Choice and definition of policy relevant indicators

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Chair, Working Group on Effects

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What is policy relevant, and what to choose?

What is policy relevant?

➔ **Indicators for use in policy relevant processes**

Need to be understood? ➔ by scientists! (& policymakers?)

Need to be ”popular”? ➔ no

Choice

Effects & trends ➔ dose-response ➔ testing scenarios

Health – effects of O_3, PM on human health

Materials – effects of S, N, PM on materials

Water – effects of S, (N) on chemistry & biology

Forest – effects of S, N, O_3 on chemistry & biology

Vegetation – effects of O_3, N on crops and vegetation

IM – effects of S, N on ecosystems (chemistry/biology)

M&M – CLoad, CLevel, S, N

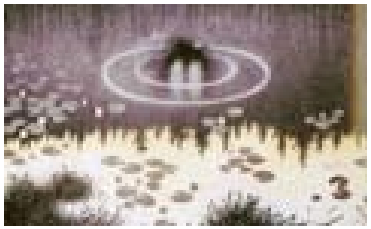
Terrestrial ecosystems

examples

Target	Indicators	chem./biol. data/dose-response
(full) recovery from previous atm. inputs	CL not exceeded; balanced nutrient conc. in foliage	+ / + / + **eg. BS, ANC / forest vitality**
healthy and vital trees; no further loss of biodiversity	reduced: crown defoliation, decrease of abiotic/biotic damage,natural regeneration..	-/ + / + **eg. ground vegetation**
avoid (all) detectable ozone damage	(large) reduction in ozone flux	+ / + / + **eg. [O3] / flux / vis.injury**
protect ecosystem structure and function	no violation of chemical and biological critical limits	+ / (+) / (+)

Aquatic ecosystems

examples



Target	Indicators	chem./biol. data/dose-response
healthy fish populations in (all) sensitive waters	presence of fish populations with normal age structure CL not exceeded	+ / + / + **eg. ANC, pH, [Al] / invertebrates, fish**
waters providing natural quality prerequisites	ANC > 20 µeq/l	+ / - /
Protect ecosystem structure and function	No violation of chemical and biological critical limits	+ / - / +
protect appropriate ecological receptors	good status, favourable conservation status	+ / + / +

Task Force on Health: Key monitored parameters

Ozone	SOMO35
Particulate matter	Annual average PM2.5 Epi studies (C-R functions)
Heavy metals	biomarkers
POPs	biomarkers

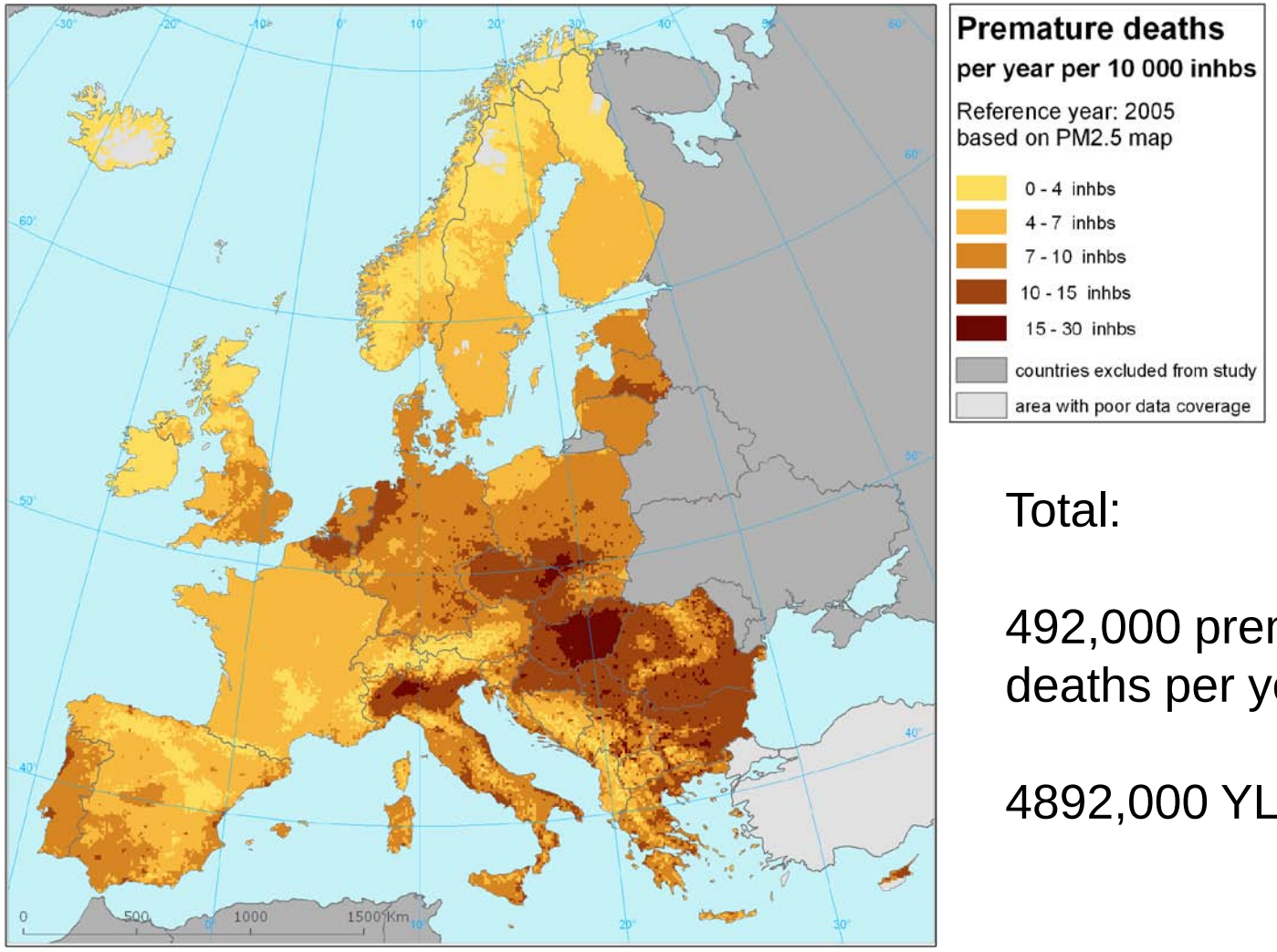
Targets for human health, 2050 and 2020

Year	Pollutants	Target	Comment
2050	Ozone (daily max 8h mean) PM2.5 (annual mean) PM10 (annual mean) NO2 (annual mean) SO2 (annual mean) Pb, Cd, Hg (annual mean)	WHO AQG	Guideline levels may be reduced in the future if new evidence, collected with more sensitive methods, becomes available
2020	*Ibid.*	WHO AQG	Present pollution trends indicate that the targets are not likely to be reached in many locations of Europe

