Für Mensch & Umwelt

Umwelt Bundesamt

54th session of the Task Force on Integrated Assessment Modelling, 3 – 4 April 2025

ICP M&M contribution to assess ecosystem effects (biodiversity) in the GP revision

Markus Geupel, Wiebke Galert, Thomas Scheuschner

UNECE

Convention on Long-range Transboundary Air Pollution

Outline

1 EMPIRICAL CRITICAL LOADS

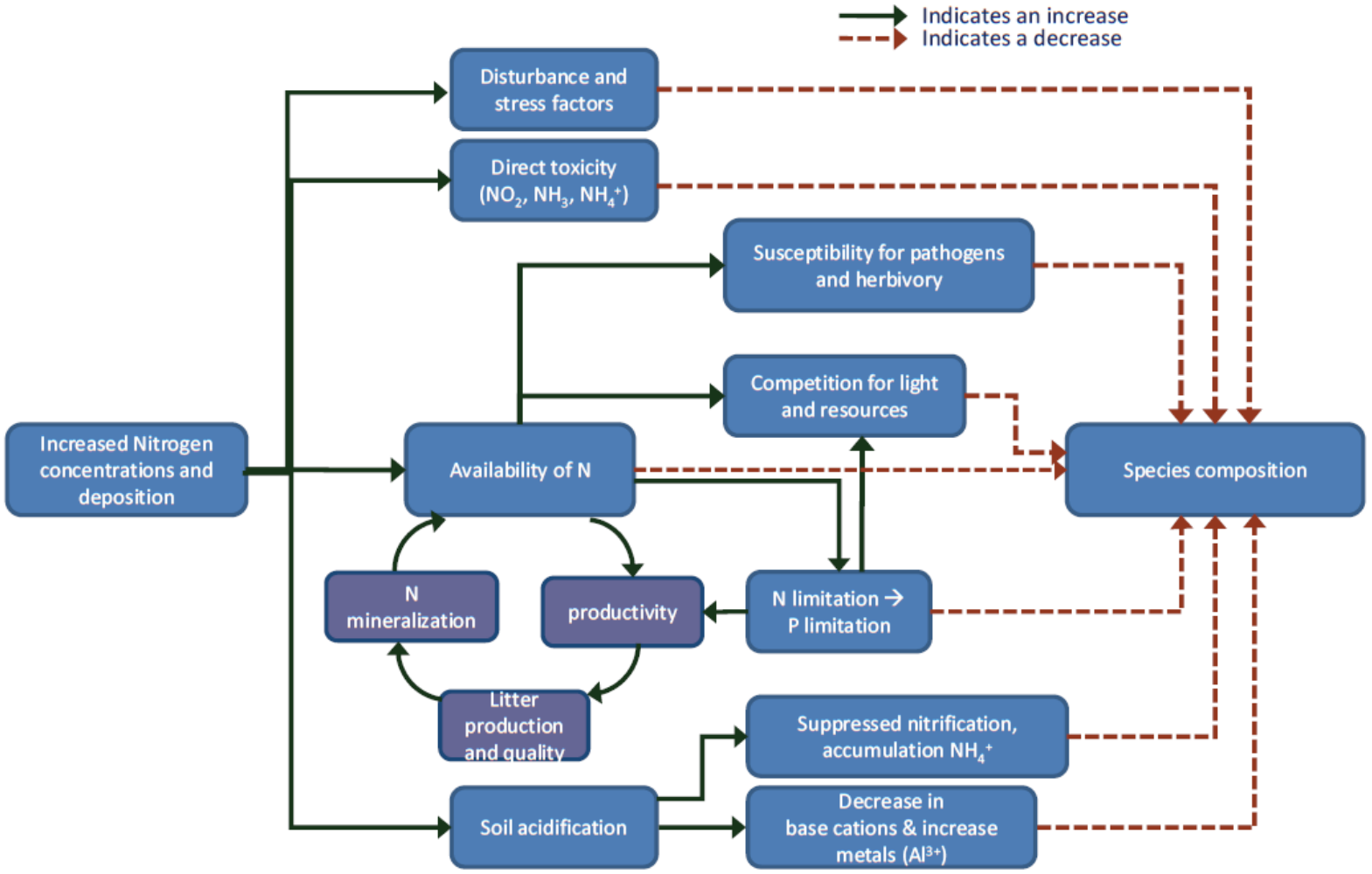
2 DATA DELIVERY TO CIAM IN 2024

3 COLLABORATION WITHIN ICP MODELLING & MAPPING

4 COMPARISON BETWEEN CL_{MIN} AND CL_{NFC} DATASETS

5 SUMMARY & PROPOSAL

Background: Nitrogenous air pollution affects biodiversity



Bobbink et al. (2022) Review and revision of empirical critical loads of nitrogen for Europe

Review 2022: Indication of exceedance relate to changes in biodiversity

$CL_{emp}N$ ranges recommended for in total 51 ecosystems

Recommended ecosystem specific $CL_{emp}N$ values are in the range between 2- 30 kg N ha^{-1} a^{-1}

In nearly all of the ecosystems the indication of exceedance of the recommended $CL_{emp}N$ value is related to biodiversity:

- Change in plant species richness
- Change in plant species composition
- Decrease in oligotrophic species
- Increase in productivity species
- Decline of typical species
- Decline in diversity

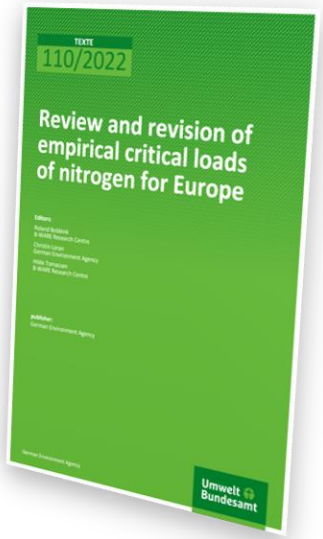


Table 5.1. **$CL_{emp}N$ and effects of exceedances on surface standing water habitats (C1)[a]. ## reliable, # quite reliable, and (#) expert judgement. Changes with respect to 2011 are indicated as values in bold.**

Ecosystem type	EUNIS code	2011 kg N ha^{-1} yr^{-1}	2011 reliability	2022 kg N ha^{-1} yr^{-1}	2022 reliability	Indication of exceedance
Permanent oligotrophic lakes, ponds and pools (including soft-water lakes)	C1.1	3-10	##	**2**-10 [b]	##	Increased algal productivity and a shift in nutrient limitation of phytoplankton from N to P; shifts in macrophyte community
Alpine and sub-Arctic clear-water lakes	C1.1			**2-4**	**##**	Increased algal productivity and a shift in nutrient limitation of phytoplankton from N to P
Boreal clear-water lakes	C1.1			**3-6**	**##**	Increased algal productivity and a shift in nutrient limitation of phytoplankton from N to P
Atlantic soft-water bodies	C1.1, elements C1.2	3-10	##	**5**-10	##	Change in species composition of macrophyte communities
Permanent dystrophic lakes, ponds and pools	C1.4	3-10	(#)	**5**-10 [c]	(#)	Increased algal productivity and a shift in nutrient limitation of phytoplankton from N to P

Review and revision of empirical critical loads of nitrogen for Europe | Umweltbundesamt

Critical Load ranges

- account for ecosystem variability and experiment specific conditions
  - Site-specific abiotic conditions (Soil, climate, management etc.)
  - differences between treatment concentrations during experiments;
  - Site-specific uncertainties (e.g. deposition)
- By using the minimum value for each ecosystem type, the largest sensitivity of biodiversity towards nitrogen deposition across the UNECE region is accounted for.
- This guarantees in principle highest precaution and protection of the biodiversity of European ecosystems.
- For national/local application, table:
- As there is no consensus on how to quantify the modifying factors for broad regional scale it is proposed to use the minimum value of the ranges of CLempN in each EUNIS class.

Table 11.2. **Suggestions to apply lower, middle or upper parts of the set critical load ranges for terrestrial ecosystems (excluding wetlands), if national data are insufficient.**

	Temperature/ frost period	Soil wetness	Base cation availability	Management intensity
Action				
Move to lower part	COLD/LONG	DRY	LOW	LOW
Use middle part	INTERMED	NORMAL	INTERMED	USUAL
Move to higher part	HOT/NONE	WET	HIGH	HIGH

Empirical Critical Loads in/for nature policies

- N2000 directive & Nature Restauration law don’t make direct references to (Empirical) Critical Loads and air pollution
- CLemp are many times part of national guidelines for project licensing (UK, NL, DE)
- ClempN Report summarizes in chapter 10 links to biodiversity policies and gives recommendations to improve links
- Min end of the range in line with the precautionary principle of N2000 directive
- However, this doesn‘t mean, that if a country selects e.g. the average, that this would not be in line with nature policies (my personal view!)

