German Environment Agency

Umwelt Bundesamt

TFIAM53

Latest developments under ICP Modelling & Mapping with the potential to integrate in IAM for GP revision

Coordination Center for Effects (CCE)
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wge Working Group on Effects of the Convention on Long-range Transboundary Air Pollution

50 Jahre Umweltbundesamt 1974–2024

Overview

1. Background information
   - ➢ Results of the GP review in relation to ICP Modelling & Mapping
   - ➢ Results of a „Joint scientific session on Biodiversity“ at 9th WGE/EMEP (2023)
   - ➢ Identified tasks for the revision of the Gothenburg Protocol
2. Overview on tools and indicators under auspices of ICP M&M in potential relation to IAM
   - ➢ Empirical Critical Loads („Biodiversity“)
   - ➢ SMB Critical Loads (Eutrophication / Acidification)
   - ➢ NH3- Critical Levels
   - ➢ CAI Baltic/HELCOM

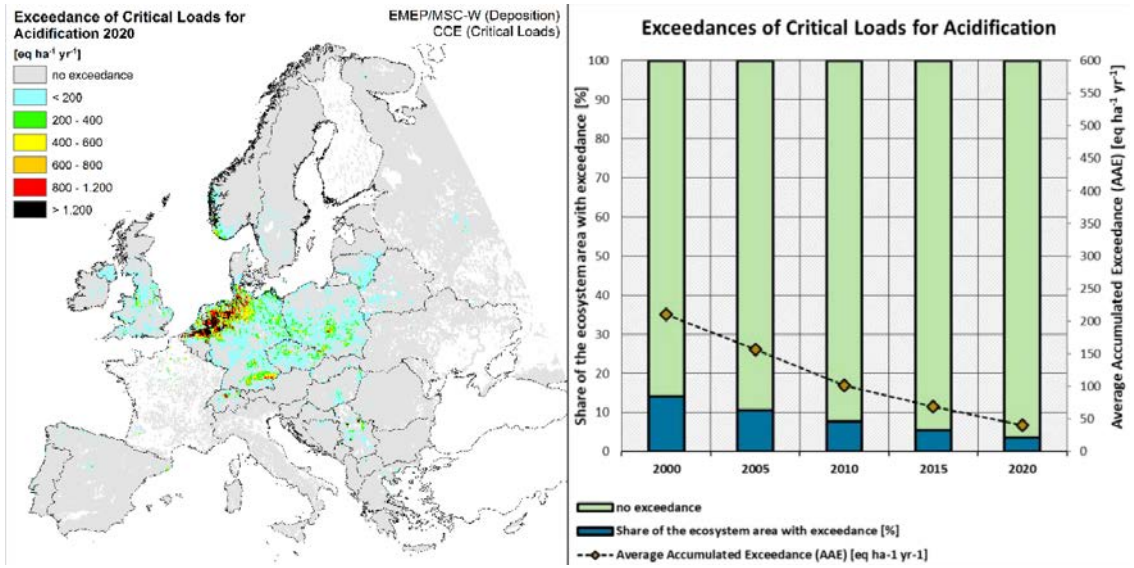
Results from the review of the Gothenburg Protocol

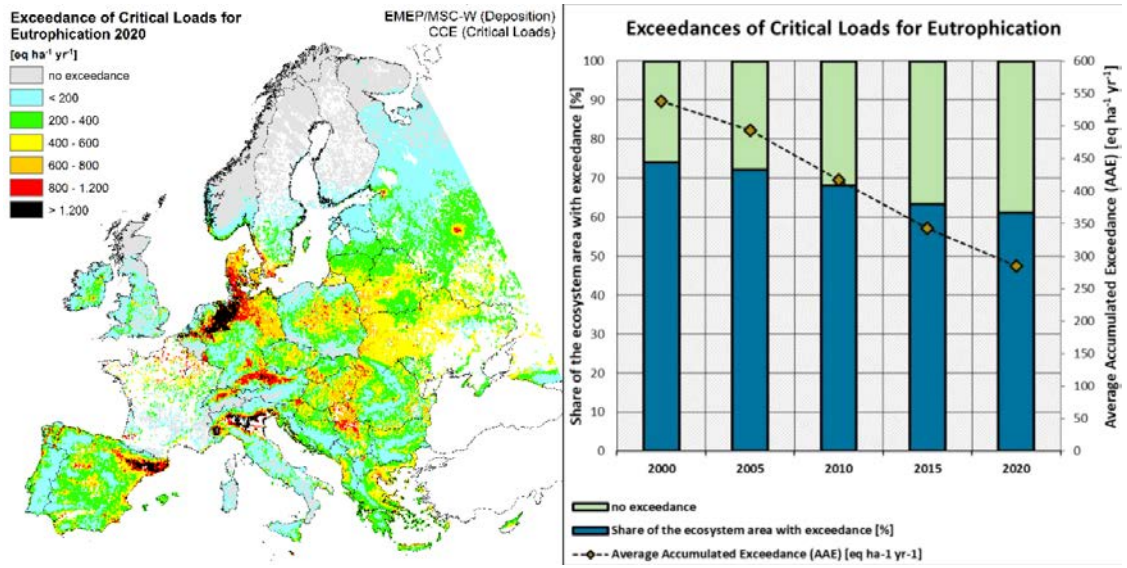
EB document ECE/EB.AIR/2020/3 – ECE/EB.AIR/WG.5/2020/3 for the Review of the Gothenburg Protocol