WORLD HEALTH ORGANIZATION EUROPE

LRTAP Long-range Transboundary Air Pollution

Effect indicator:
Premature mortality attributable to PM2.5 (2005)



Total:

492,000 premature deaths per year;

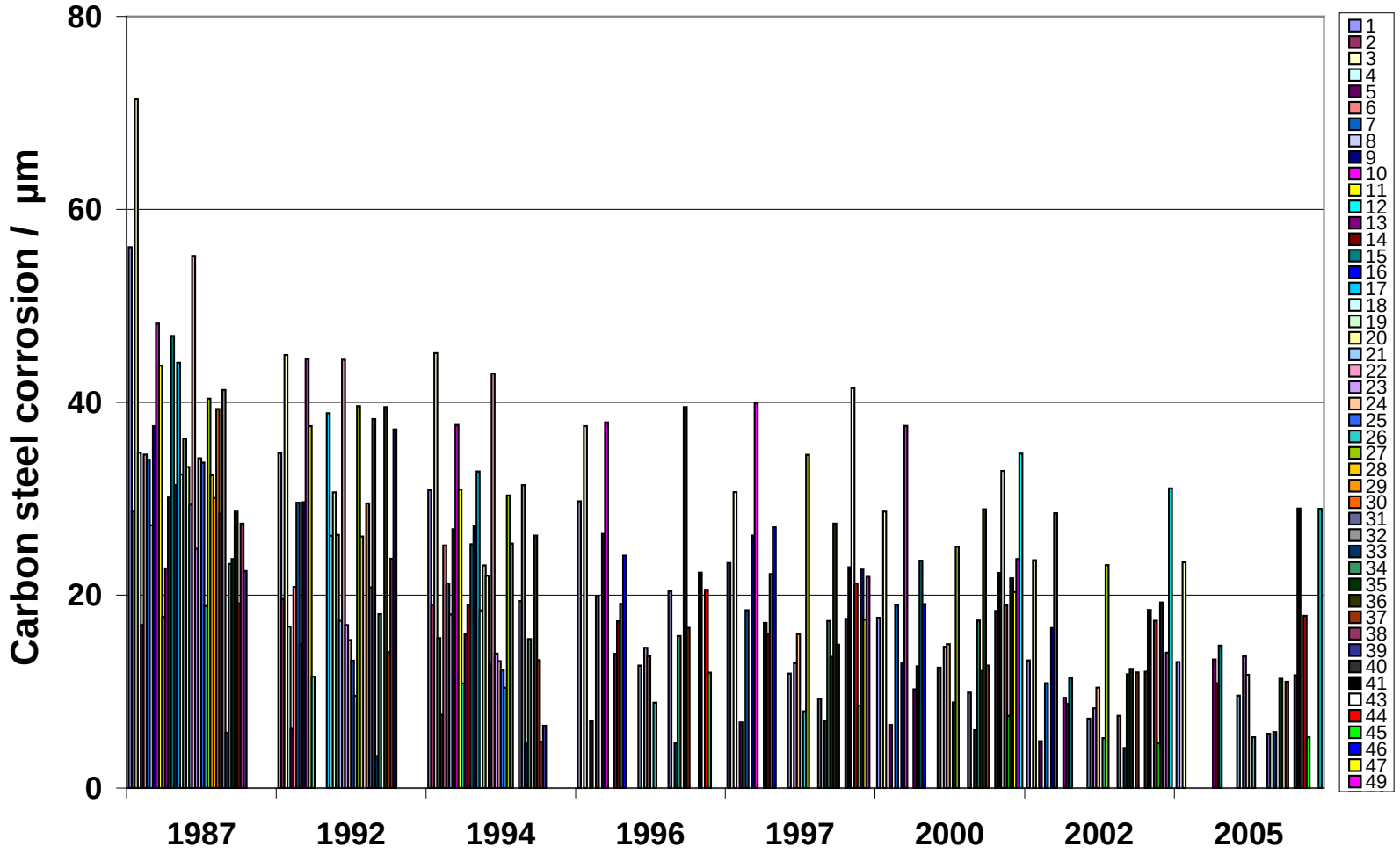
4892,000 YLL

Source: F. De Leeuw, J. Horalek, ETC/ACC, 2009

WORLD HEALTH ORGANIZATION
EUROPE

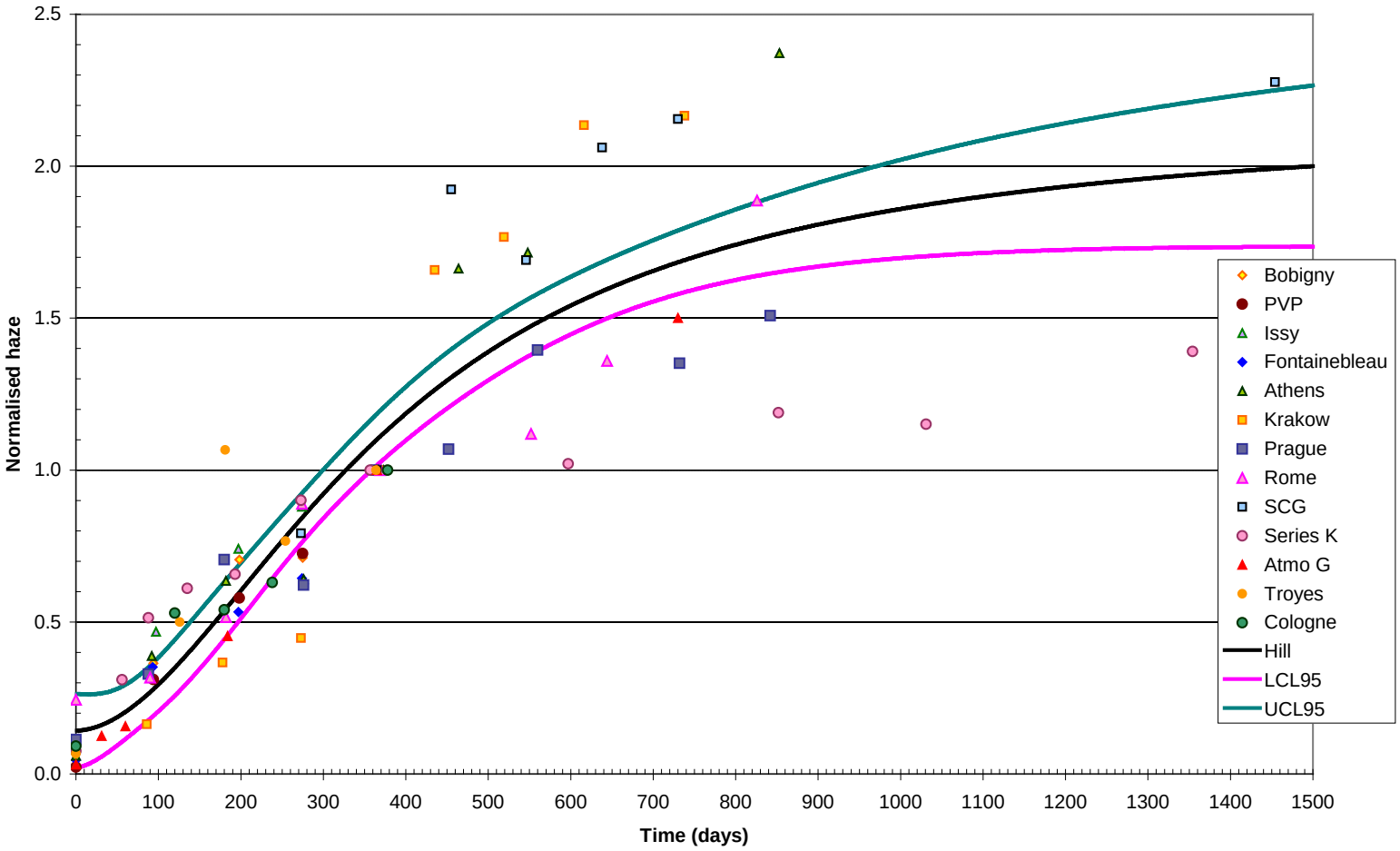
II. Key parameters, Corrosion

Trends in pollution and corrosion of carbon steel, zinc and limestone 1987-2009 (ICP M)



II. Key parameters, Soiling

Soiling of exposed materials and dose-response functions for modern glass (ICP M)



III. Targets / tolerable levels 2020/2050 (ICP M)

Table 13. Targets for protecting materials of infrastructure and cultural heritage monuments for 2050 and 2020 by ICP Materials