$CL_{emp}N$ delivery to CIAM in march 2024

ID	Ecosystem type	EUNIS_group	EUNIS_code	CLempN	CLempN_min	CLempN_avg	CLempN_max	reliability
1	Atlantic upper-mid salt marshes	MA	MA223	10-20	10	15	20	(#)
2	Atlantic mid-low salt marshes	MA	MA224	10-20	10	15	20	(#)
3	Atlantic pioneer salt marshes	MA						
4	Shifting coastal dunes	N						
5	Shifting coastal dunes	N						
6	Coastal dune grasslands (grey dunes)	N						
7	Coastal dune heaths	N						
8	Coastal dune heaths	N						
9	Moist and wet dune slacks	N						
10	Dune-slack pools (freshwater aquatic cor	N						
11	Dune-slack pools (freshwater aquatic cor	N						
12	Permanent oligotrophic lakes, ponds anc	C						
13	Alpine and sub-Arctic clear water lakes	C						
14	Boreal clear water lakes	C						
15	Atlantic soft water bodies	C						
16	Permanent dystrophic lakes, ponds and p	C						
17	Raised and blanket bogs	Q						
18	Valley mires, poor fens and transition mi	Q						
19	Palsa and polygon mires	Q						
20	Rich fens	Q						
21	Rich fens	Q						
22	Rich fens	Q						
23	Rich fens	Q						
24	Arctic-alpine rich fens	Q						
25	Semi-dry Perennial calcareous grassland	R						
26	Mediterranean closely grazed dry grassla	R						
27	Mediterranean tall perennial dry grassla	R						
28	Mediterranean annual-rich dry grassland	R						
29	Lowland to montane, dry to mesic grassl	R						
30	Oceanic to subcontinental inland sand gr	R						
31	Inland sanddrift and dune with siliceous	R						

ID	lon	lat	EUNIS_code	ecoarea_km2	CLempN_min	CLempN_max	CC
AD_165911	1,45	42,45	R1E				
AD_165914	1,45	42,45	R43				
AD_165916	1,45	42,45	S2				
AD_165918	1,45	42,45	S2				
AD_165922	1,45	42,45	T17				
AD_165924	1,45	42,45	T1				
AD_165926	1,45	42,45	T1E				
AD_165928	1,45	42,45	T32				
AD_165930	1,45	42,45	T3				
AD_165932	1,45	42,45	T37				
AD_165934	1,45	42,45	T3A				
AD_165937	1,55	42,45	R43				
AD_165939	1,55	42,45	S2				
AD_165942	1,55	42,45	T17				
AD_165944	1,55	42,45	T1				
AD_165946	1,55	42,45	T1E				
AD_165947	1,55	42,45	T32				
AD_165949	1,55	42,45	T33				
AD_165950	1,55	42,45	T3				
AD_165952	1,55	42,45	T37				
AD_165954	1,55	42,45	T3A				
AD_165958	1,65	42,45	R43				
AD_165960	1,65	42,45	S2				
AD_165964	1,65	42,45	T1				
AD_165966	1,65	42,45	T32				
AD_165968	1,65	42,45	T3				
AD_165970	1,65	42,45	T37				
AD_165974	1,75	42,45	R43				
AD_165977	1,75	42,45	S2				
AD_165987	1,75	42,45	T3				

Datensatz: 35 von 1431759

Data delivery to IIASA/CIAM: Documentation

Version 18 March 2024

Coordination Centre for Effects (CCE)

1. Background

This document contains the documentation about the data delivery of updated of empirical critical loads ($CL_{emp}N$) on basis of the most recent receptor data and report of empirical Critical Load. (to fill with more content if needed)

For data delivery plain text files (e.g. *.csv, *.txt) are used.

2. Documentation and other general information

For further information please contact cce@uba.de.

3. The grid system (to do: update if needed)

A critical load site is the part of an ecosystem that lies entirely in a single **0.10°×0.10° Longitude- Latitude grid cell**. A grid cell is referred to by its centroid grid coordinates in decimal degrees.

4. Data format

The deliverd tables are in plain text files (e.g. *.csv, *.txt). Following tables will be provided separately.

CLempN – Empirical critical loads, with additional information.
To do: Include other tables?

Table 1. Attributes of the database-table '*CLempN*'

Variable	Explanation	Note
ID	Unique(!) identifier of the site	1)
Lon	Longitude (decimal degrees)	2)
Lat	Latitude (decimal degrees)	2)
Ecoarea_km2	Area of the ecosystem within the grid cell (km^2)	3)
EUNIS_code	EUNIS code, max. 6 characters	4)
CLempN_min	Empirical critical load of nitrogen (kg ha^{-1} a^{-1})	
CLempN_max	Empirical critical load of nitrogen (kg ha^{-1} a^{-1})	
CC	Country code according to ISO 3166-1 alpha-2	5)

Notes on Table 1 (see last column):

1) Assigned by CCE includes the country code;
2) The geographical coordinates of the site or a reference point of the polygon (sub-grid) of the receptor

Meetings CIAM/CCE in 2024:

- February, March, June 24

Documentation:

- In preparation in collaboration between CIAM & CCE

Data:

- 48 EUNIS classes
- Min, (avg), max values
- Mapped with the CCE receptor map consistantly incl. EECCA and Turkey

NFC Data for policy support

- Historically, national data supplies and cooperation between the parties have always been very important

- In the 2012 revision of the GP NFC Critical Load data were part of the database submitted to CIAM for use in IAM (see CCE Status report 2011)

- Two Call-for-datas to ICP M&M NFC on
    1. application of CLempN to national territories
    2. Modelling of SMB/steady State CL for Eutrophication and acidification

- Discussions at 40th (Oslo, April 2024) and 41st (Helsinki, Feb 2025) ICP M&M meeting
    - ➢ it has been shown that national data can be significantly different and more reliable (and sometime more precautionary although not always), than data gap-filled by CCE.
    - ➢ most NFC expressed wish to see NFC data included in policy-relevant dataset
    - ➢ ICP M&M Task Force concluded to recommend use of $CLemp_{NFC}$ in IAM

Call for Data 2023 – 2024

Call_for_Data_2023.pdf .pdf-Datei | Instructions_CfD_2023.pdf .pdf-Datei

Dear National Focal Centers of the ICP Modelling & Mapping (ICP M&M) of Critical Loads & Levels and Air Pollution Effects, Risks and Trends,

The International Co-operative Program on Modelling and Mapping (ICP M&M) is pleased to invite you to participate in the Call for Data (CfD) 2023 on empirical Critical Loads, which has been agreed at the 38th meeting of the ICP Modelling and Mapping Task Force along with the 29th meeting of the Coordination Centre for Effects on 3–5 May 2022.

The main objective of this Call for Data is to implement the recently reviewed and updated empirical Critical Load and to prepare a future item in the WGE/EMEP workplan 2024-2025 on applying next risk assessment including the $CL_{emp}N$.

The proposed deadline for the data delivery is the end of March 2024.

Please, find attached the official Call for Data, i.e. the information on the envisaged process to plan your activities and resources until then, as well as the instructions to reply to the call.

Any contribution shall be sent to cce@uba.de (cc alice.james@ineris.fr)

Best regards,

Alice James Casas, as the Chair of the ICP M&M
Markus Geupel, on behalf of the Coordination Center for Effects (CCE)

Alice James Casas
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UNECE Air Convention Working Group on Effects - Critical Loads & Levels

Call for Data | Umweltbundesamt

Table 1. Attributes of the database-table '*ecords*'

Variable	Explanation	Note
SiteID	Unique(!) identifier of the site	1)
Lon	Longitude (decimal degrees)	2)
Lat	Latitude (decimal degrees)	2)
EcoArea	Area of the ecosystem within the grid cell (km^2)	3)
Protection	0: No specific nature protection applies 1: Special Protection Area (SPA), Birds Directive applies 2: Special Area of Conservation (SAC), Habitats Directive applies 3: SPA *and* SAC (1 *and* 2) 4: SPA *or* SAC (1 *or* 2) [don't know which one(s)] 9: A national nature protection program applies (but *not* 1 to 4!) -1: protection status unknown	
EUNIScode	EUNIS code, max. 6 characters	4)