Question 2.2 b. What is the annual change (or change every 5 years) in exceedance of Critical Loads for acidification and eutrophication between 1990 and 2019 in terms of percentage ecosystems with exceedances and accumulated excess, based on current Critical Loads? What are projected changes up to 2030 and beyond?

Question 2.8. What are the expected impacts of new scientific findings on environmental and health effects assessments, including marine ecosystems?

Results: ECE/EB.AIR/2022/4





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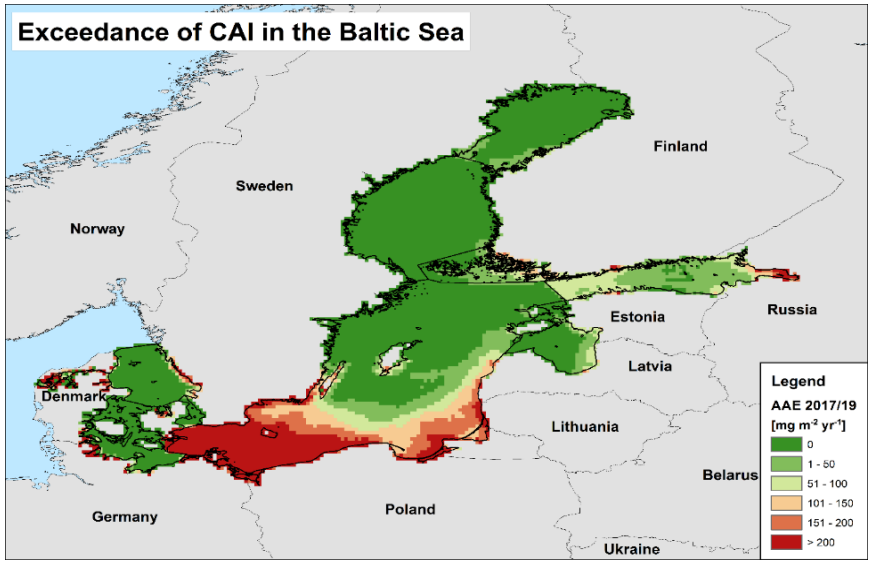
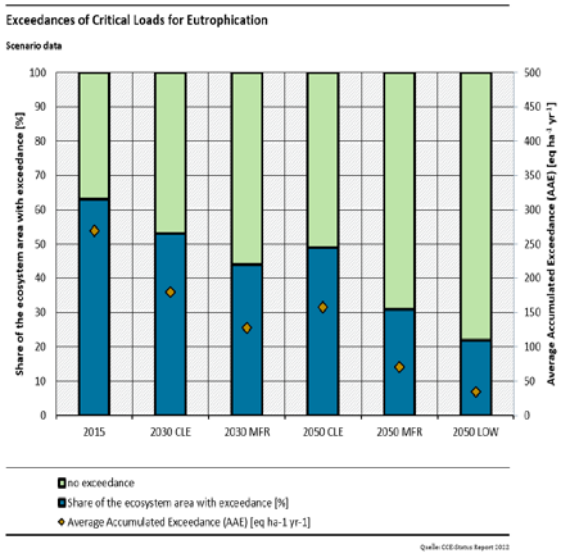
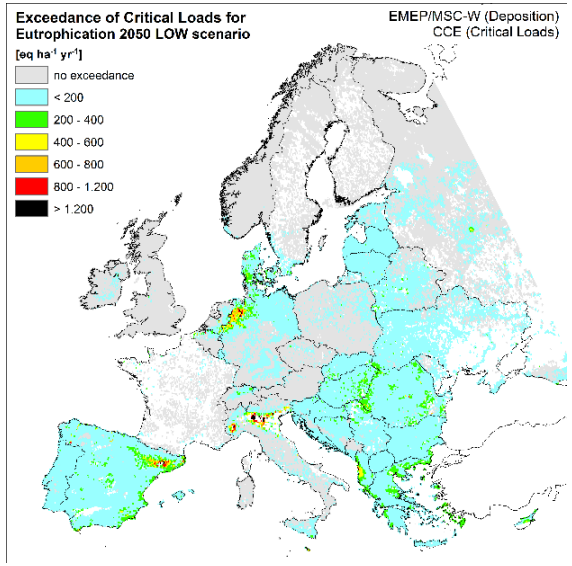