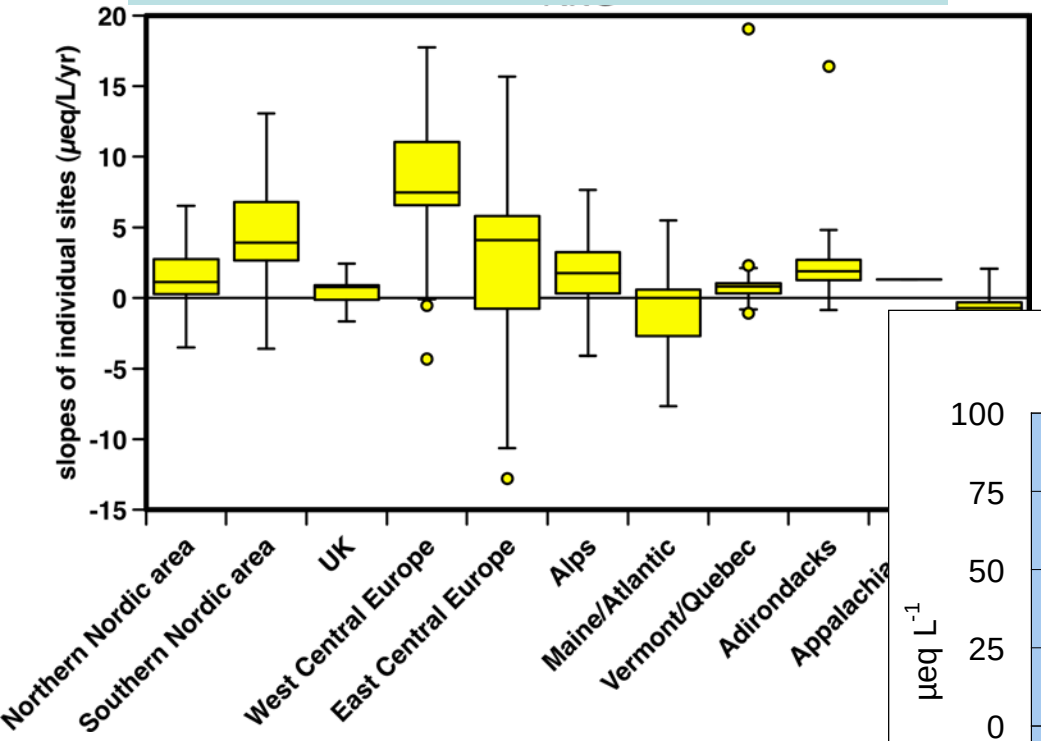
Year	Target	Indicators	Remarks
2050	Corrosion	Carbon steel <16 µm a^{-1}; zinc < 0.9 µm a^{-1}; limestone < 6.5 µm a^{-1}	Indicator values correspond to 2.0 times current background levels
	Soiling	Loss in reflectance (<35 per cent compared to unsoiled surface after 20 years)	Tolerable value is based on replies from people confronted with photographs of different soiling levels of actual monuments
2020	Corrosion	Carbon steel <20 µm a^{-1}; zinc <1.1 µm a^{-1}; limestone <8.0 µm a^{-1}	Indicator values correspond to 2.5 times current background levels
	Soiling	Loss in reflectance (<35 per cent compared to unsoiled surface after 10 years)	ibid. 2050

Note: All indicators are calculated with dose-response functions.

