WGE-ICP Modelling and Modelling ex-post impact analysis: Status and next …

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www.icpmapping.org hosted at RIVM

Outline

Status:

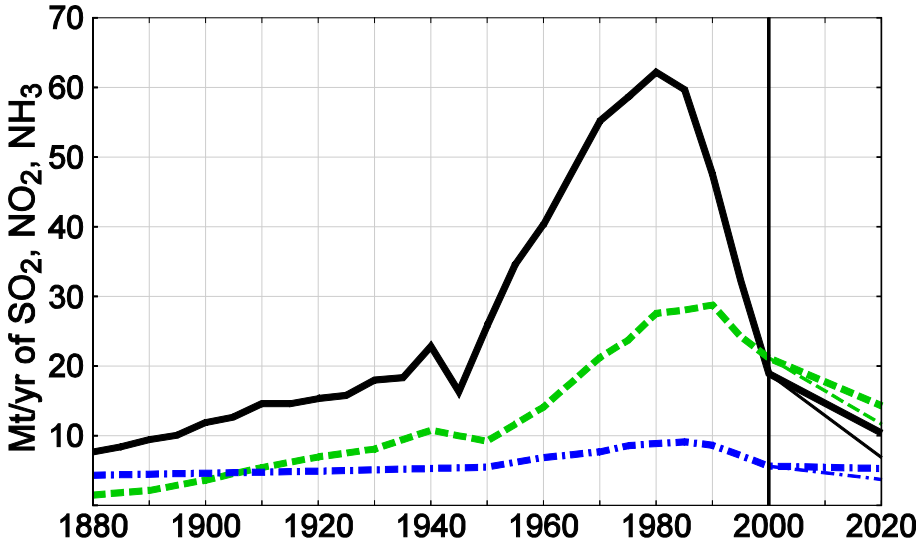
- ICP M&M analysis of current scenario's
- Other WGE-ICPs as at 39th TFIAM (see presentation by chairperson of TF M&M, Anne-Christine Le Gall)

Next:

- Complete ICP M&M ex-post endpoints:
  - tentatively assess impacts on ecosystem service (e.g. C-sequestration) based on de Vries and Posch, *Env.Poll.* (2011)

- Complete logic for TFIAM-WGSR scenario analysis with an effect-based approach:
  - use impacts as a basis for selecting "*impact efficient key measures*"

Europe's emissions over time



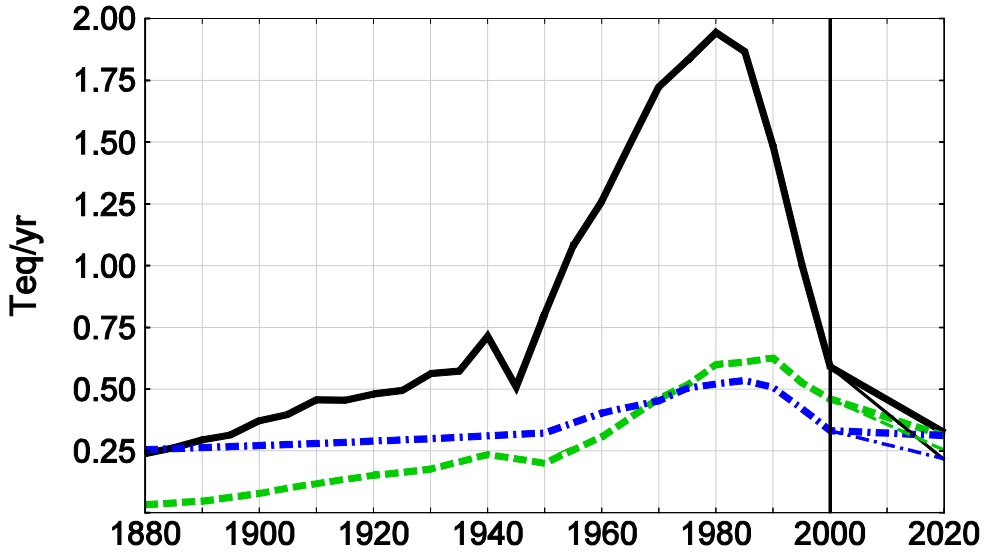
Mt or Tg SO_2

Mt or Tg NO_2

Mt or Tg NH_3

(T=Tera = 10^{12})

Europe's receptor-inputs over time:



Teq S

Teq N

Teq N

➔ **NH_3 more prominent!**

Scenarios (as of Feb 2011)

Year: **2020**, all based on PRIMES model

Cost-optimal Baseline (COB – formerly known as CLE)

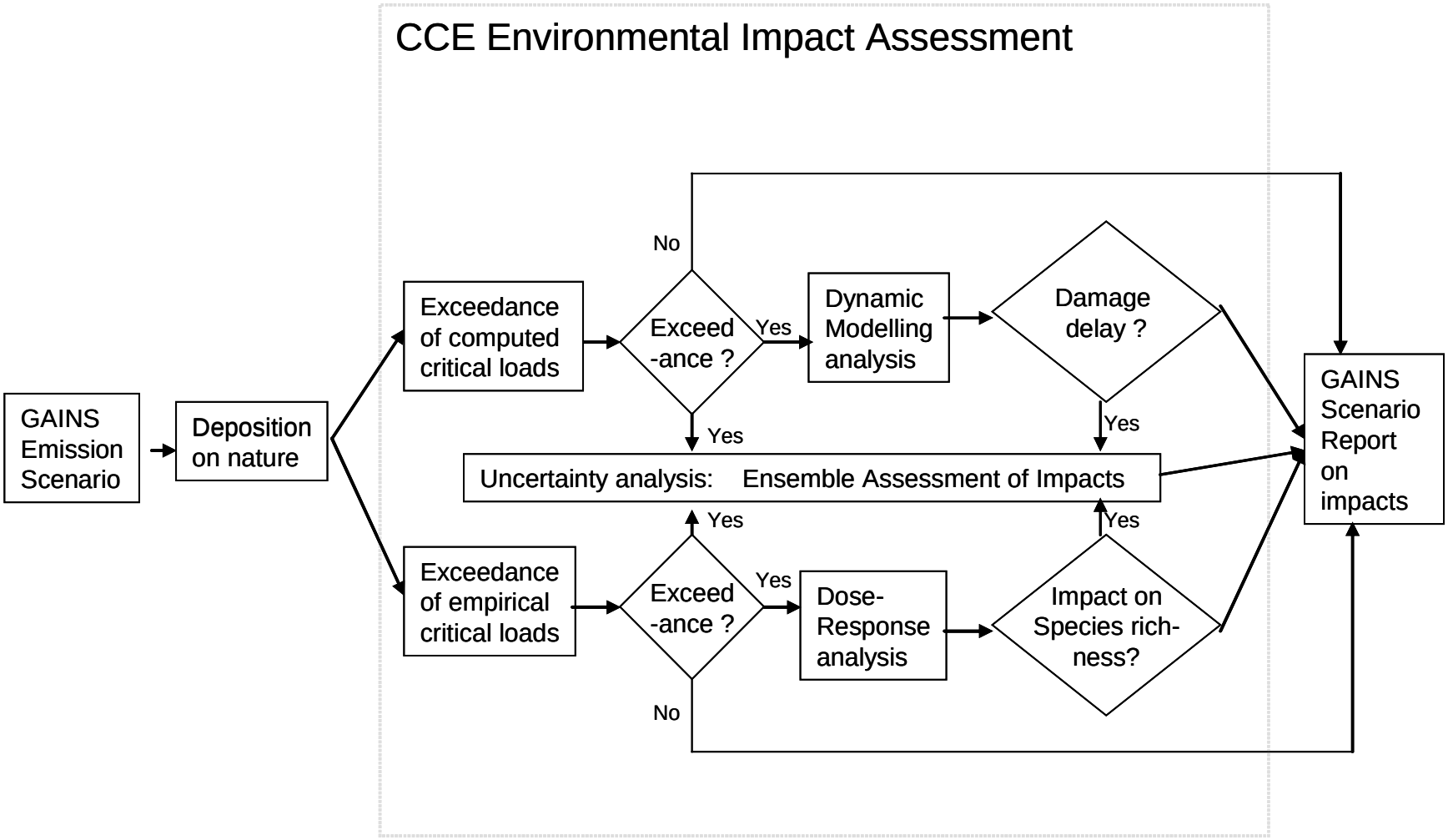
5 ambition levels:

Table: Summary of gap closure percentages for the impact indicators

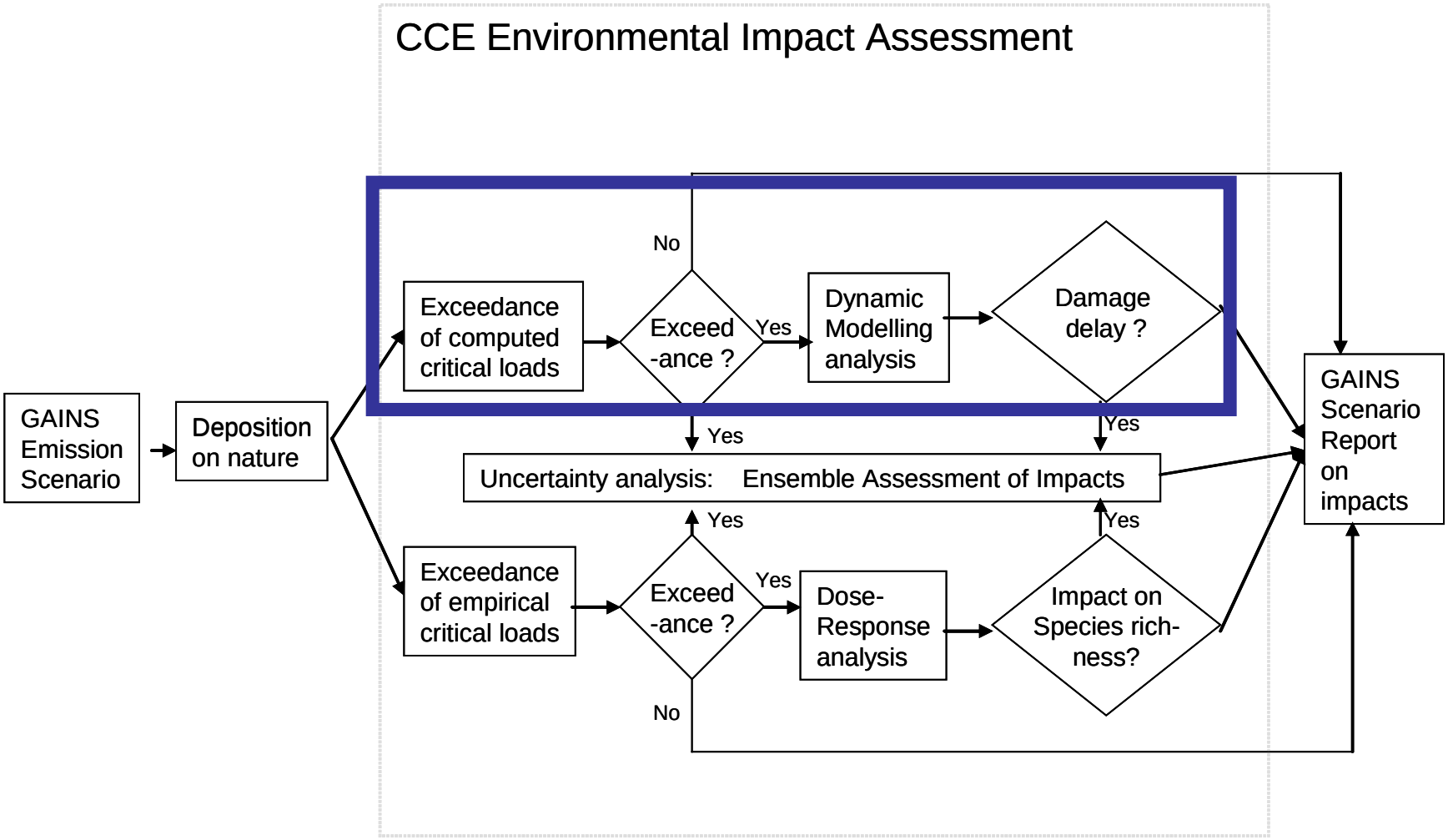
Scen	Health-PM	Acidification	Eutrophication	Ozone
HIGH	75%	75%	75%	75%
High*	75%	75%	75%	50%
MID	50%	50%	60%	40%
Low*	25%	25%	50%	25%
LOW	25%	25%	25%	25%

+ Maximum Feasible Reductions (MFR)

Structure of ICP M&M Impact assessment



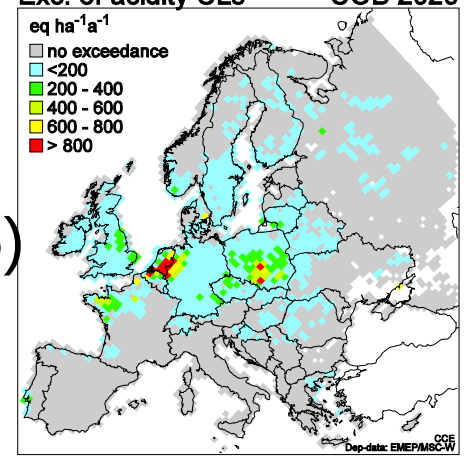
Modelled critical loads, Exceedance, Dynamic Modelling