Results from a „Joint scientific session on Biodiversity“ at 9th WGE/EMEP (2023)

- The WGE recommends the formal endorsement of the Kunming-Montreal Global Biodiversity Framework to encourage collaboration between the two Conventions → **draft ECE/EB.AIR/WG.5/2024/1:** “Parties may wish to consider the implementation of the recently agreed Kunming-Montreal Global Biodiversity Framework”

- Critical loads is a well established method to address air pollution effect on ecosystems. The updated empirical critical loads for nitrogen are expected to be better linked to biodiversity than mass balance based critical loads and are going to be used for European Assessment.

- WGE recommends EB to use biodiversity loss as an indicator in the revision of the Gothenburg protocol

Identified tasks for GP revision (draft ECE/EB.AIR/WG.5/2024/1)

- Overarching, collective risk-based target(s) to reduce harmful effects to health and to ecosystems**, <u>including biodiversity loss in ECE region</u>**

Overview on tools and indicators under auspices of ICP M&M

- **Modelled Critical Loads ($CL_{nut}N$; $CL_{max}S$) [deposition]** to assess risks for ecosystems through eutrophication and acidification (Mapping Manual)
- **Empirical Critical Loads ($CL_{emp}N$) [deposition]** based on literature review of experiments and observations (Review Report 2022)
- **Critical Levels (CLev) [concentration]** to protect vegetation from negative effects of ammonia (NH3) (Review Report 2023)
- **Critical Atmospheric Inputs (CAI) [deposition]** to protect Baltic Sea Basins from eutrophication (CCE Status Report 2022)
- **Receptor Map** UNECE region (Documentation)
- **Background Database** to model $CL_{nut}N$; $CL_{max}S$ (Documentation)

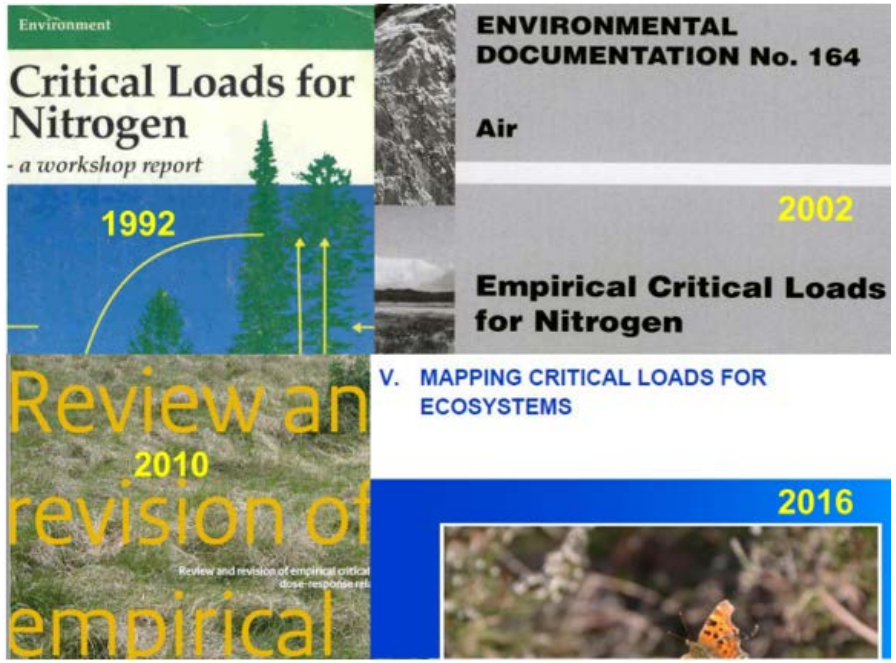
Empirical Critical Loads to assess risks for biodiversity

$CL_{emp}N$ were first presented in a background document for a workshop in 1992 in Sweden (Grennfelt and Thörnelöf, 1992)

4 Updates:

- Bobbink et al. (1996)
- Achermann & Bobbink (2003)
- Bobbink & Hettelingh (2011)
- Bobbink et al. (2022)

Overview publication: Bobbink, R. et al. (2015). Effects and Empirical Critical Loads of Nitrogen for Europe. In: de Vries, W., Hettelingh, JP., Posch, M. (eds) Critical Loads and Dynamic Risk Assessments. Environmental Pollution, vol 25. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-9508-1_4