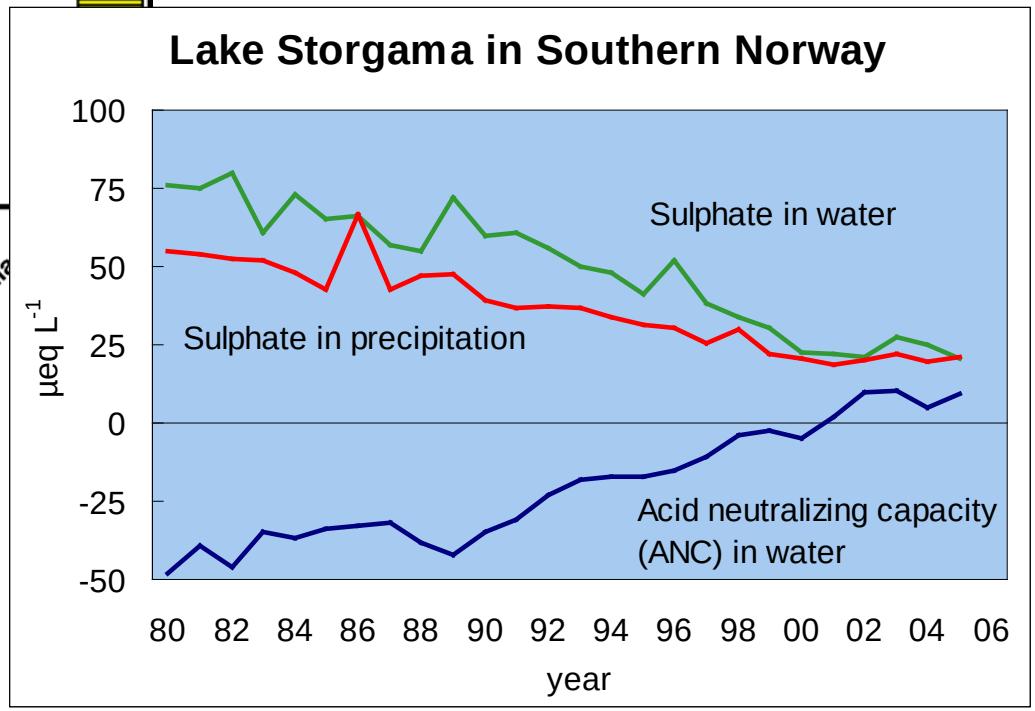
- Every reduction for materials corrosion is important – no thresholds or critical loads/levels
- "2020" = current tolerable levels

(i) Selected key monitored and modelled Guidelines parameters

Changes in ANC 1994 - 2004



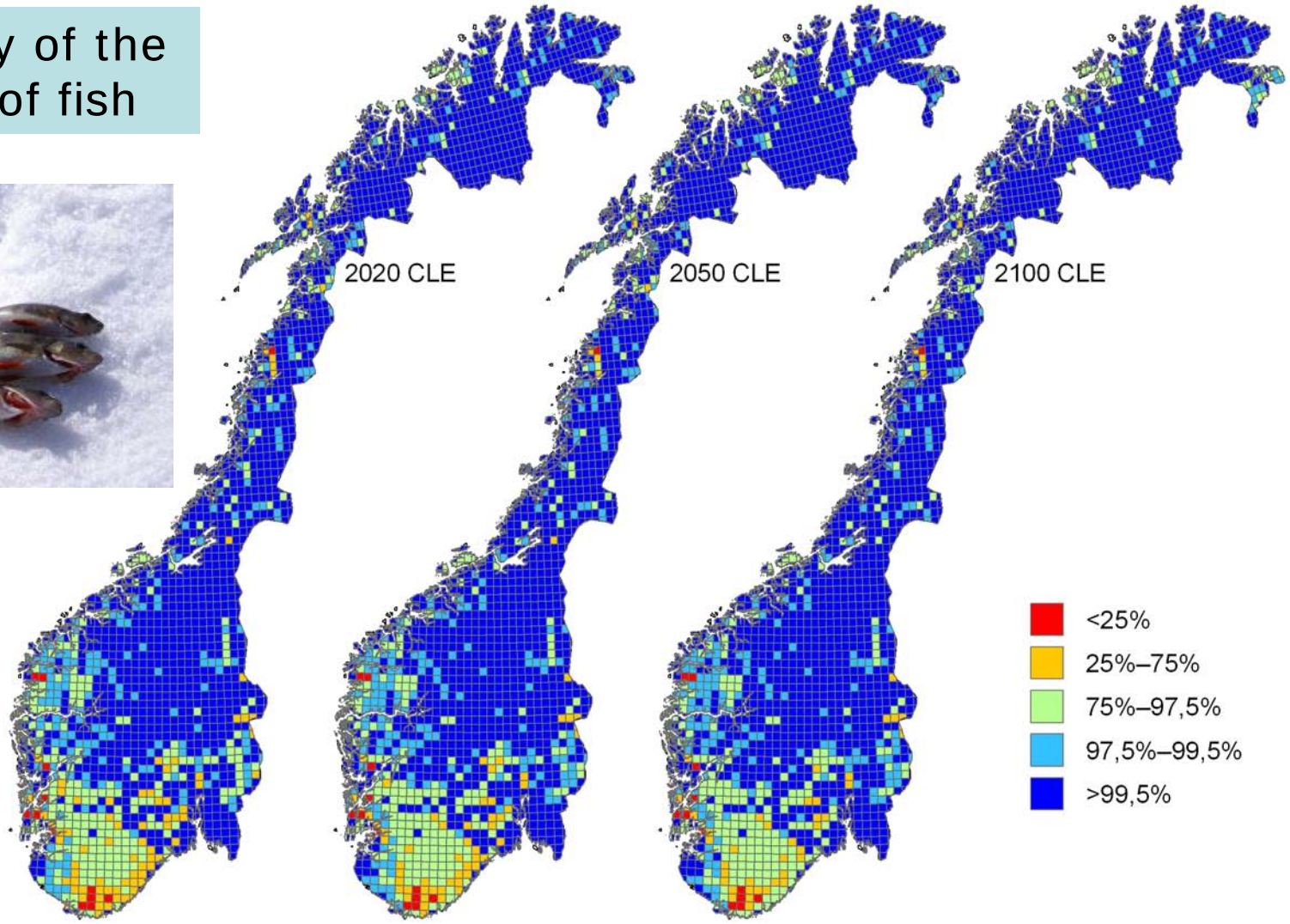
Acidification of aquatic ecosystems:
ANC, pH, alkalinity, TOC, Critical Loads, Invertebrates, Dynamic Modeling



