE-2020		MFR-2020	
	Protected area %	AAE eq ha^{-1} a^{-1}	Protected area %	AAE eq ha^{-1} a^{-1}	Protected area %	AAE eq ha^{-1} a^{-1}
AL	100	0	100	0	100	0
AT	**100**	**0**	**100**	**0**	**100**	**0**
BA	100	0	100	0	100	0
BE	**97**	**12**	**98**	**4**	**100**	**0**
BG	**100**	**0**	**100**	**0**	**100**	**0**
BY	**52**	**189**	**64**	**121**	**96**	**3**
CH	**93**	**29**	**94**	**20**	**99**	**1**
CY	**100**	**0**	**100**	**0**	**100**	**0**
CZ	**52**	**193**	**76**	**67**	**98**	**3**
DE	**41**	**364**	**53**	**227**	**83**	**44**
DK	**89**	**18**	**92**	**15**	**100**	**1**
EE	**100**	**0**	**100**	**0**	**100**	**0**
ES	**100**	**0**	**100**	**0**	**100**	**0**
FI	**99**	**2**	**99**	**2**	**100**	**0**
FR	**92**	**24**	**95**	**16**	**100**	**0**
GB	**86**	**46**	**91**	**28**	**98**	**3**
GR	100	0	100	0	100	0
HR	**100**	**0**	**100**	**0**	**100**	**0**
HU	**100**	**0**	**100**	**0**	**100**	**0**
IE	**90**	**23**	**94**	**13**	**99**	**0**
IT	**100**	**0**	**100**	**0**	**100**	**0**
LT	**39**	**290**	**44**	**197**	**86**	**13**
LU	81	116	87	53	100	0
LV	**100**	**0**	**100**	**0**	**100**	**0**
MD	**97**	**10**	**97**	**5**	**100**	**0**
MK	94	18	98	2	100	0
NL	**21**	**1594**	**22**	**1433**	**33**	**606**
NO	**88**	**27**	**89**	**22**	**96**	**5**
PL	**36**	**364**	**55**	**155**	**100**	**1**
PT	98	2	99	1	100	0
RO	72	150	80	84	100	0
RU	**99**	**2**	**99**	**1**	**100**	**0**
SE	**87**	**16**	**90**	**12**	**99**	**0**
SI	100	0	100	0	100	0
SK	**86**	**67**	**91**	**26**	**100**	**0**
UA	97	2	98	0	100	0
YU	90	3	97	1	100	0
EU25	86	71	90	41	98	6
EU27	86	72	90	41	98	5
EU	92	34	94	20	99	3

Numbers in bold are based on data submissions from NFCs.