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

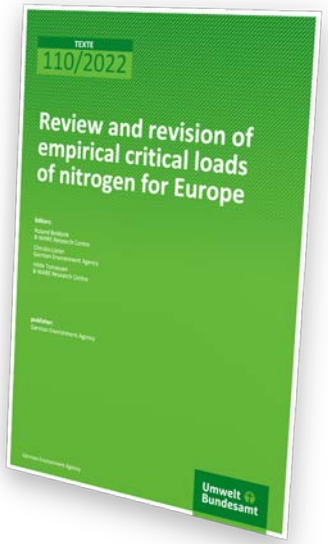
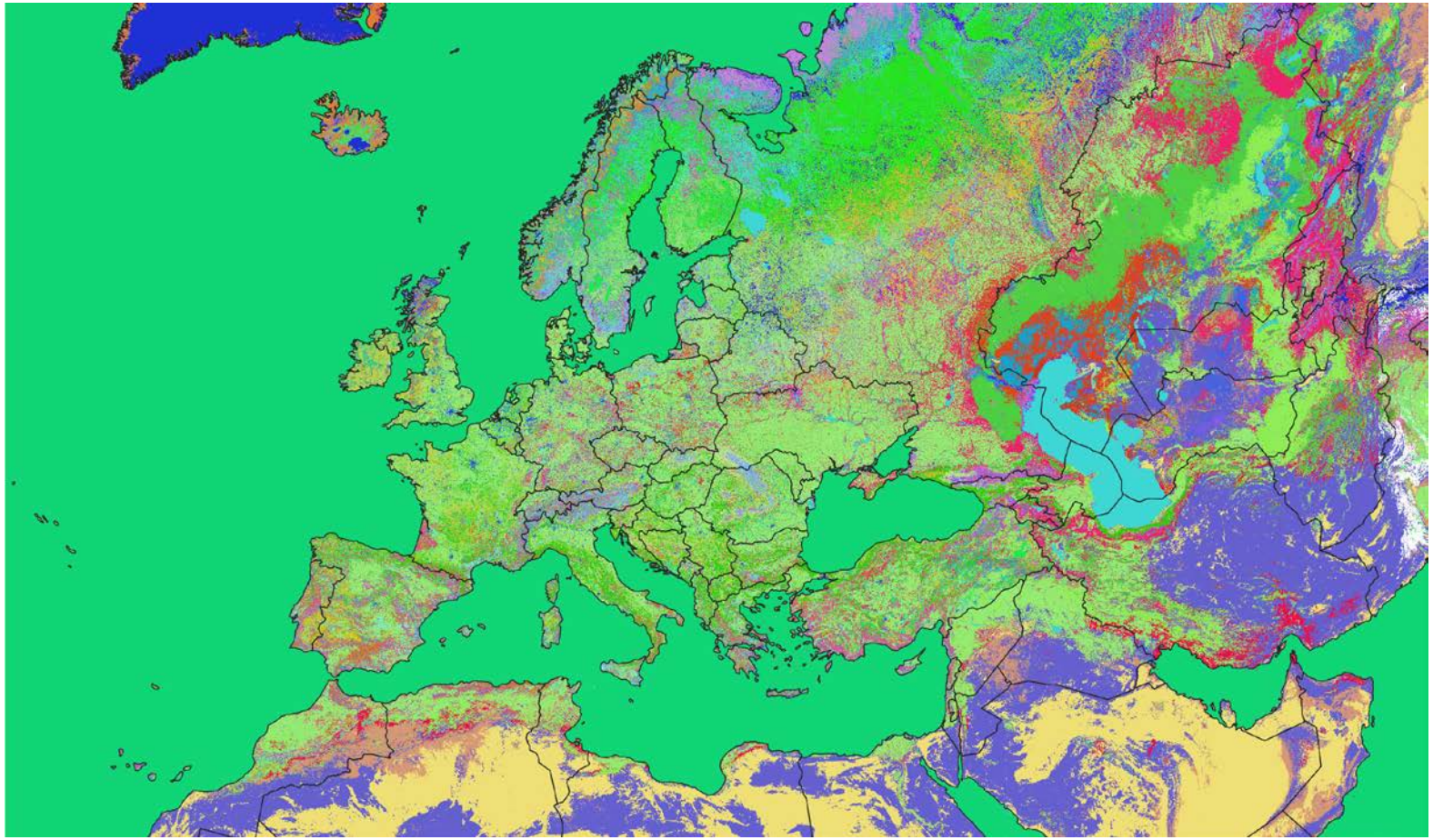


Table 5.1. **$CL_{emp}N$ and effects of exceedances on surface standing water habitats (C1)[a]. ## reliable, # quite reliable, and (#) expert judgement. Changes with respect to 2011 are indicated as values in bold.**