Heavy metals:
Water and lake sediments

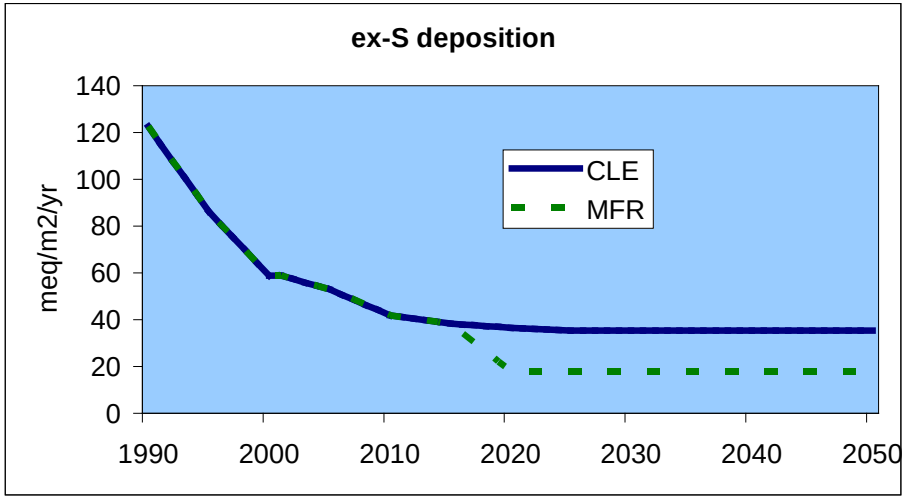
(iii) Quantified policy-relevant effects indicators and links to integrated modelling (ICP W)

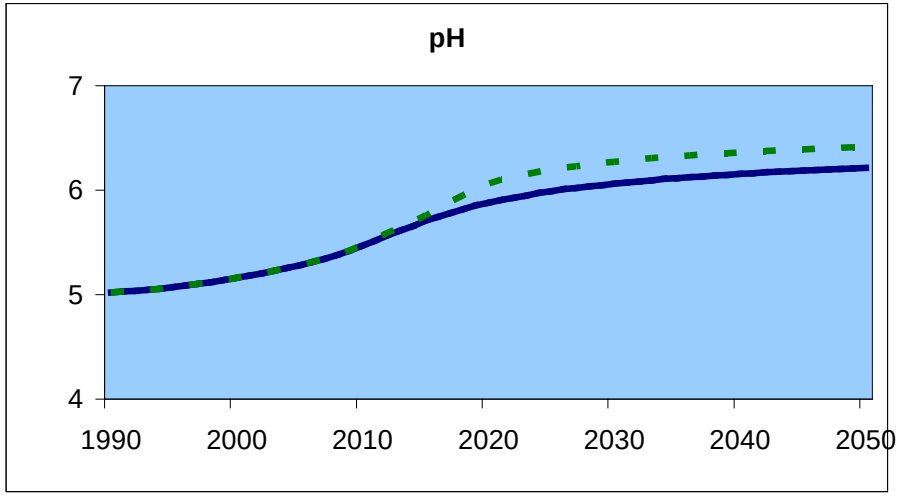
Probability of the precence of fish

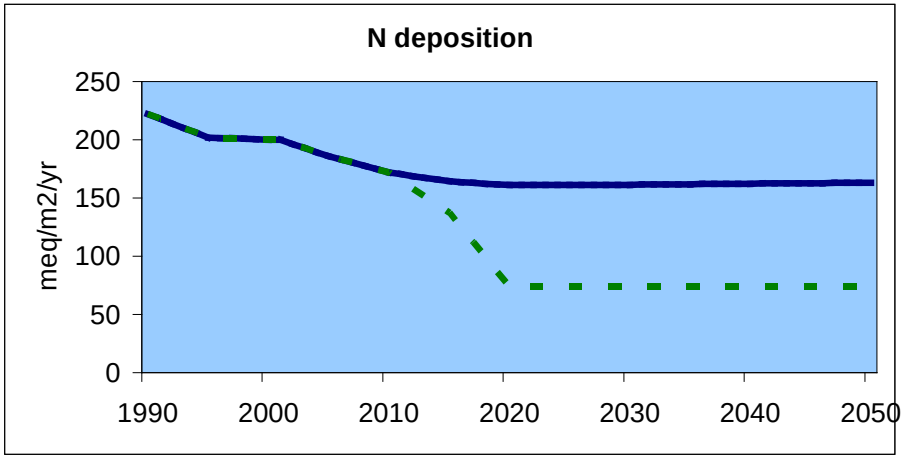


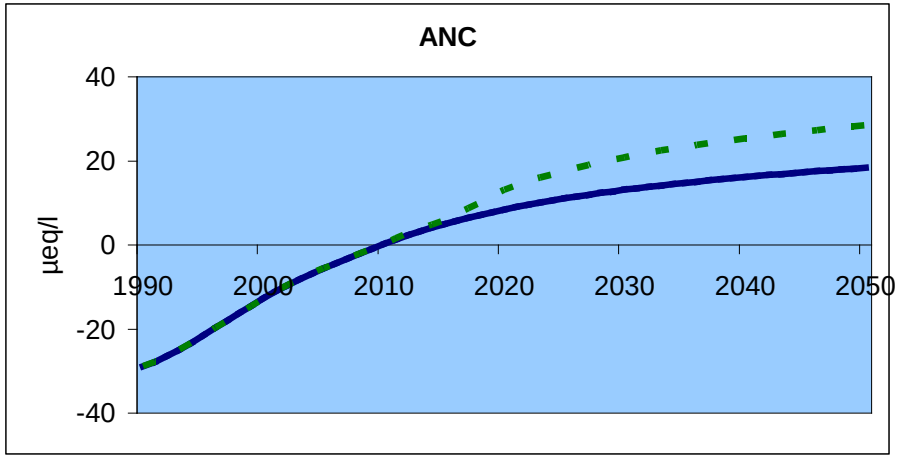
(iv) Results and experiences from the "dry run"

Saudlandsvatn, Norway









(ICP F)

1.1 Acidification (examples)

Table 2. Acidification of terrestrial ecosystems

Parameter	ICP Forests
BS	xx
ANC leaching	x
pH	xx
$[SO_4]$	x
$[NO_3]$	x
Total [Al]	x
BC/Al	x
Calculated CL, exceedance, threshold criteria	X, –, –
DM *	–

Note: For ICP Forests, x = level II only, xx = levels I and II.