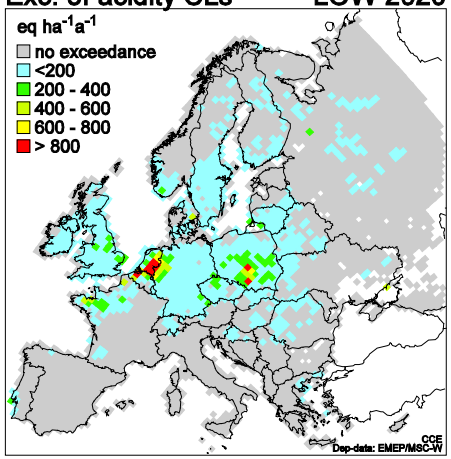


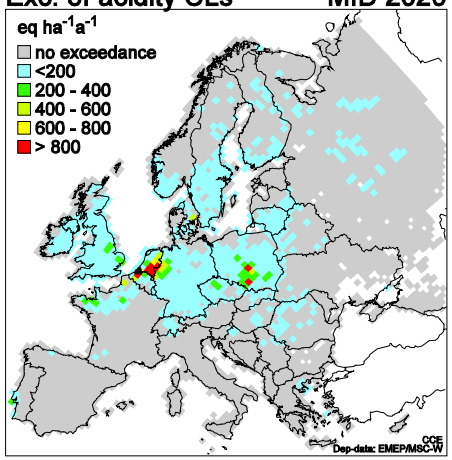
Exceedances (AAE) of Acidity Critical Loads and % area at risk in Europe and (EU27)

3% (5)

3.5% (6)

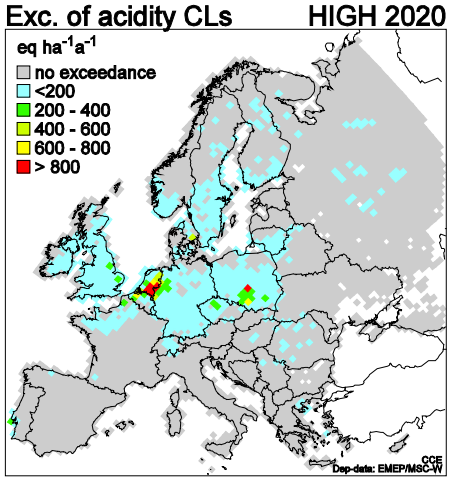


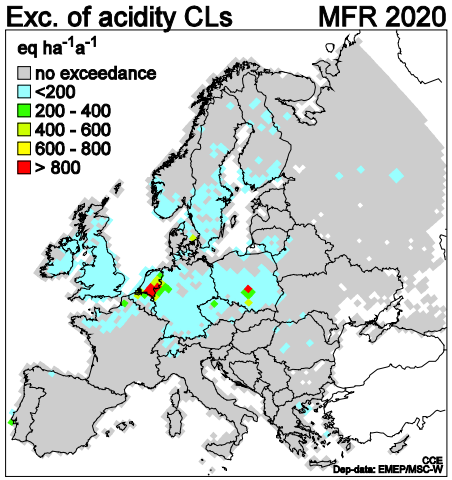




2.4% (4)

1.9% (3.4)



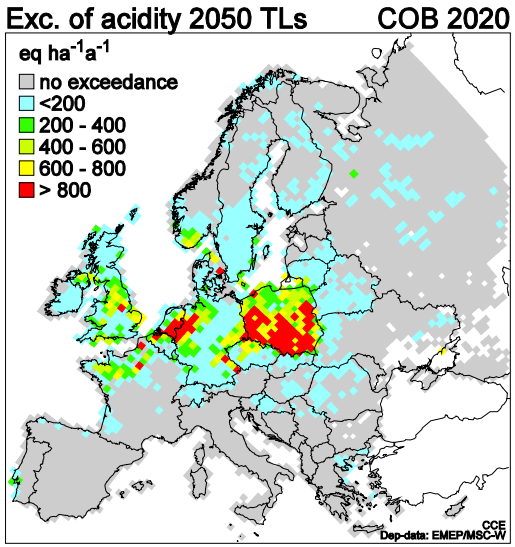


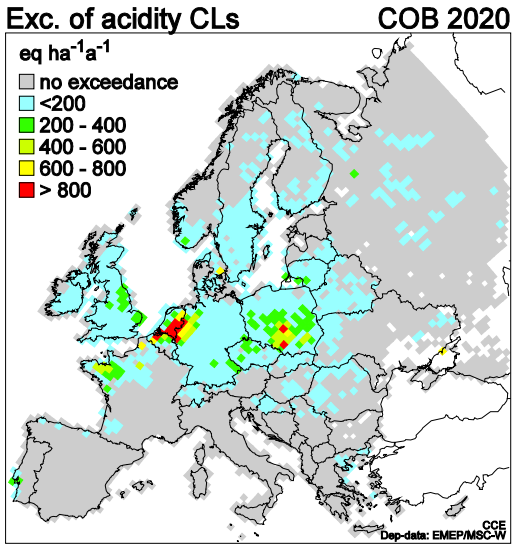
1.4% (2.6)

DYNAMIC MODELLING of acidification:
Violation of Acidity 2050 Target Loads (compared with CLs) and % area not recovering before 2050 in Europe and (EU27)

Target Loads | **CLs**

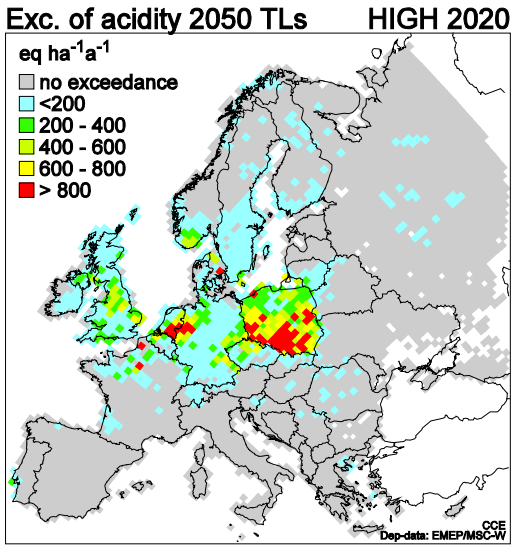
COB 5.2% (9)

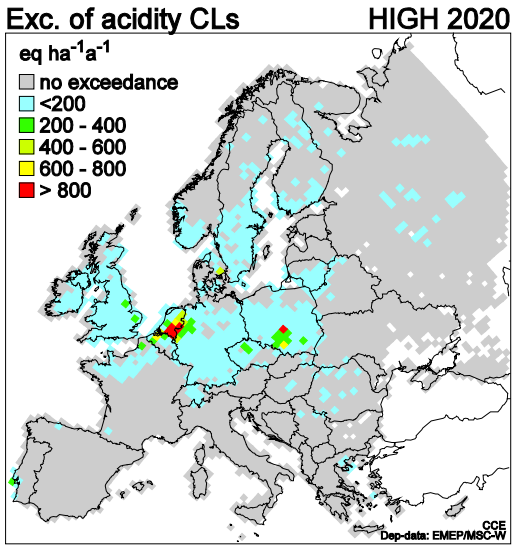




3.5% (6)