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

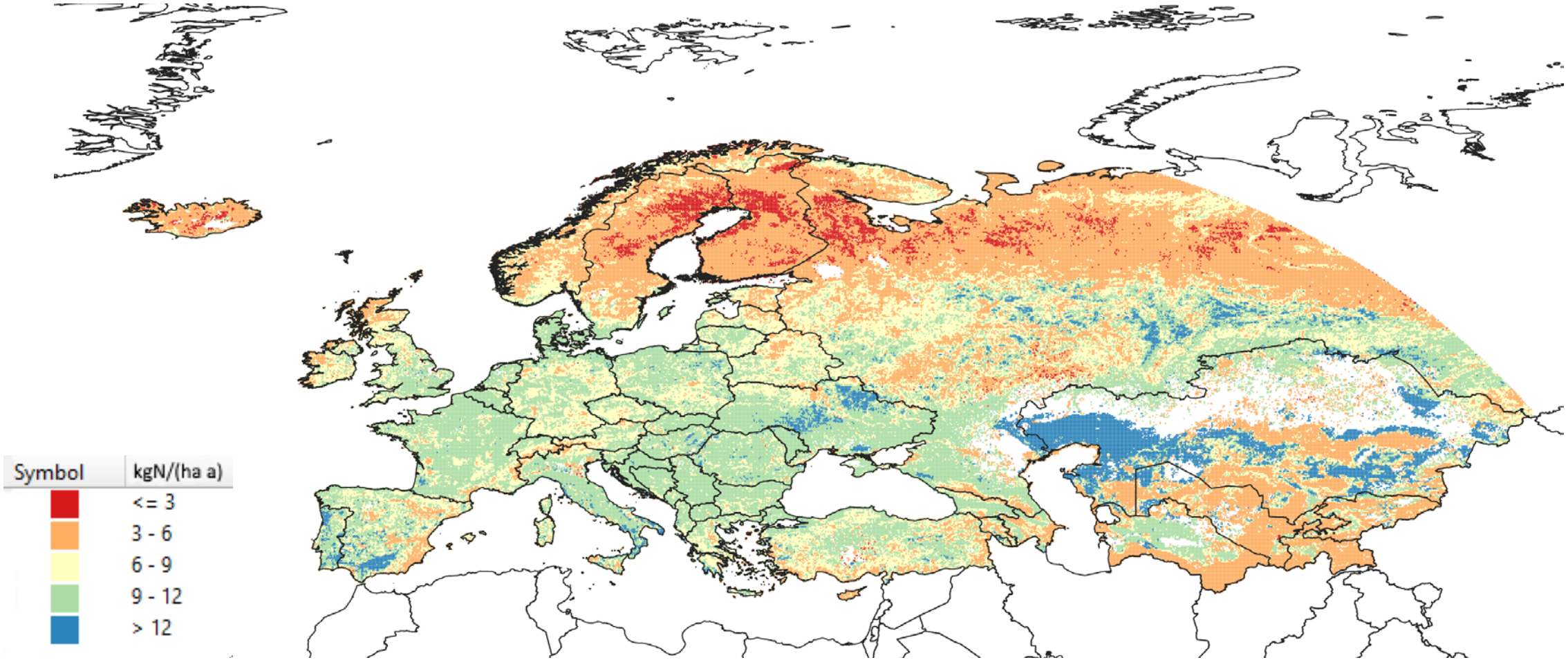
Application of the updated Receptor Map



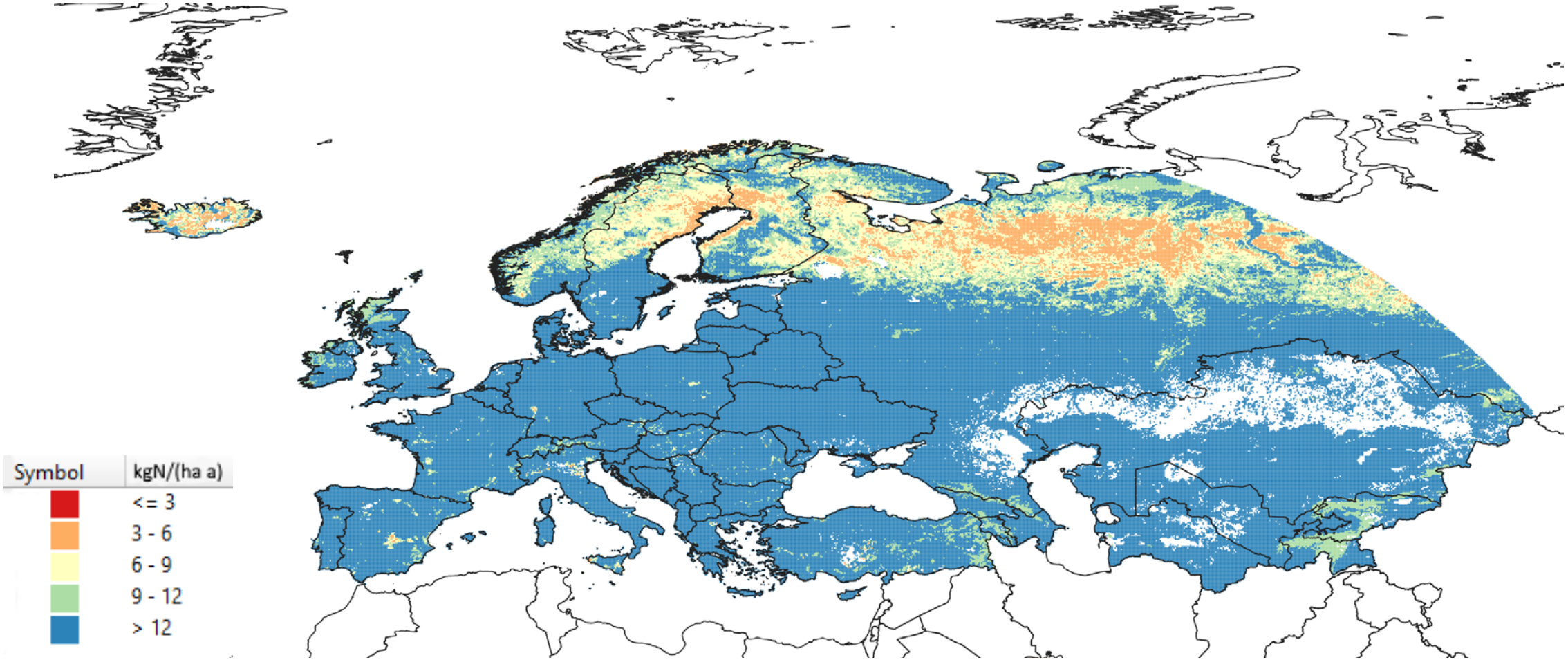
- Extended spatial scope (Europe and EECCA)
- Harmonized method for deriving information about distribution of ecosystems
- Classification of 219 classes (EUNIS system, up to detail level 3)
- for 64 ecosystems $Cl_{emp}N$ are available
- Good coverage of seminataural ecosystems on the EMEP grid (about 1.4 million data records) → in most of the grid cells at least one record)