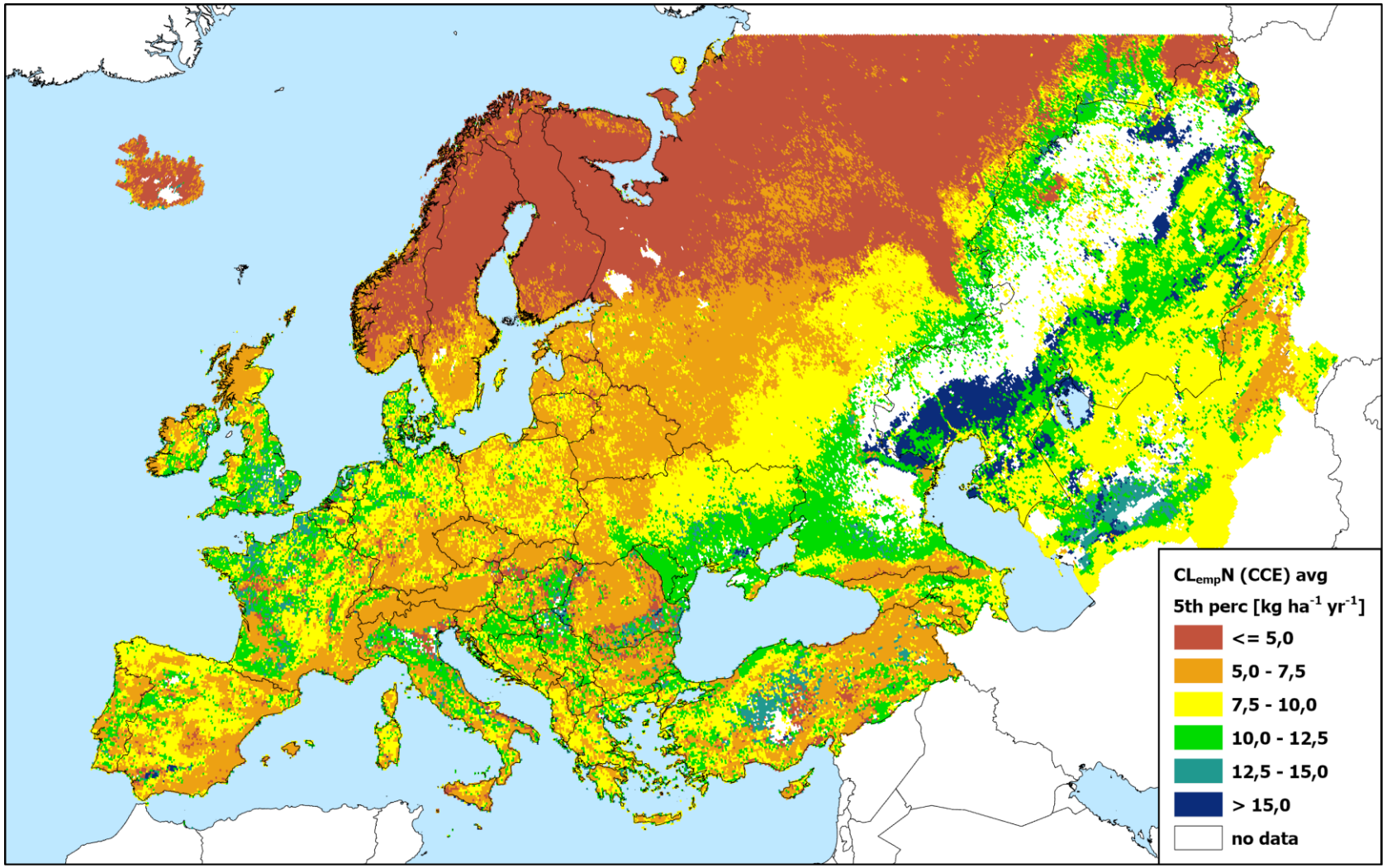
Notes on Table 1 (see last column):

1) Use integer values only (4-bytes)!
2) The geographical coordinates of the site or a reference point of the polygon (sub-grid) of the receptor under consideration (in decimal degrees, i.e. 48.533 for 48º31', etc.);
3) Please don't submit spurious records with an ecosystem area smaller than 0.1 ha, unless it has relevance other than for exceedance calculations (e.g. Natura 2000 sites). Furthermore, make sure that the total ecosystem area does not exceed the size of the land area of your country in the respective grid cell;
4) You can find information on EUNIS at https://eunis.eea.europa.eu/habitats-code-browser-revised.jsp

Table 2. Attributes of the database-table '*CLempN*'

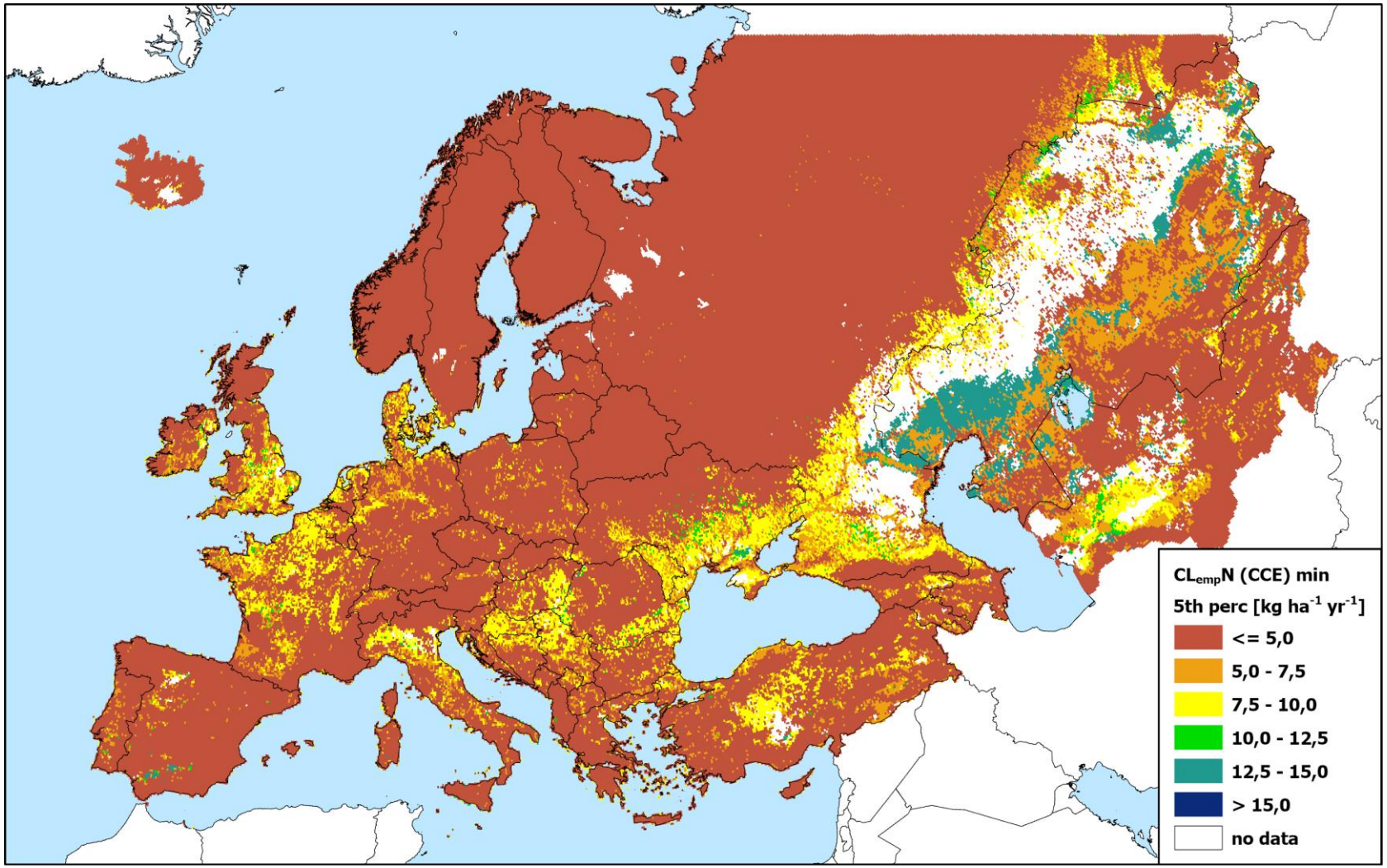
Variable	Explanation	Note
SiteID	Identifier of the site (see *ecords* Table)	
CLempN	Empirical critical load of nitrogen (eq ha^{-1} a^{-1})	
Derivation	1: Minimum value of the range 2: Maximum value of the range 3: Mean value of the range 4: Another method	
CLempN_ID	Link to the CLempN table provided by CCE (Integer)	1)