HIGH 3.8% (7)



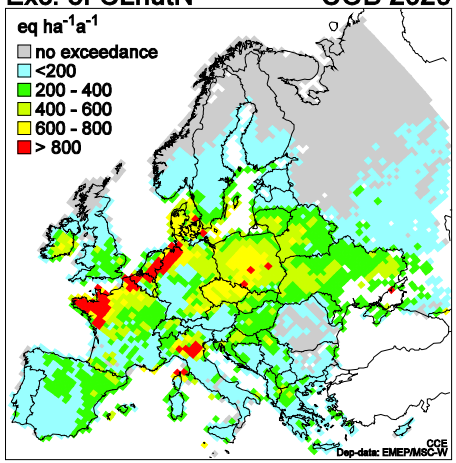


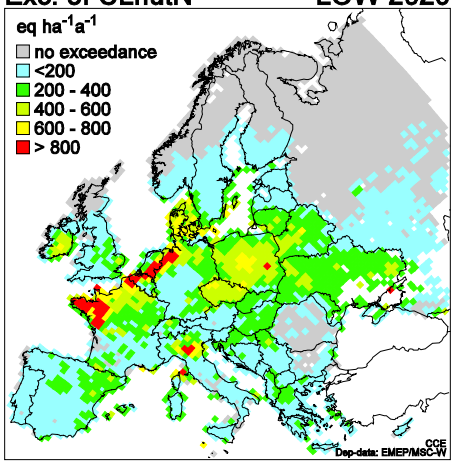
1.9% (3.4)

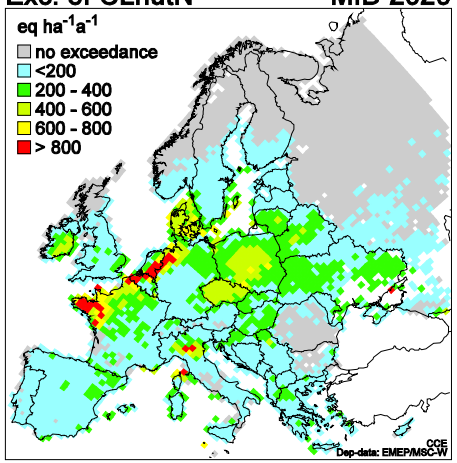
Exceedances (AAE) of Nutrient Critical Loads and % area at risk in Europe and (EU27)

32% (52)

37% (58)

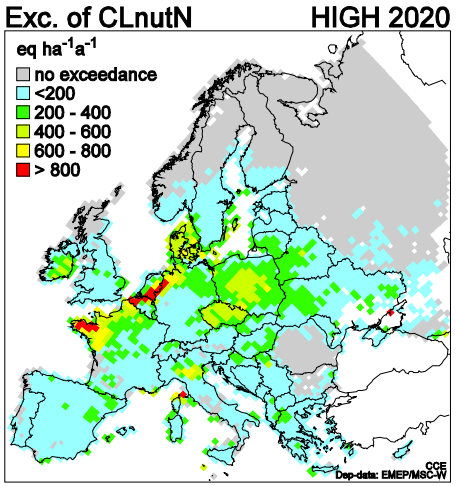


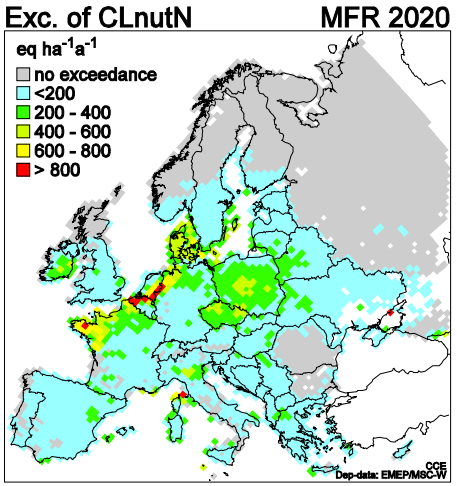




28% (46)

25% (42)



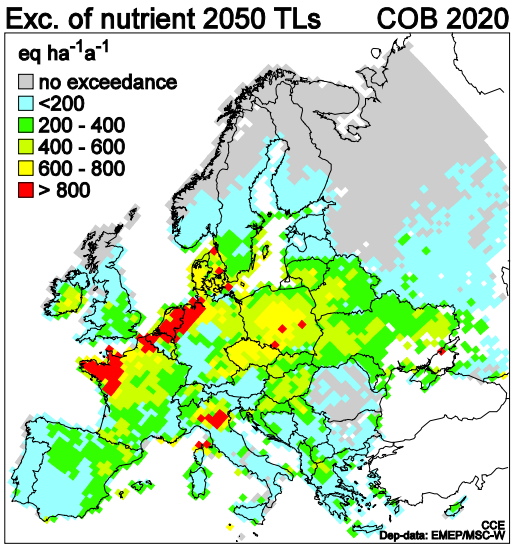


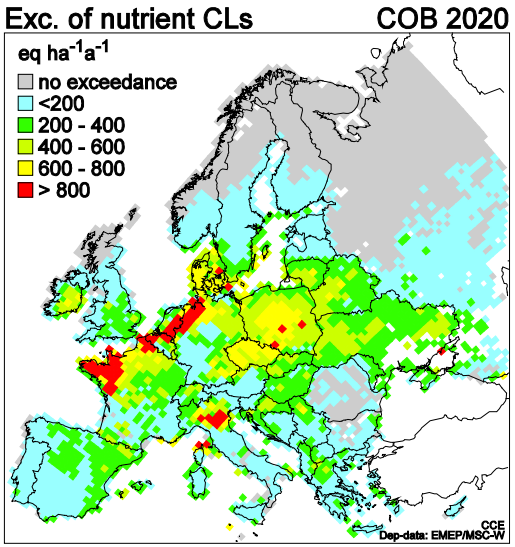
21% (36)

DYNAMIC MODELLING of eutrophication:
Violation of Nutrient 2050 Target Loads (compared with CLs) and % area not recovering before 2050 in Europe and (EU27)

Target Loads **CLs**

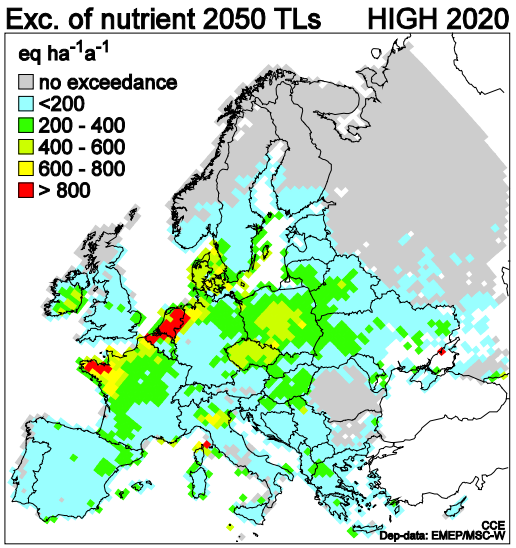
COB 37% (60)