BS

- Data for 5000 Level I plots (1990s). Validation and evaluation of recently (2006) assessed data is ongoing.
- Data for Level II plots, data base and publication (2000). Repeated assessments for 2006 are presently validated

ANC

- Soil solution data for 250 Level II plots.
- ANC has not been evaluated up to date.

pH

- Soil solution data for 200 Level II plots. Recent evaluation for 56 Level II plots over the period of 2001 -2006.
- Soil solid phase data for around 5000 Level I plots from the 1990s. Validation of repetition for 4000 plots (2006) ongoing.
- Soil solid phase data for 400 Level II plots from the 1990s. Validation of repetition for 100 plots (2006) ongoing.

(ICP F)

1.2 Eutrophication (examples)

Table 3. Eutrophication of terrestrial ecosyste

Parameter	ICP Forests
N_{total}	x
NO_3 leaching	x
C/N	xx
Ratio of nutrients in foliage (N/P, N/K, N/Mg) for dominant and key species	xx
Calculated CL, exceedance, threshold criteria	X
Empirical CL, exceedance, threshold criteria	–
N concentration in mosses *	n.a.
Effects on biodiversity *	x
DM *	x

N_{total}

- N pools in organic and mineral soil calculated for 515 Level II plots in 2000.
- Repeated assessments for 2006 are presently validated

NO_3 leaching

- NO_3 leaching flux has been calculated for 121 Level II sites in 2001

Foliage nutrient ratios

- For 674 Level II plots N/P, N/K, N/MG ratios in the tree foliage were evaluated for four main tree species groups in the year 2000.

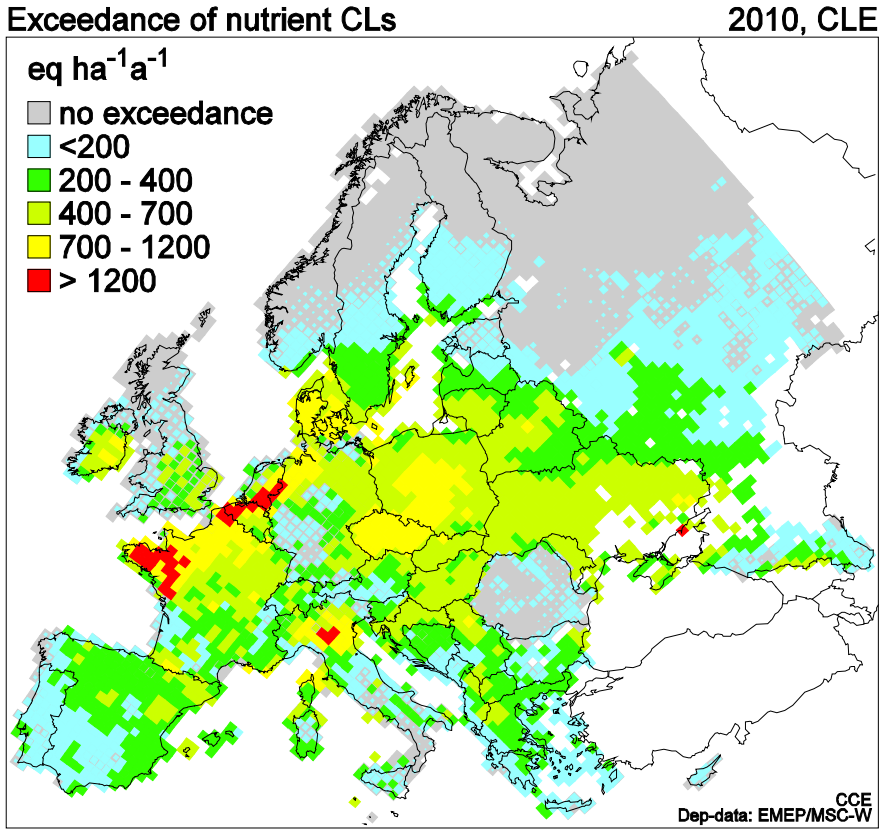
. . .

Aspirational impact targets in 2050:
focus on the LRTAP impacts and bio-geochemical processes
(CCE/M&M)

- No exceedance of critical loads in 2050 ?

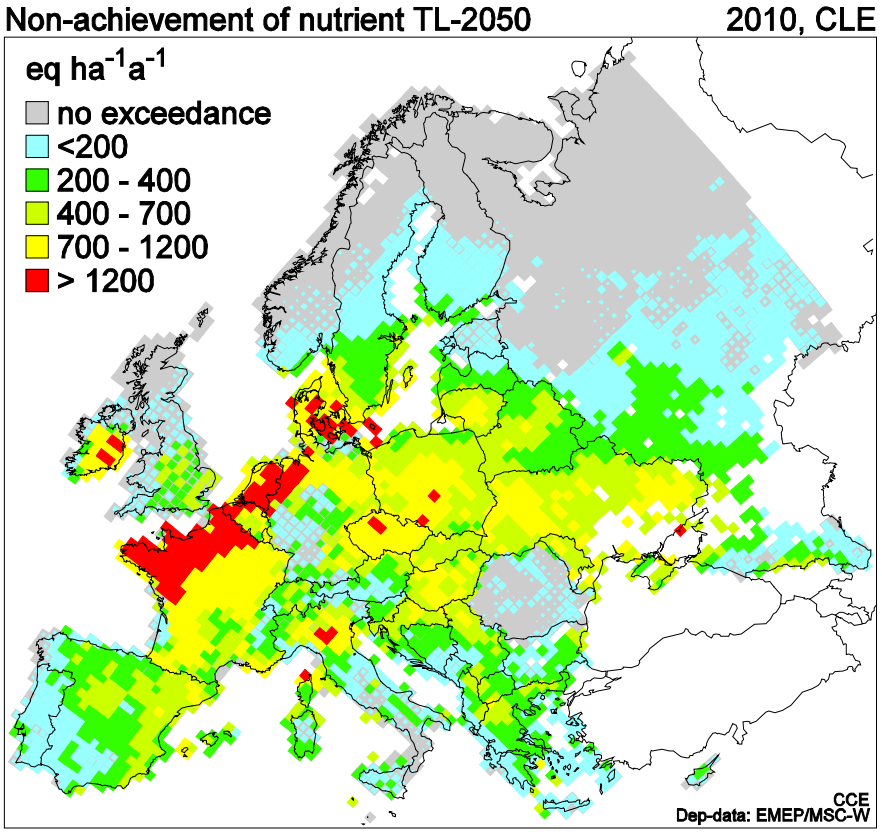
  This might still violate the underlying criterion (e.g. of buffer capacity) of natural systems by 2050…
- …No exceedance of critical loads and non violation of the underlying criterion in 2050? *find depositions as of e.g. 2020 such that recovery of European ecosystems is obtained in 2050; These depositions are called target loads.*
- Target loads are smaller than critical loads !