Visual comparison CL maps



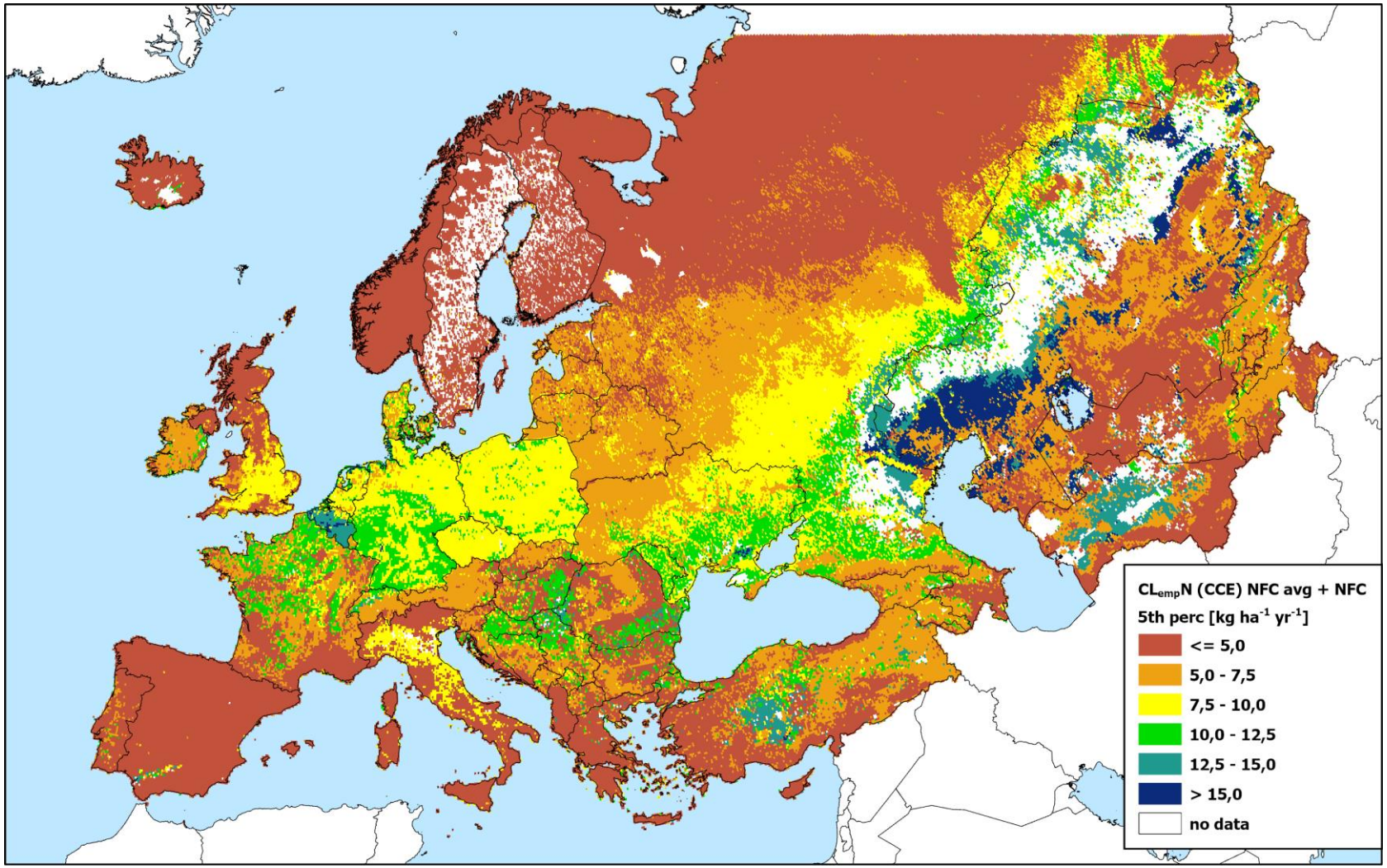
CLemp CCE avg 5th percentile

Visual comparison CL maps



CLemp CCE min
5th percentile

Visual comparison CL maps



CLemp NFC + NFC_{avg} 5th percentile

NFC data for:
BE, CH, CZ, DE, ES, FI, IT, NL, NO, PL, SE and UK

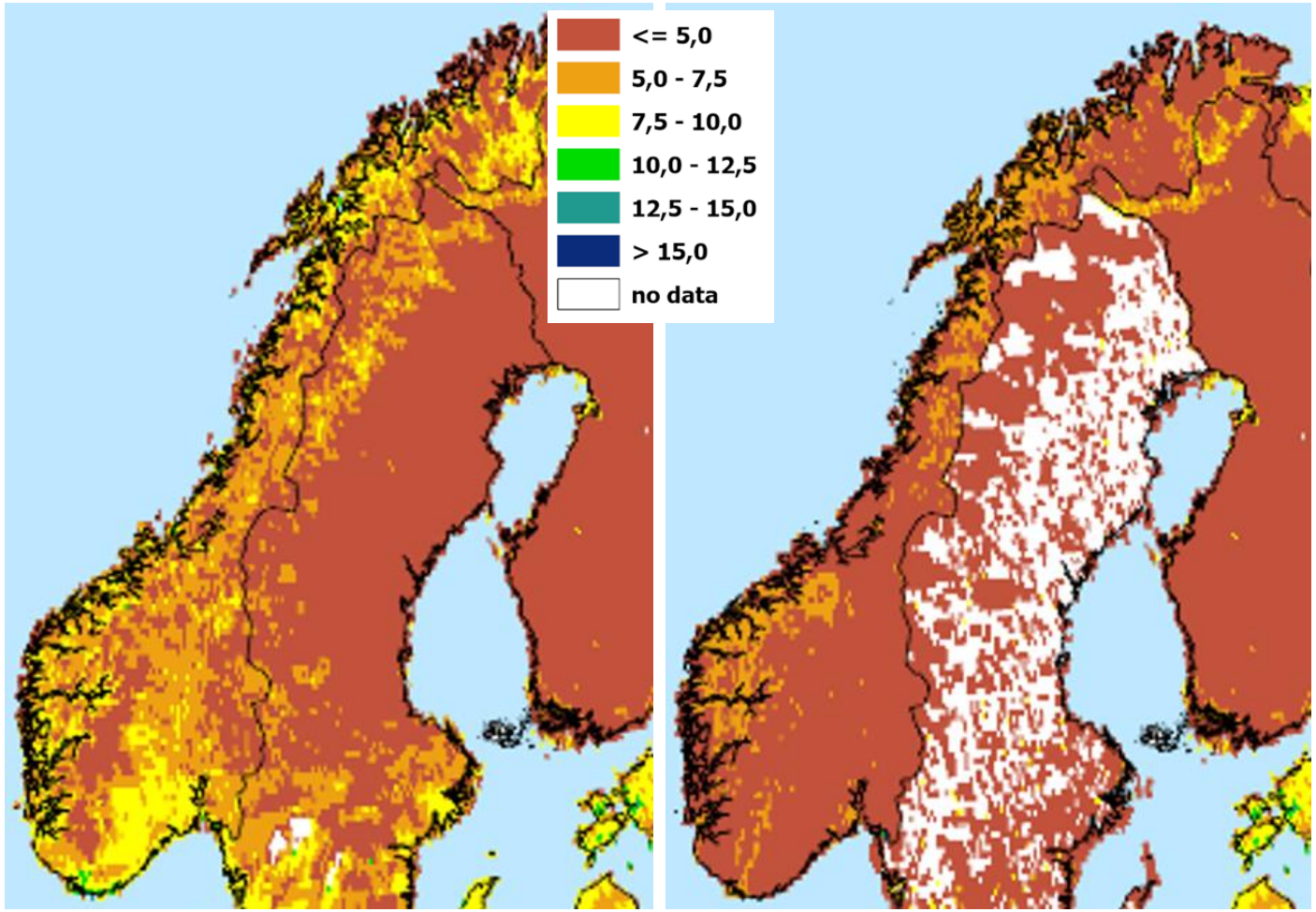
All other countries:
Gap-filled by CCE with the average of NFC-delivery

Comparison between Cl_{min} and CL_{nFC} datasets: Clemp ranges / NFC values (examples)

NFC data

ID	Ecosystem type	EUNIS_ group	EUNIS_ code	CLemp N	CLemp N_min	CLempN_ avg	CLemp N_max	CLempN_ NFC_avg	NFC1	NFC2	NFC3	NFC4	NFC5	NFC6
1	Atlantic upper-mid salt marshes	MA	MA223	10-20	10	15	20	15,0	20		15	20		10
...	...													
9	Moist and wet dune slacks	N	N1H	5-15	5	10	15	13,3	20			15		
...	...													
11	Dune-slack pools	N	N1J1	10-20	10	15	20	10						
...	...													
14	Boreal clear water lakes	C	C1.1	3-6	3	4,5	6	3,8	6				3	3
15	Atlantic soft water bodies	C	C1.2	5-10	5	7,5	10	5,0	7					3
...	...													
18	Valley mires, poor fens and transition mires	Q	Q2	5-15	5	10	15	8,0	13	11	10	8	5	5
...	...													
22	Rich fens	Q	Q43	15-25	15	20	25	15,2	16	20	20			5
23	Rich fens	Q	Q44	15-25	15	20	25	5,0						5
24	Arctic-alpine rich fens	Q	Q45	15-25	15	20	25	16,7				#		
25	Semi-dry Perennial calcareous grassland (basic meadow steppe)	R	R1A	10-20	10	15	20	13,6	20	15	15	15		4
...	...													
29	Lowland to montane, dry to mesic grassland usually dominated by Nardus stricta	R	R1M	6-10	6	8	10	7,3	10		8	10		5
30	Oceanic to subcontinental inland sand grassland on dry acid and neutral soils	R	R1P	5-15	5	10	15	7,9	15		10	10	5	5
...														
32	Low and medium altitude hay meadows	R	R22	10-20	10	15	20	13,6	19		15	# 22		8
33	Mountain hay meadows	R	R23	10-15	10	12,5	15	10,8		12,5	12,5	#		8
...	...													
38	Arctic-alpine calcareous grassland	R	R44	5-10	5	7,5	10	7,5		10	7,5			
39	Tundra	S	S1	3-5	3	4	5	3						
...	...													
44	Dry heaths	S	S42	5 -15	5	10	15	7,4	10		10	5	10	5
45	Maquis, arborescent matorral and thermo- Mediterranean scrub	S	S5	5-15	5	10	15	5,0						
...	...													
47	Broadleaved deciduous forest	T	T1	10-15	10	12,5	15	12,3	21		12,5	#	10	
48	Fagus forest on non-acid and acid soils	T	T17	10-15	10	12,5	15	10,5	15		15	#		3
49	Fagus forest on non-acid and acid soils	T	T18	10-15	10	12,5	15	11,2	15		15	13		3
...	...													
60	Mediterranean lowland to submontane Pinus forest	T	T3A	5-17	5	11	17	5,0				5		
61	Dark taiga	T	T3F	3-5	3	4	5	3,7					3	5
62	Pinus sylvestris light taiga	T	T3G	2-5	2	3,5	5	3,0					2	5