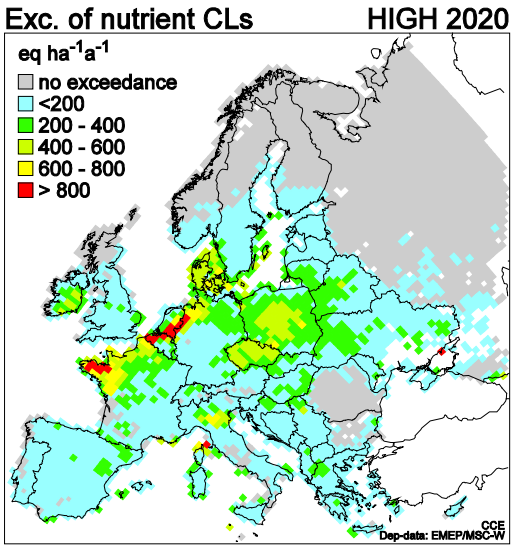




37% (58)

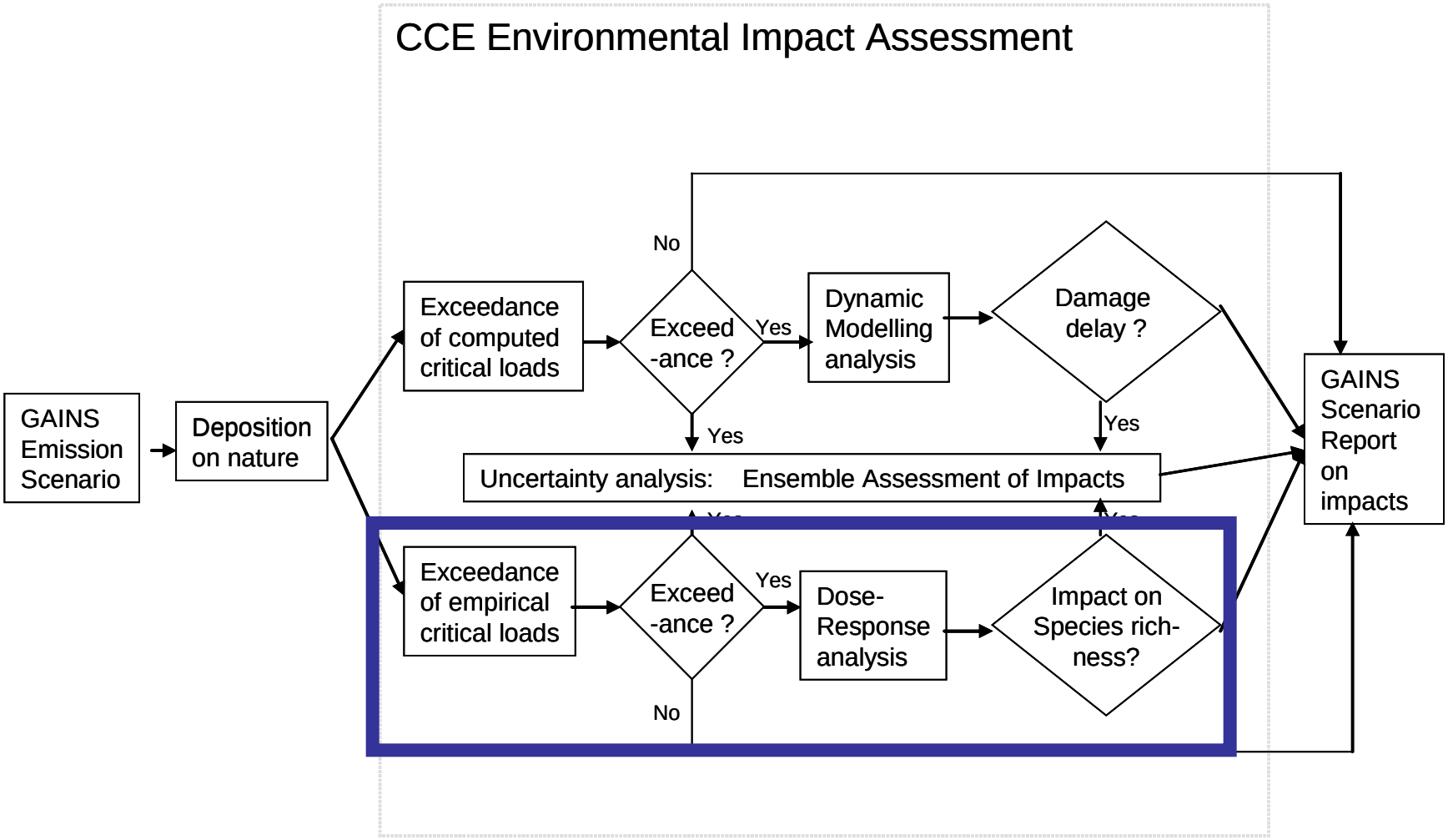
HIGH 26% (45)





25% (42)