Exc. of CL eutrophication



48 % area exceeded (AAE > 0)

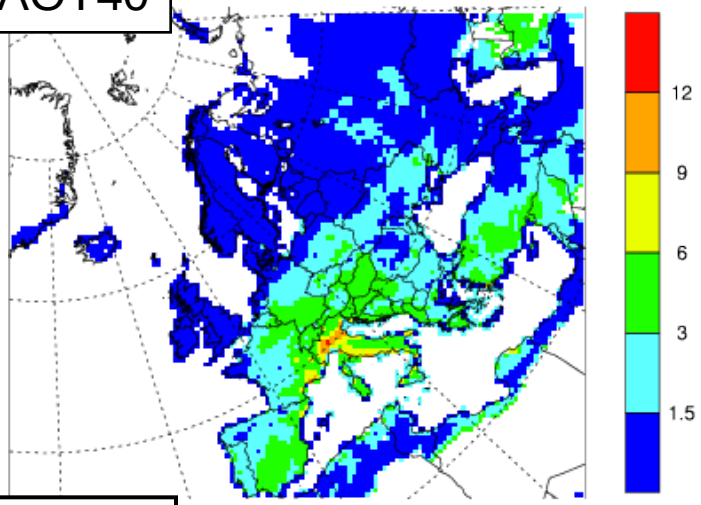
Violation TL eutrophication



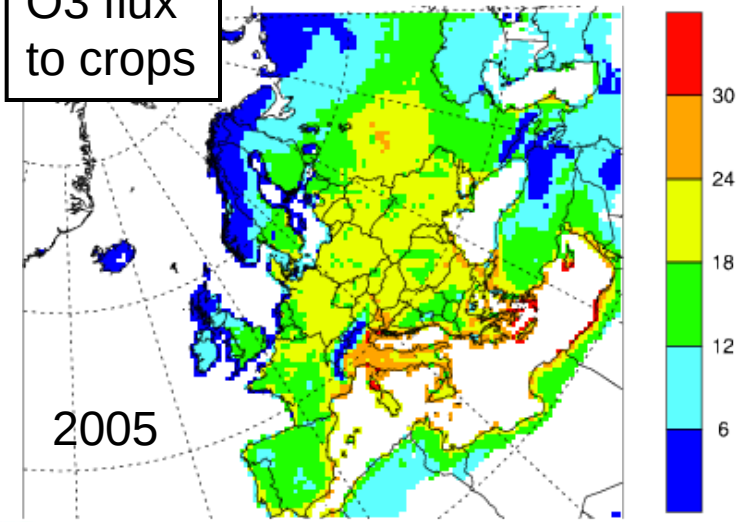
49 % area violated (AAE >0)

Ozone Exposure and Impacts in the Nordic Countries and the Baltic States

AOT40



O3 flux to crops



- Expert Meeting was held in Gothenburg, June 2008
- Results to be reported in a Special issue of Ambio

Conclusions:

- O_3 impacts are found on vegetation in northern areas
- Long summer days enhance ozone uptake
- AOT40 underestimates damage
- Ozone flux methods are essential for risk assessments in Northern areas

Source: Study by Per-Erik Karlsson and Hakan Pleijel, Sweden; maps by EMEP

Target Setting for ozone

The ICP Vegetation recommends that **by 2050**, all effects of O_3 on the following should be avoided:

- The yield quantity and quality of agricultural and horticultural crops (including forage)
- The growth of individual species and biodiversity of (semi-)natural vegetation
- The leaf appearance and growth of forest trees
- The ecosystem services (including carbon sequestration) of vegetation

Interim Targets

The "**gap closure**" principle or other strategies that prioritize areas with high O_3 fluxes, could be useful for defining interim targets.