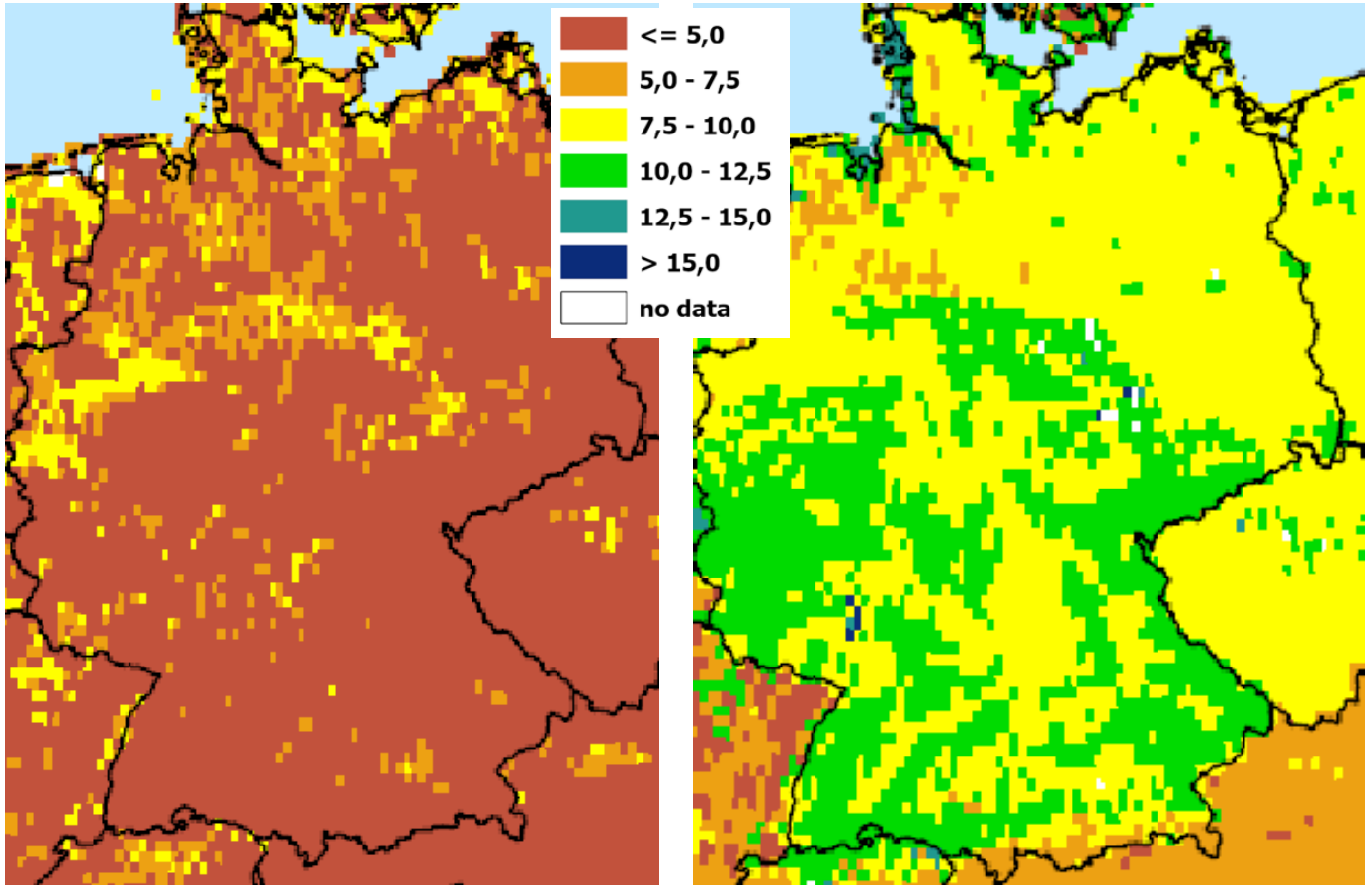
Zoom into country-data examples: Norway gets more sensitiv



Clemp NFC (right)
vs
$Clemp_{min}$ CCE (left)
area weighted average

- National receptor map
- Applying minimum $CL_{emp}N$ (cold climate, and nutrient-poor soils + precautionary)
- Expert judgement where $CL_{emp}N$ not defined
- Main differences
  - Coniferous forest (Dark Taiga)
  - Deciduous forest (Betula forests)

Zoom into country-data examples: Germany gets less sensitive



Clemp NFC (right)
vs
$Clemp_{min}$ CCE (left)
5th percentile

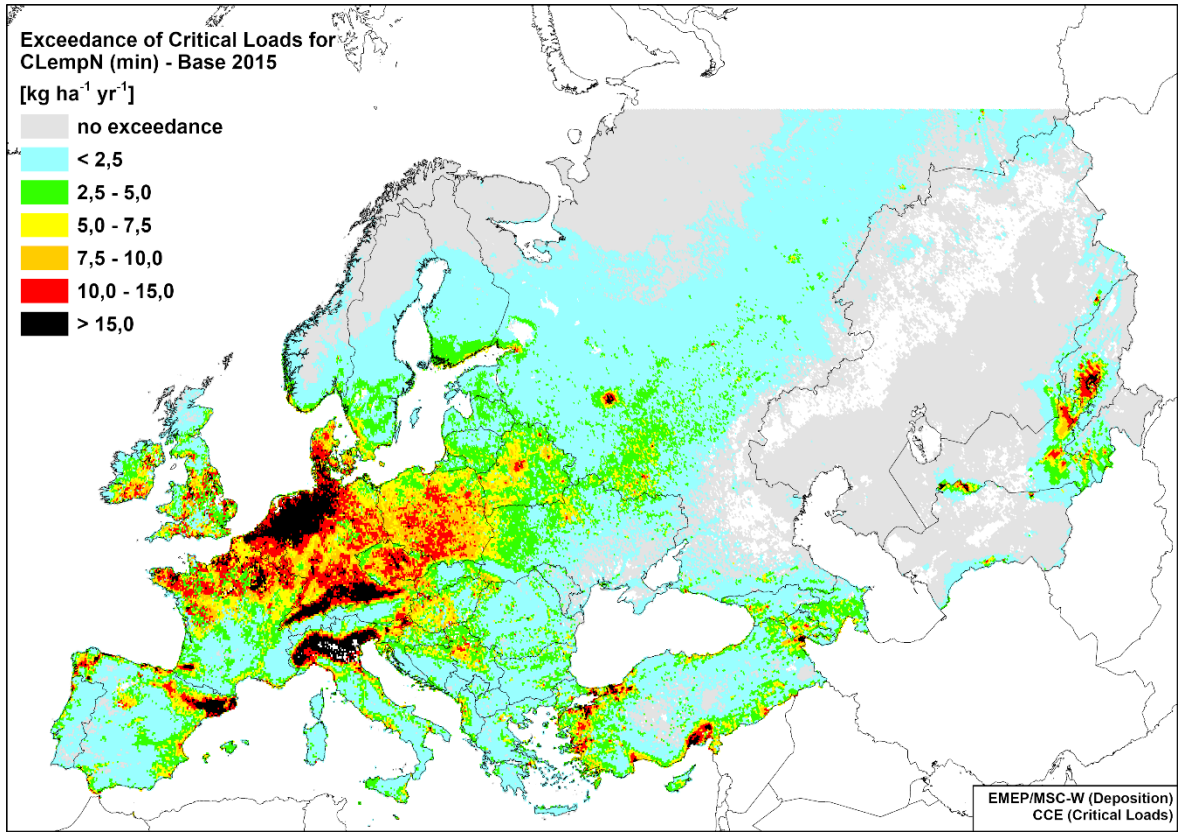
- For all EUNIS class mid-point of the range
- To cope with uncertainties
- Fits well with modelled CL