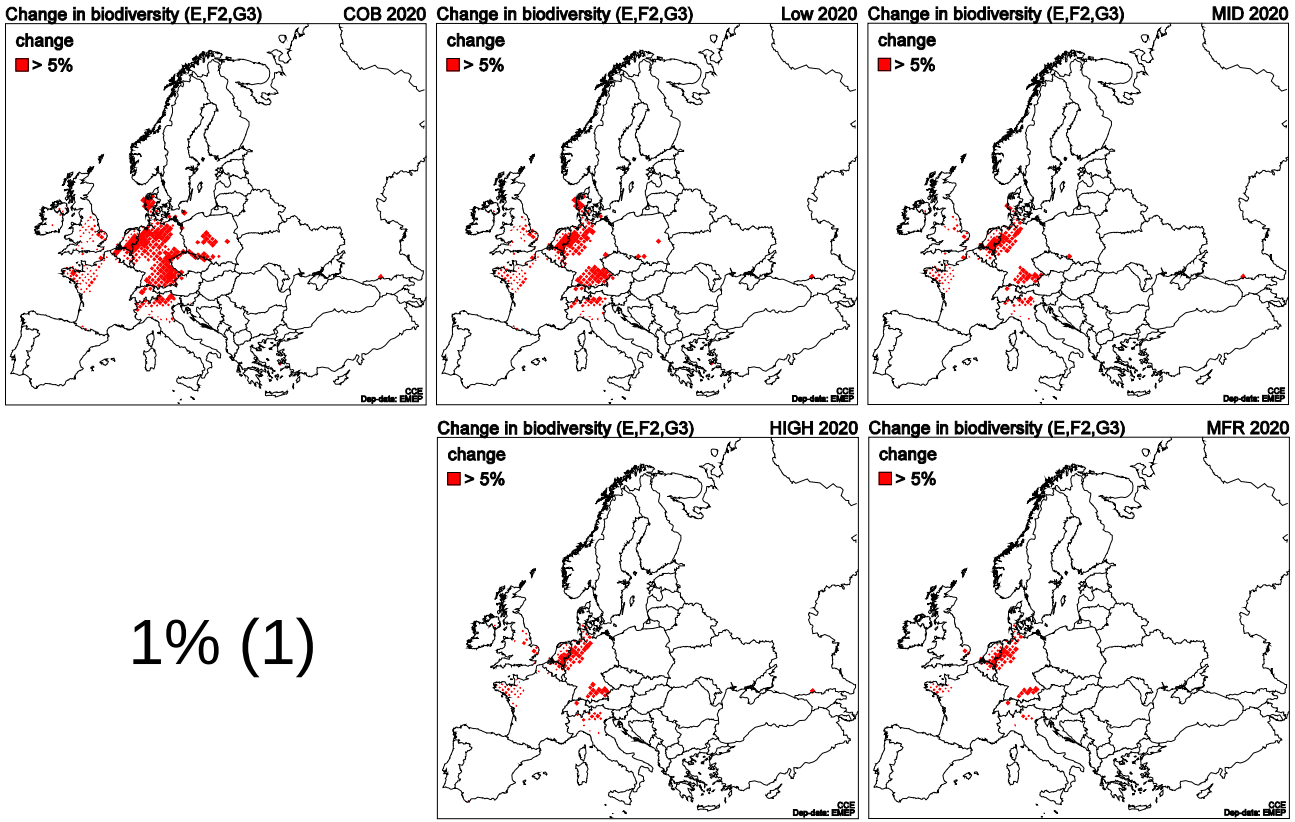
Assessment of the “change of biodiversity”



Area at N-risk of a more than 5% “change in biodiversity”, i.e. of species richness [semi-natural grass lands; s-alpine scrub habitats], and similarity [coniferous boreal woodlands], together covering 53% of European natural area

2% (3)

3% (5)



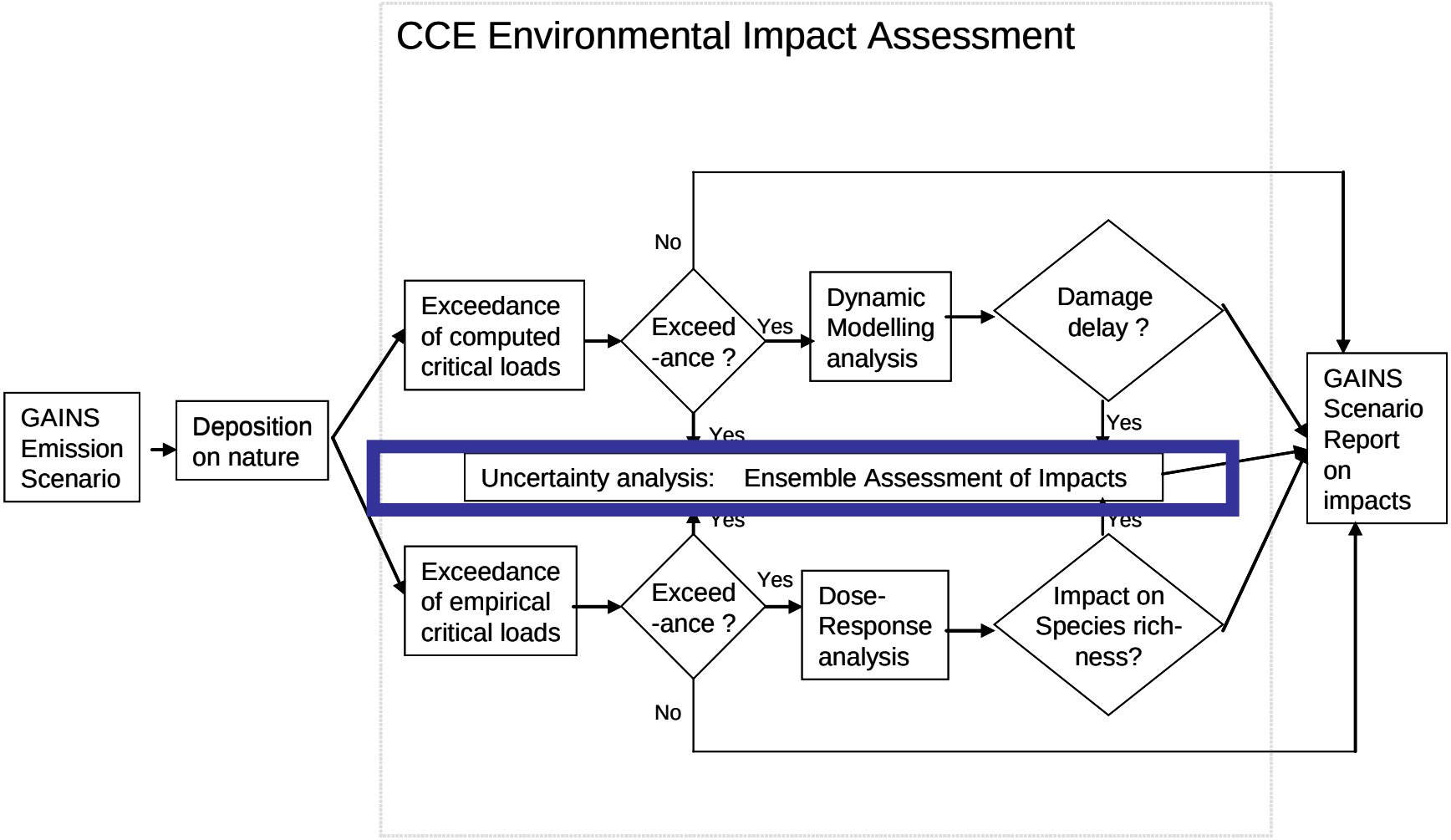
1% (2)

1% (1)

0% (1)

See CCE Status Report 2010, chapter 3, for caveats

Assessment of the robustness of scenario impacts



Next…

(1) ICP M&M proposal to further complet ex-post endpoints:

- tentatively assess impacts on ecosystem service (e.g. C-sequestration) based on de Vries and Posch, *Env.Poll.* (2011)

(2) Proposal to further complete logic for TFIAM-WGSR scenario analysis with an effect-based approach:

- use impacts as a basis for selecting "*impact efficient key measures*"

Next (1)…

to **tentatively** assess impacts on an ecosystem service (e.g. C-sequestration)

based on de Vries and Posch, Env.Poll. (2011)

- *Objective*: air quality and climate impacts on productivity and carbon sequestration:

- *Modelling approach*:
  - Inclusion of interactions of drivers
  - Empirical evidence effects individual drivers
  - Assessing changes in drivers