ICP Vegetation Expert Panel Meeting

Flux-based assessment of ozone effects for air pollution policy

Ispra, Italy, 9 – 12 November, 2009

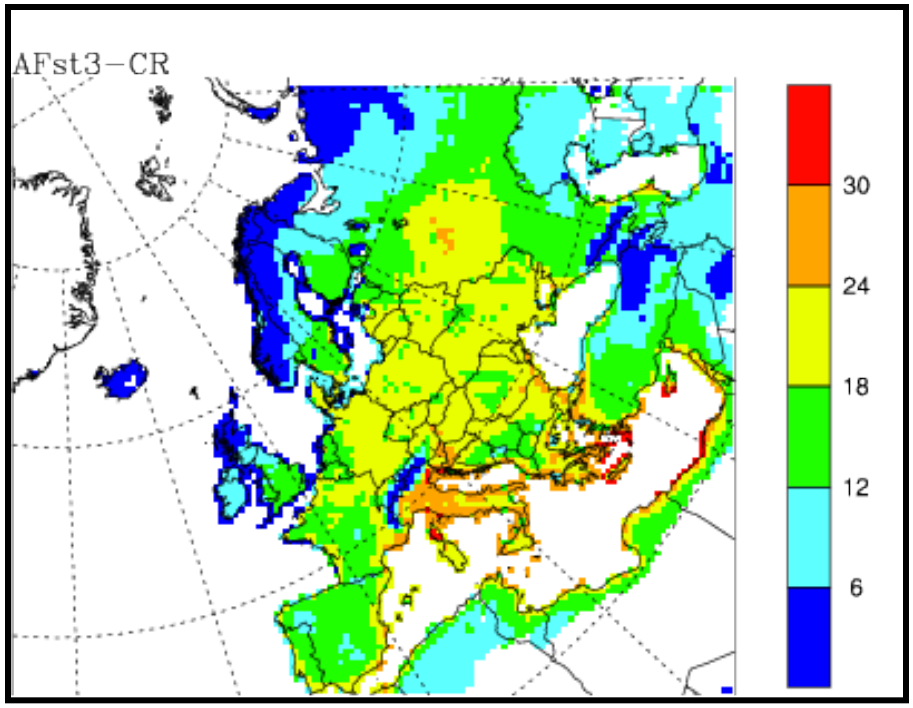
Aims and expected outcomes

1. To review the needs of the LRTAP Convention in using flux-based methodology
2. To agree flux-effect relationships for use by the LRTAP Convention.
3. To recommend the range of applications, including where possible, the setting of new/revised critical levels
4. To make recommendations for changes to the Modelling and Mapping Manual (to be approved at ICP Vegetation and ICP Forests TFMs).

Participation: ICP Vegetation, ICP Forests, TFIAM, CIAM, EMEP etc.

For further information, please contact Gina Mills (gmi@ceh.ac.uk)

Example: After the Ispra meeting, we shall be able to identify critical levels for effects for application to generic flux maps



Generic crop ozone flux for 2005

Example

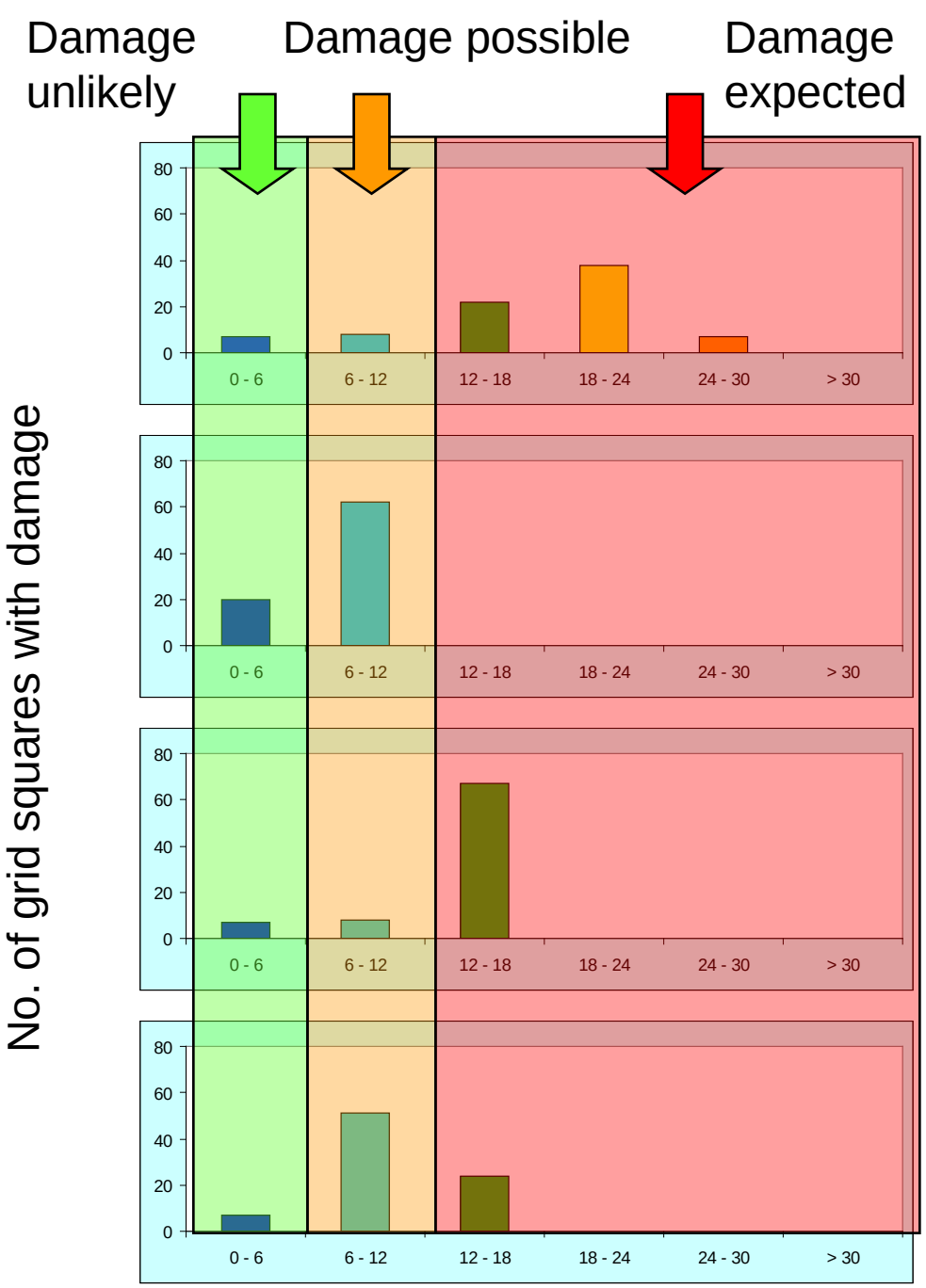
Damage to vegetation expected

Damage to vegetation possible

Damage to vegetation unlikely

❑ These new generic flux-based critical levels could be applied for interim target setting

* Map produced by EMEP



Interim Target Setting
e.g. beneficial effect of different approaches

Current

60% reduction, all grids

60% gap closure, to a target of 12 mmol m^{-2}

60% gap closure to a target of 6 mmol m^{-2}

* Data from Hayes et al, 2007.The “Evidence Report.”

Aspirational targets

Clean air ➔ healthy ecosystems ➔ healthy people

- **Healthy forests**
- **”Living” lakes and rivers**
- **”Fresh / stainless” crops, vegetables & vegetation**
- **No damage to materials**

Critical loads and levels are not exceeded