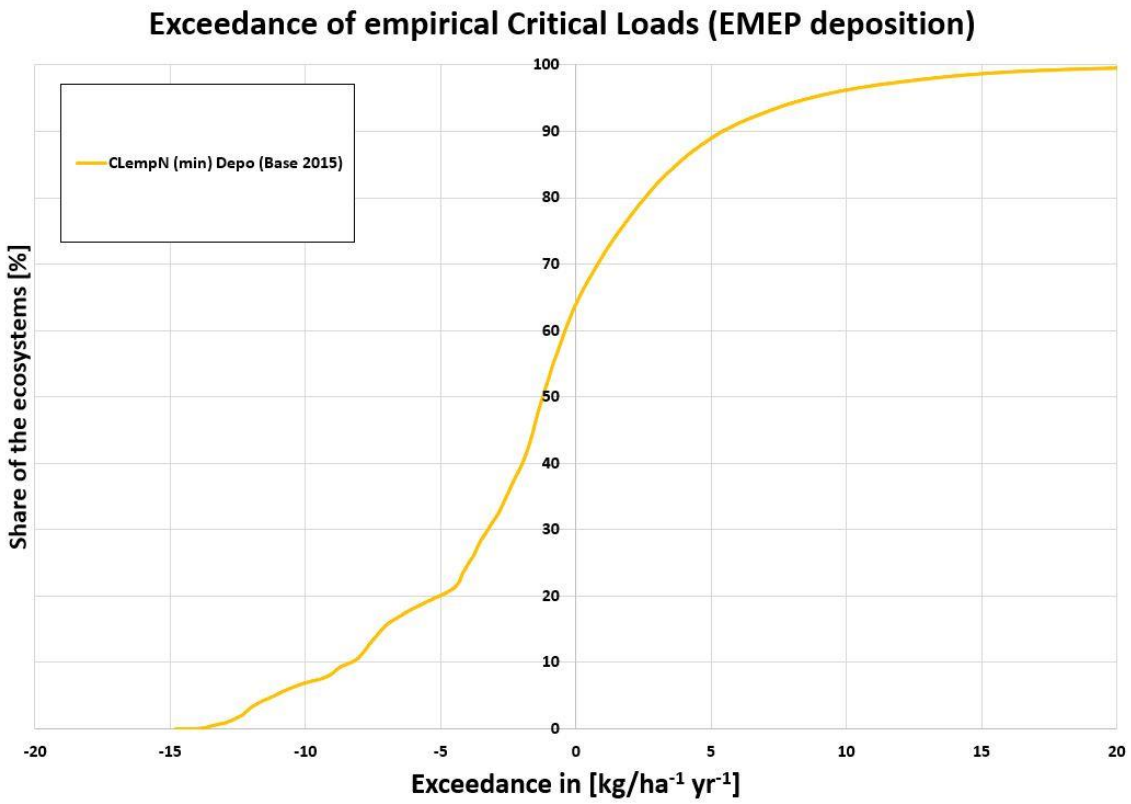
Technical differences / difficulties

- NFC didn‘t stick to generic Bobbink 48 EUNIS classes ($CLemp_{min}$) but provided data also for other EUNIS subdivisions (~ 300 classes)
- NFC not always were explicit, no clear assignment to one EUNIS class
- EUNIS class specific gap-closure will be difficult
- Grouping to „forests“ „semi-natural“ or „waters“ is possible