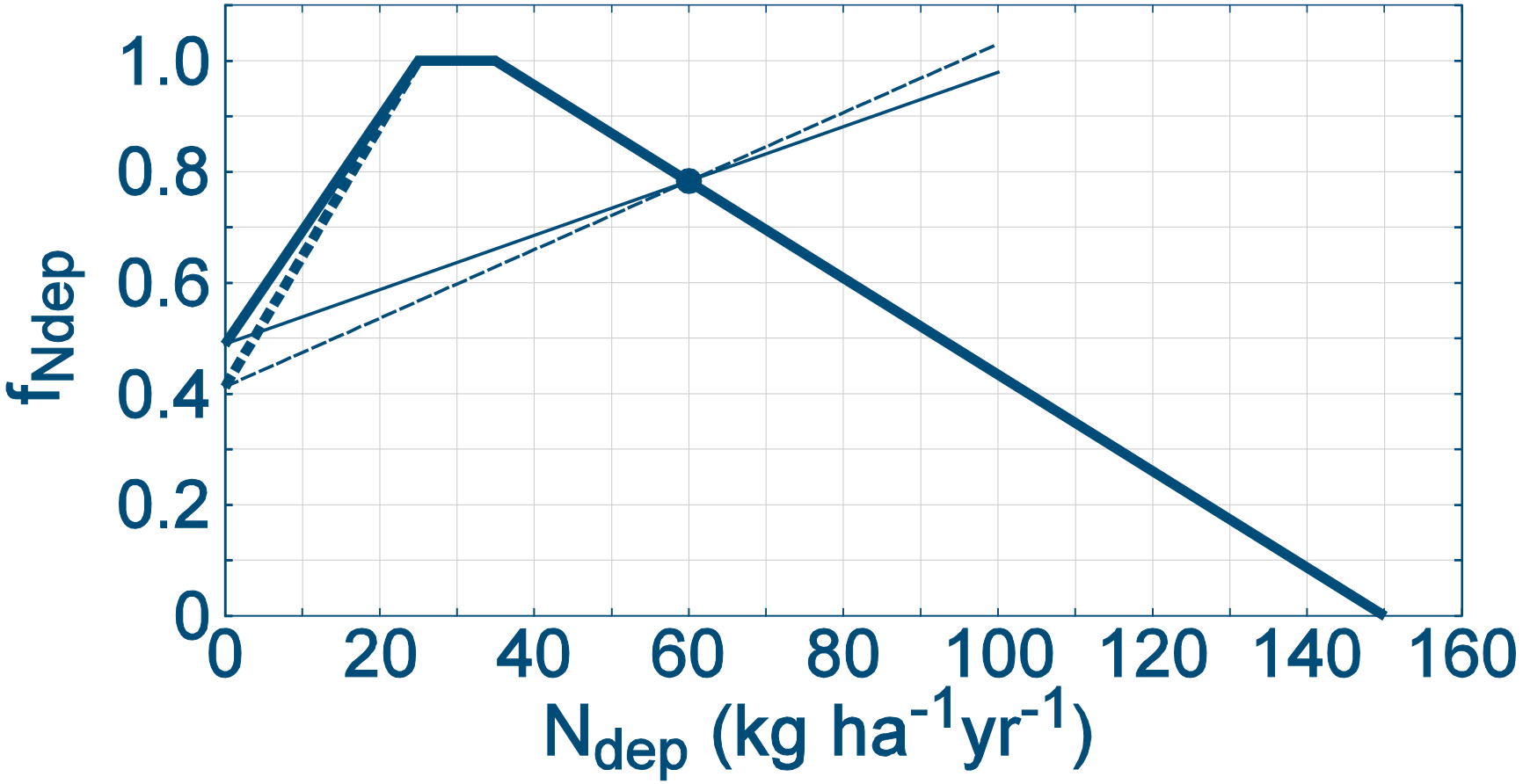
- *Results:* Effects of climate and air quality change on growth/carbon sequestration of European forests in the period 1900–2050

Impacts of air quality and climate change

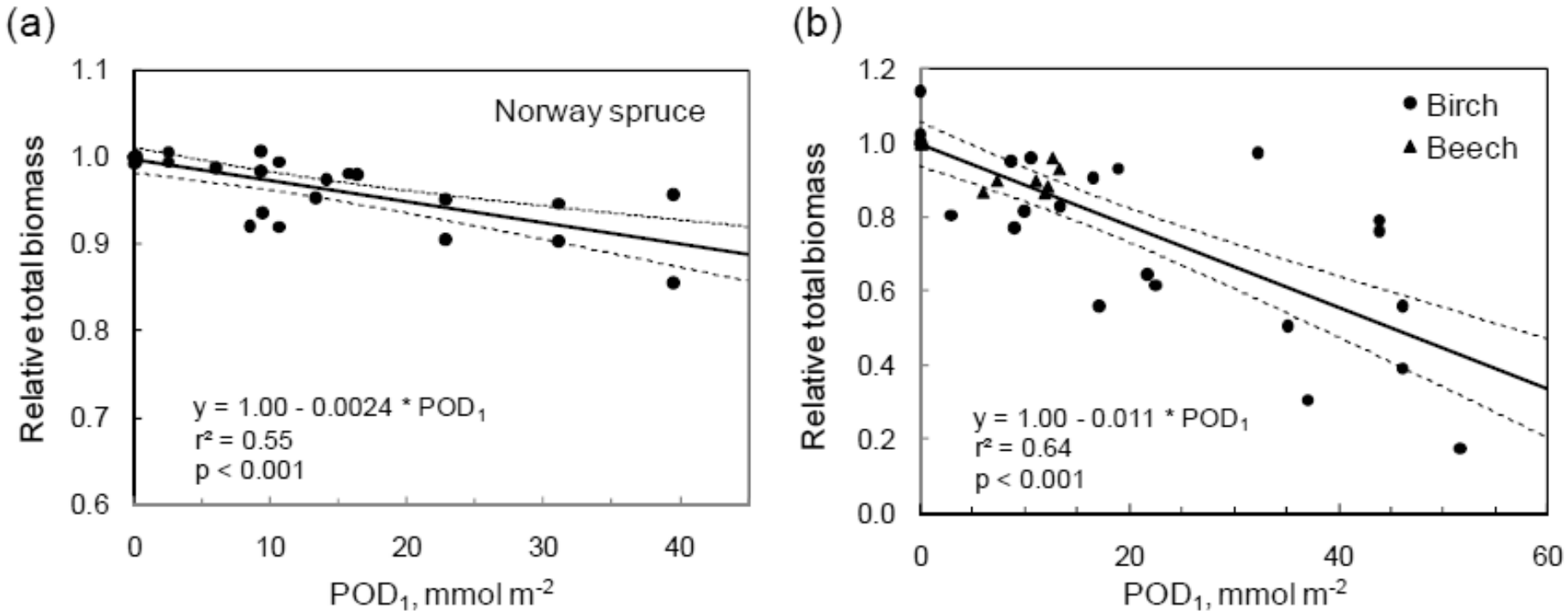
Forest growth/carbon sequestration is affected by