https://www.umweltbundesamt.de/en/publikationen/creation-of-a-harmonized-land-cover-map-as-an

$CL_{emp}N$ on basis of new receptor map - CL_{min}



$CL_{emp}N$ on basis of new receptor map - CL_{max}



$CL_{emp}N$ 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 and	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

2 Meetings CIAM/CCE:

- February & March 24

Documentation:

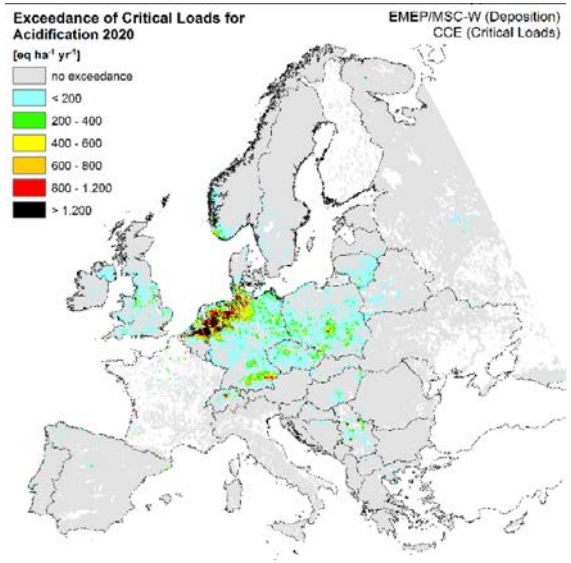
- In preparation in collaboration between CIAM & CCE

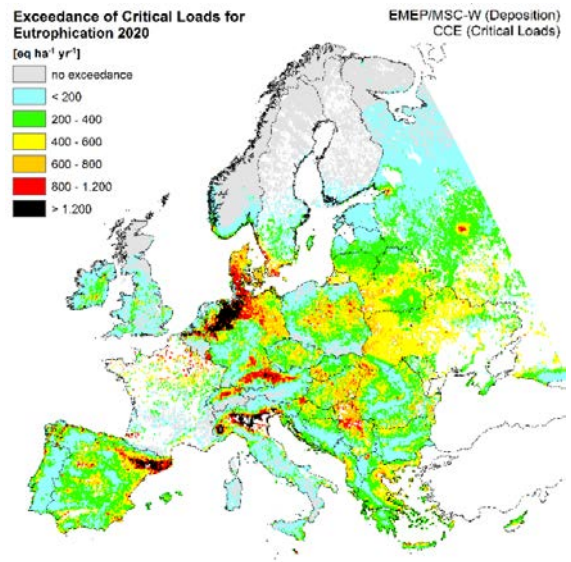
Decision needed:

- Upper or lower end of the range?
- Uniform deision, national decision?
- **To be discussed at ICP M&M meeting next week in Oslo.**

Modelled Critical Loads to assess eutrophication and acidification

- ”classical” indicator → used for GP1 (1999) and GP2 (2012)
- Current database 2021, used in the GP review (mix of national reported and CCE-modelled CL)
- Current domain focus on Europe without Turkey and EECCA region
- Next steps under workplan 24/25:
  - ➢ Update CCE background database (soil and growth data for Turkey and EECCA)
  - ➢ Consider uptake of new critical limits
  - ➢ CfD to National Focal Centers to update their modelled CL





→ **New policy relevant dataset for GP revision**; however probably not before WGE/EMEP 2025, **tbd at our ICP M&M TF meeting in Oslo next week**

Critical Levels for ammonia (NH_3)

*"The **fertilisation effect** of NH_3 can in the longer-term lead to a variety of adverse effects on vegetation, **including direct toxic effects on epiphytic lichens** through the increase of extracellular pH and fertilization effects such as **growth stimulation** (which can alter species balance with some species being potentially out-competed) and increased susceptibility to abiotic (drought, frost) and biotic stresses."*

Plant and lichen individuals and communities	Critical level NH_3 [µg m^{-3}]	Time period
Lichens and bryophytes (including ecosystems where lichens and bryophytes are a key part of ecosystem integrity)	1	Annual mean
Vascular plants (including ecosystems where lichens and bryophytes are not a key part of ecosystem integrity)	3	Annual mean

Workplan 24/25 – 1.1.1.24

Critical Levels of NH3: map exceedance data

Critical Levels for ammonia (NH_3)

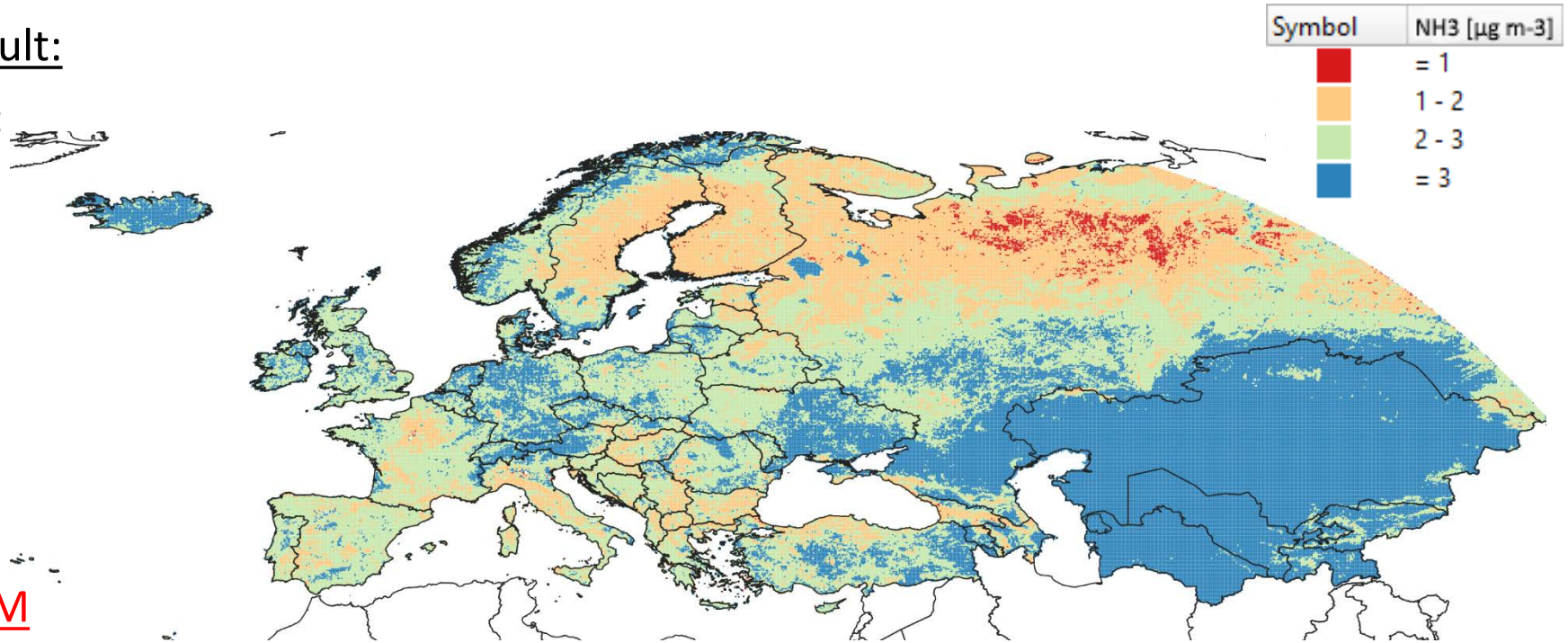
Assignment of Clev 1 or 3 µg m^{-3} to the UNECE receptor map