Visual and quantitativ comparison of exceedance data

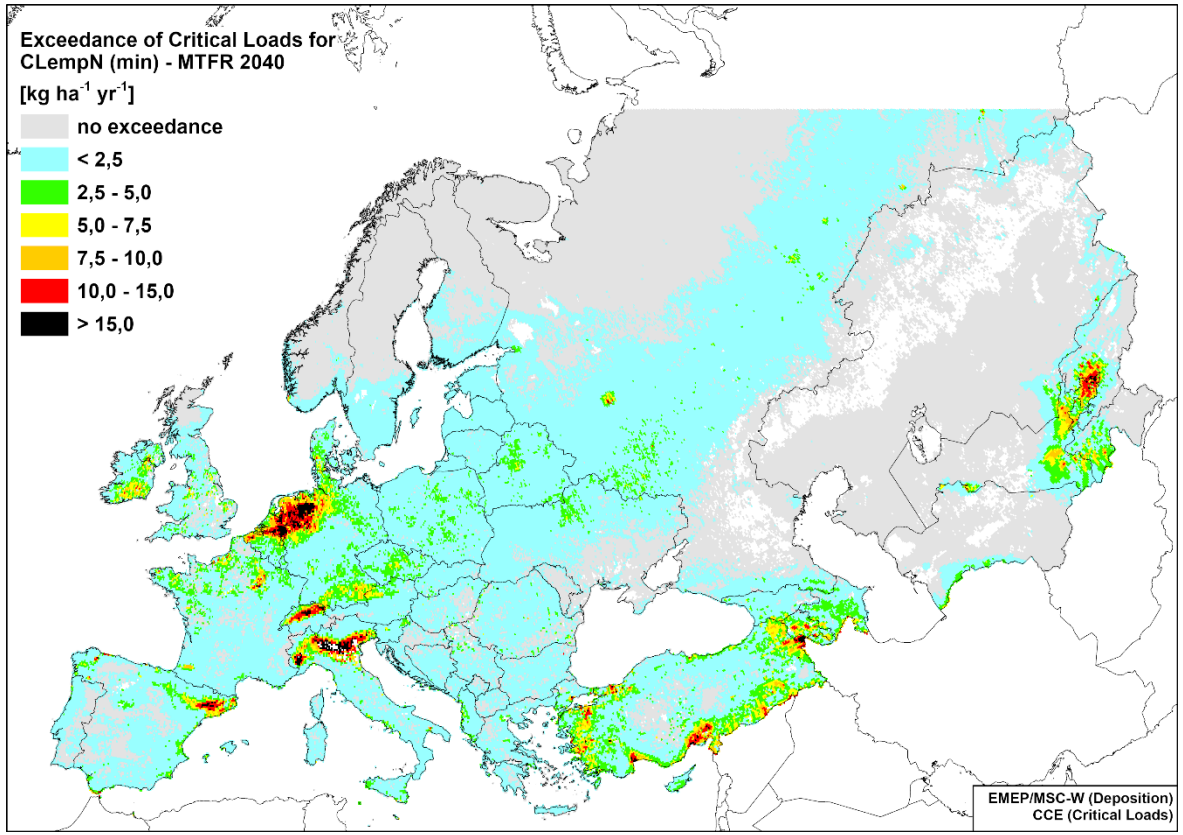
CLemp CCE min & MSC-W Baseline 2015

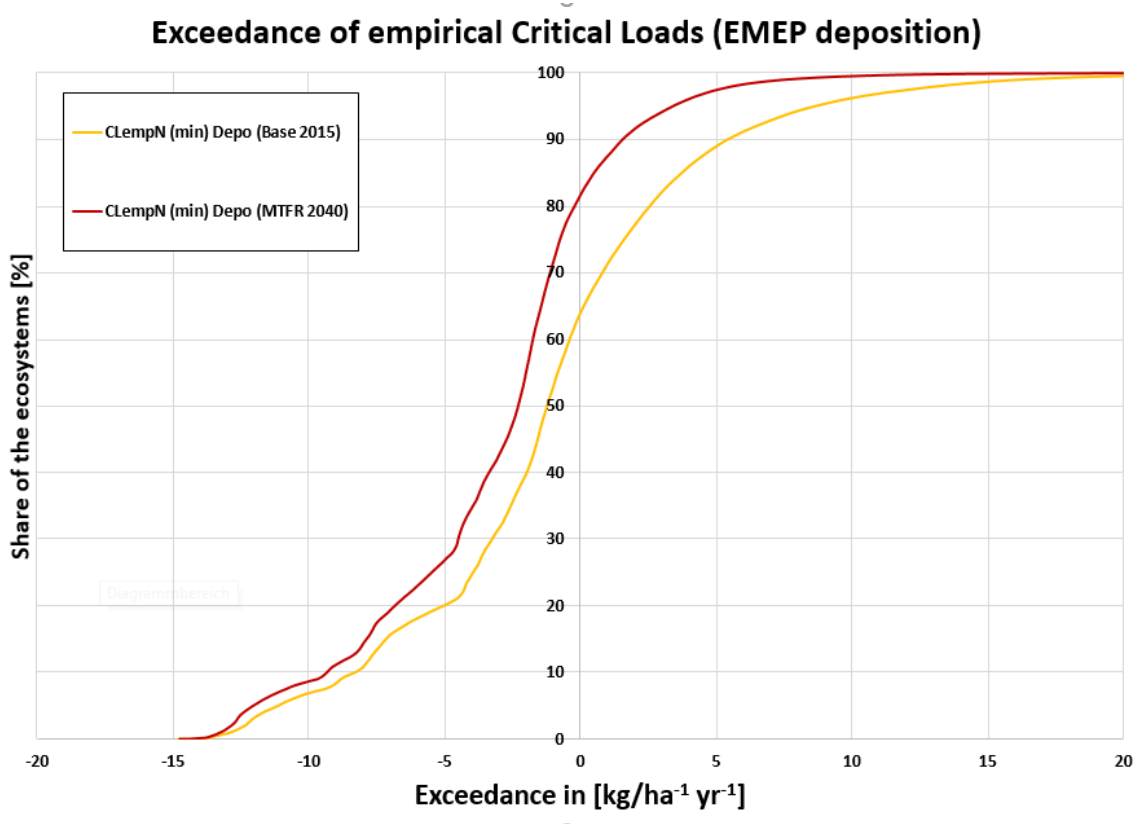




Visual and quantitativ comparison of exceedance data

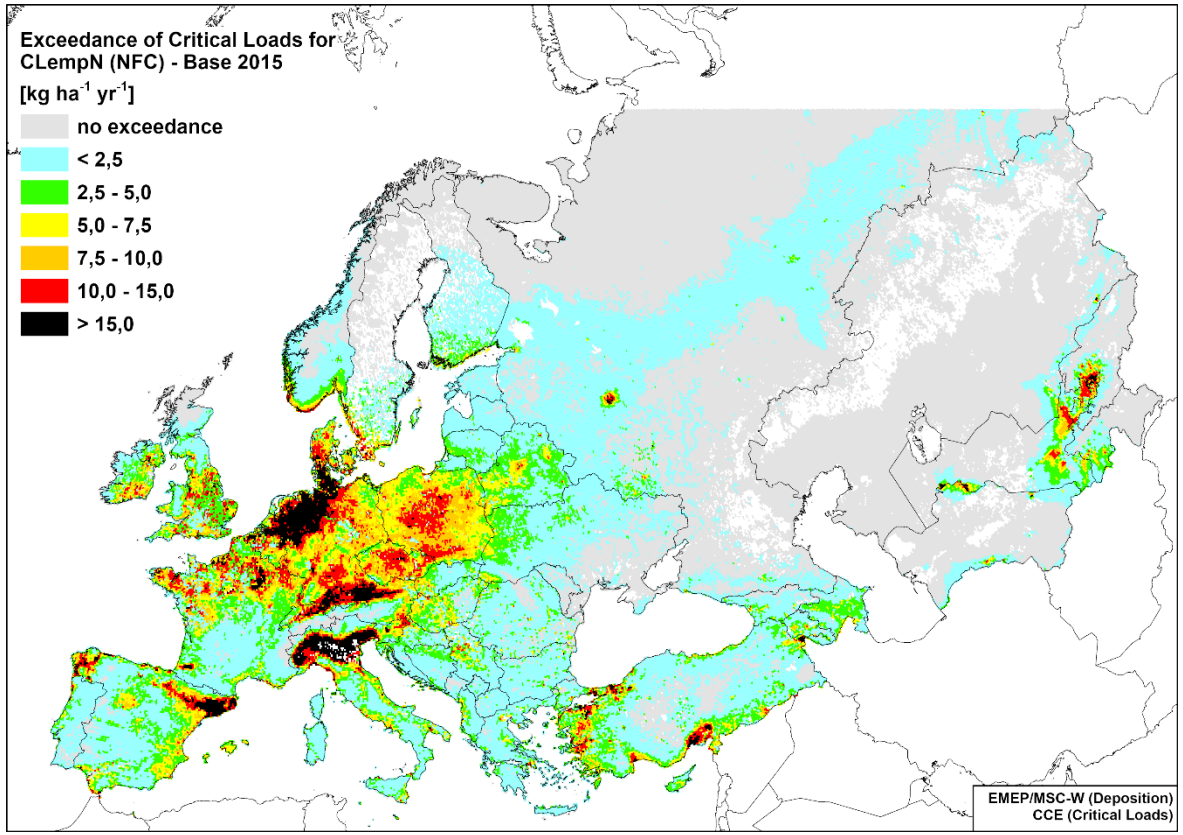
CLemp CCE min & MSC-W MTFR 2040

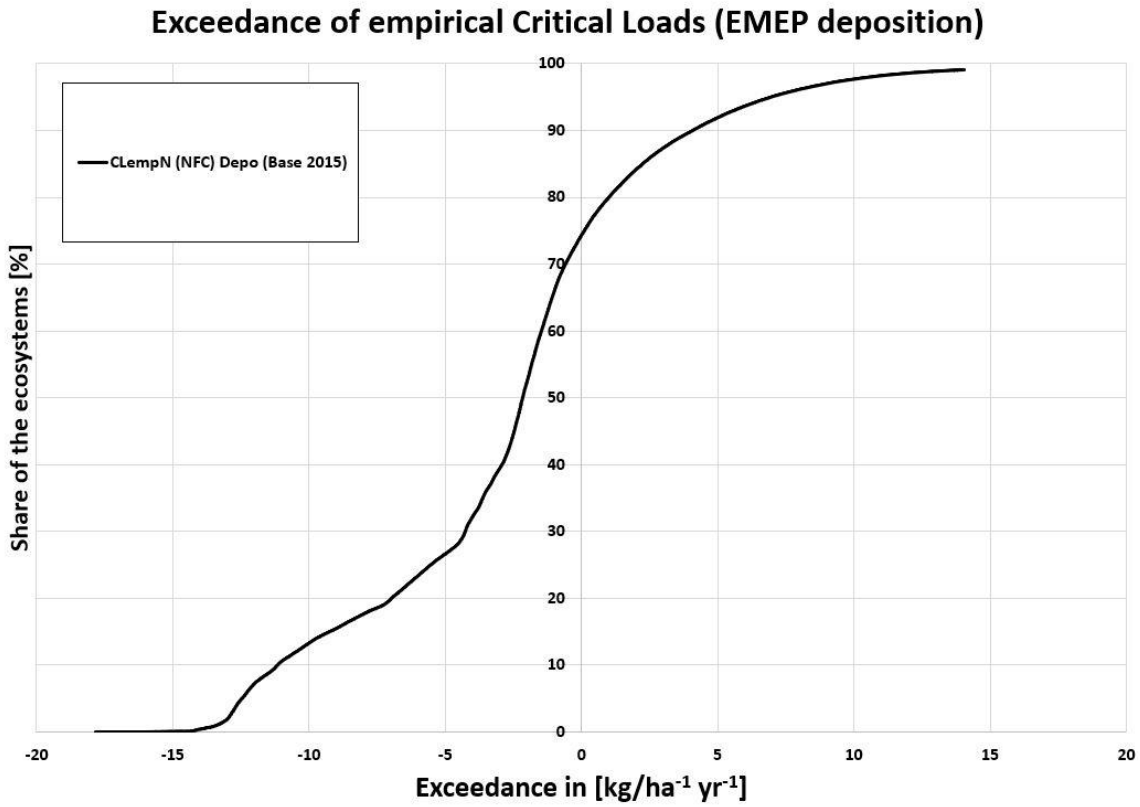




Visual and quantitativ comparison of exceedance data

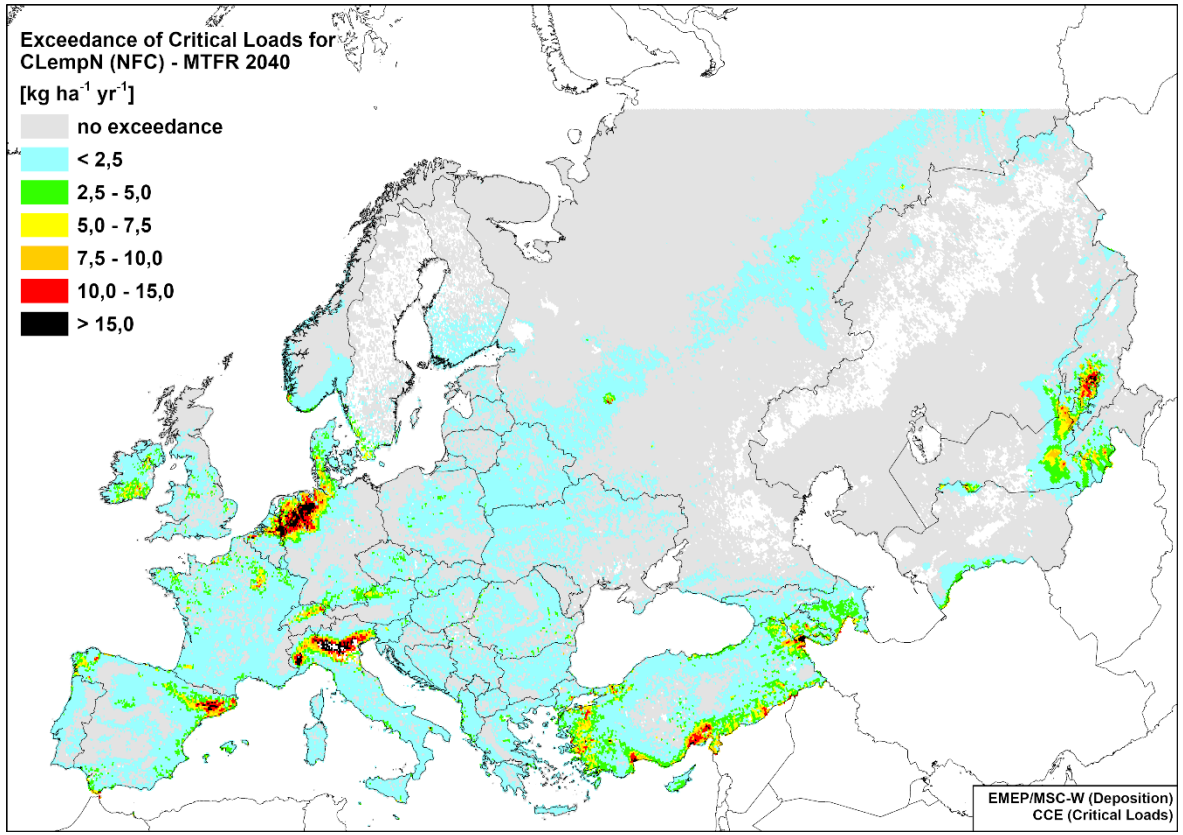
CLemp NFC & MSC-W Baseline 2015

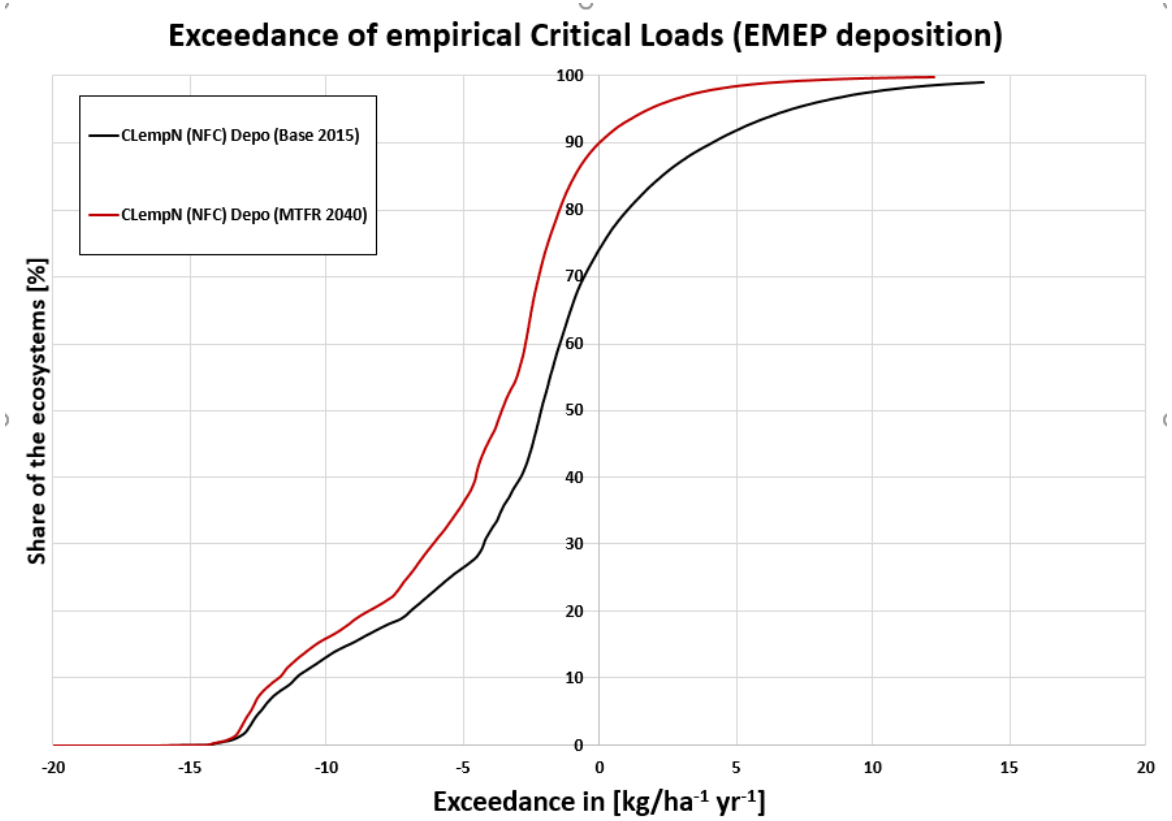




Visual and quantitativ comparison of exceedance data

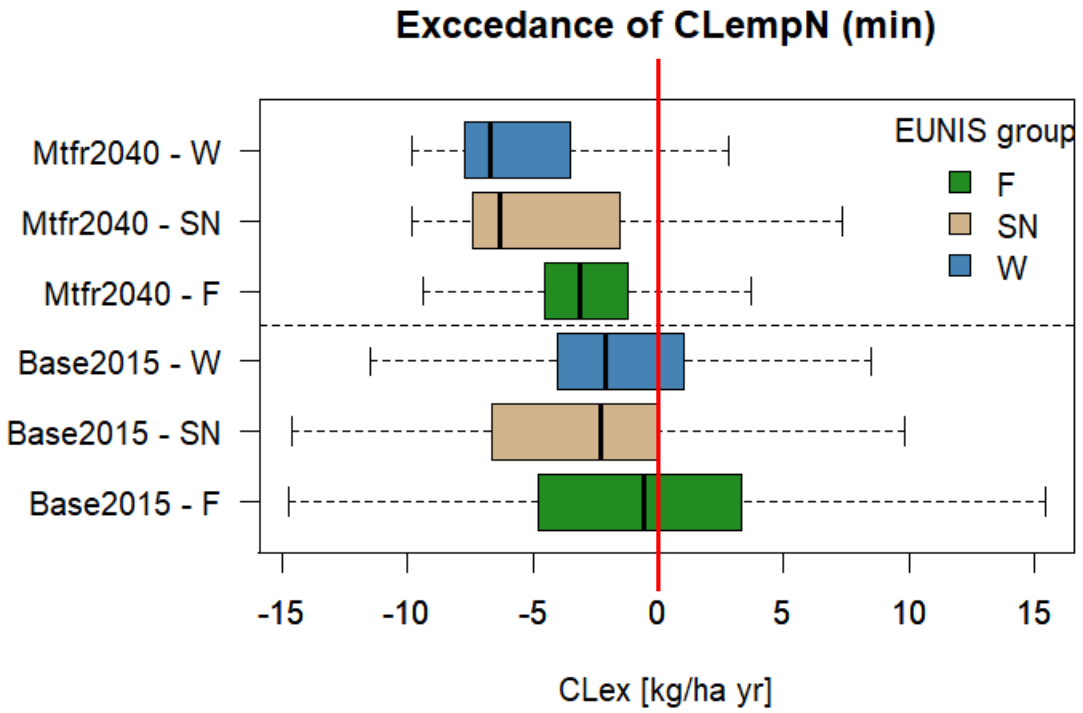
CLemp NFC & MSC-W MTFR 2040



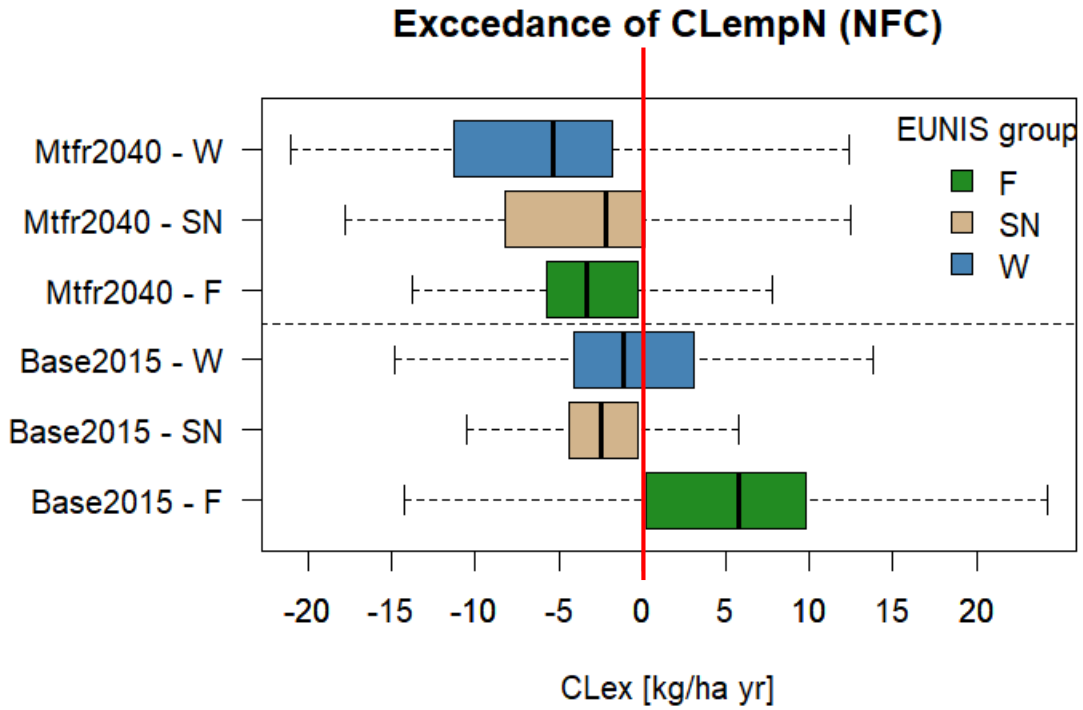


Visual and quantitativ comparison of exceedance data

CLemp CCE min & MSC-W MTFR 2040



CLemp NFC & MSC-W MTFR 2040



Summary

- ICP M&M recommendation: 12 parties have reported national Clemp data for biodiversity assessment under GP revision
- In total NFC data slightly less sensitive, some country data appear to be more precautionary
- A recommendation which part of the CL range really corresponds to the nature conservation regulations is not clear and not easy (→ CL_{min} clearly most precautionary)
- EUNIS class specific assessment of gap closure (new) → difficult/different with NFC data
- Aggregated assessment of gap closure (forest, semi-natural) → possible, needs some further data processing of NFC data (CIAM together with CCE)
- Add small paragraph, summarizing this presentation, to TFIAM policy brief to let WGSR decide

Questions? Comments? Remarks?

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