- Air quality effects and interactions
  - N [and S] deposition: N availability/limitation; soil acidity.
  - Phosphorous and base cation availability/limitation.
  - [Ozone exposure]
- Climate change
  - [CO_2 fertilization]
  - Water availability
  - Temperature

Response function relating forest growth to N deposition



Response function, relating forest growth to ozon



POD_1 : Phytotoxic ozone dose above 1 mmol $m^{-2}s^{-1}$

Scenarios for N deposition and climate

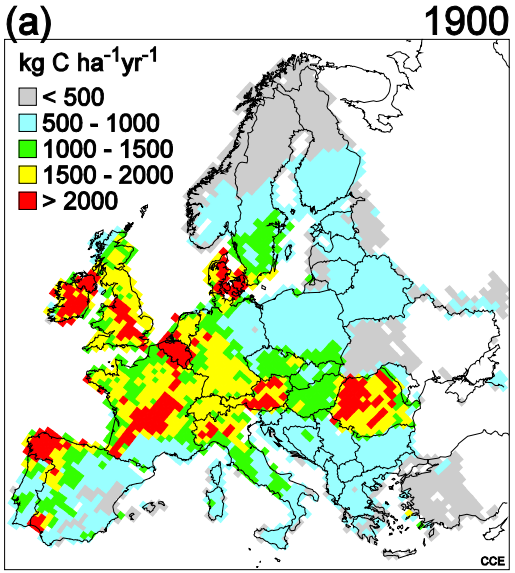
- Historic air quality and climate data from 1900 to 2000; 4 scenarios up to 2050
- 2 for N deposition:
  - Current legislation ('CLE').
  - Stringent legislation (SLE).
- 2 for climate:
  - **SRES A1 climate scenario**.
  - SRES B2 climate scenario.

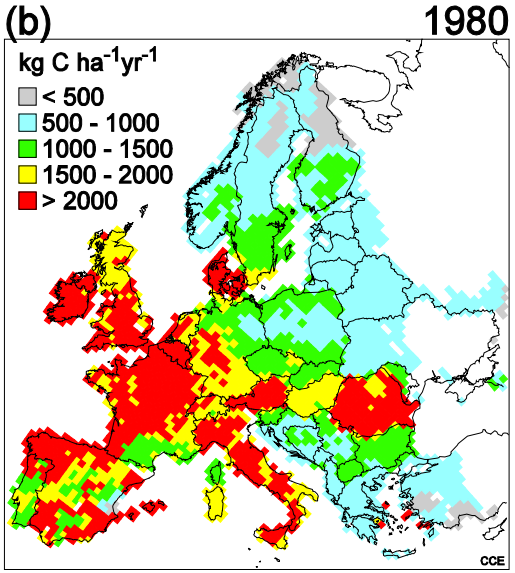
Tree C sequestered per EMEP grid cell in 1900, 1980 and 2050,

(exl. Effect of S-dep, CO2-fertilization, O3-effect)

Source: Updated from de Vries and Posch (2011), Env.Poll online, Fig. 7

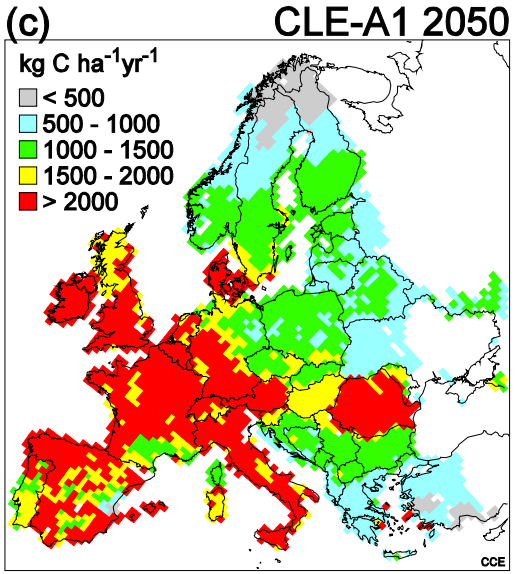
1900

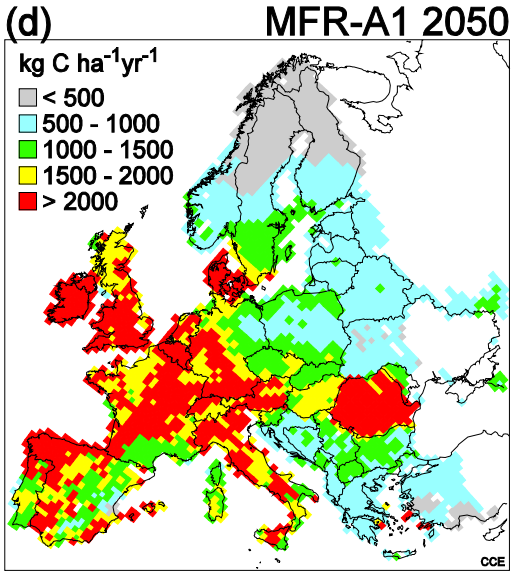




1980

2050
CLE-A1





2050
MFR-A1

Observations from the tentative analysis of C-sequestration

- Historical N-depositions have enhanced C-sequestration over the last 100 years
- Future N-depositions (MFR) have a reduced effect on C-sequestration, which is “compensated” by the growth-effect of climate change (T-up, CO2-up, Drought-down…)
- Foreseen reduction of [O3] would further enhance C-sequestration in 2050

Next (2) …

to select "*impact efficient key measures", following the logic developed by CIAM for identifying "limited (cost-effective) key measures"*

1. Identify impacts of all measures under MID in terms of the following endpoints:
   - PM health
   - O3 health
   - O3 environment
   - Acidification
   - Eutrophication
   - Instantaneous radiative forcing
2. Rank measures by their potential to reduce impacts *(…single endpoint + co-impacts; any combination of endpoints; all endpoints*…)
3. Select a subset of measures to obtain the impacts as under LOW
4. Apply, of this subset, those in each country whenever cost-effective
5. Apply all measures in this subset in each country
6. Compare results of 4 and 5 to the original CIAM proposed logic and ensuing scenario appraisal.

Conclusions and recommendations

ICP M&M ex-post analysis:

- ICP M&M endpoints of ex-post analysis include *exceedances and areas at risk; recovery and damage delays; relative change of biodiversity; robustness..*
- explore inclusion of endpoints for ecosystem services (e.g. scenario specific C-sequestration) in collaboration with Mike Holland

Effect oriented TFIAM scenario analysis:

- Explore selection of “impact efficient key measures”, following the logic developed by CIAM for identifying “limited (cost-effective) key measures”

Final scenario for ex-post analysis required:

- WGE ready to run “draft final” scenario (…MID ?) in collaboration with EMEP (MSC-W and CIAM)