1 µg: ecosystem specific occurrence of sensitive lichens and bryophyte as dominant, characteristic or constant species based on EUNIS fact sheets

Preliminary approach and result:

Assignment on EUNIS Level 3:

35 Ecosystem types of the receptor map: 1 µg m^{-3}

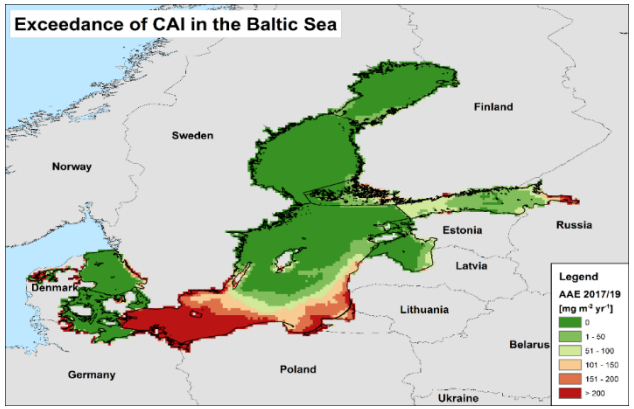


Next steps:

Evaluate EUNIS Level 4

Potential to be included in IAM

Critical Atmospheric Nitrogen Inputs (CAI) to the Baltic Sea



1. Review of the GP Protocol (ECE/EB.AIR/2020/3), Annex 1, Question 2.8
   - WGE was assigned to deliver information on the risk of eutrophication of marine ecosystems by nitrogen deposition
   - Ad-Hoc Group on Marine Protection (AMP) with members of HELCOM (RedCore), MSC-West, CCE

2. CAI values of nitrogen have been developed for the seven sub-basins of the Baltic Sea and assessed for the review of the GP (ECE/EB.AIR/2022/4)
   - for the first time AAE of CAI was estimated for a marine ecosystem
   - CAI, which only address the open sea, are exceeded in 2019 in all 7 Baltic Sub-basins, **but AAE is low compared to terrestrial systems in Central Europe**
   - Even with MFR some exceedance remains in 2030
   - Most sensitive coastal zones are not included, yet → future work

Potential to be included in IAM

→Baltic Sea Action Plan Action E 22 from the eutrophication segment: **Enhance HELCOM cooperation with the UNECE CLRTAP in order to promote the inclusion of the protection of the Baltic Sea ecosystem as an additional criterion in the process of GP revision.**

Further reading:
Informal Doc. 7a (8th WGE/EMEP in 2022) ; CCE Status Report 2022

Baltic Sub-basin	CAI [kg ha^{-1} yr^{-1}]	AAE 2019 [kg ha^{-1} yr^{-1}]	AAE 2030 Baseline	AAE 2030 MFR
Baltic Proper	4.20	1.78	0.71	0.38
Bothnian Bay	2.31	0.02	0.00	0.00
Bothnian Sea	3.99	0.06	0.00	0.00
Gulf of Finland	5.41	0.08	0.00	0.00
Gulf of Riga	5.34	0.13	0.00	0.00
Kattegat	9.64	0.25	0.03	0.01
Danish Straits	13.48	0.09	0.02	0.00
Total/Avg		**0.94**	**0.11**	**0.06**

Conclusions and outlook

- Summary:
  - 4 ecosystem indicators potentially ready for IAM in the process of GP revision
  - ClempN (biodiversity)
  - CLnutN and CLmaxS (eutrophication and acidification)
  - Clev NH3 (vegetation)
  - CAI (marine protection)

- Different sensitivity, that means different influence on necessary emission reduction
- While CLempN have been provided already and CAI would be ready
- Clev NH3, CLnutN and CLmaxS require further work for the under the Workplan 24/25

- At Oslo ICP M&M meeting next week further details will be determined

Vielen Dank für Ihre Aufmerksamkeit

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https://www.umweltbundesamt.de/en/Coordination_Centre_for_Effects

50 Jahre Umweltbundesamt 1974–2024

Umwelt Bundesamt