Critical Loads for Biodiversity
CCE work ≤ 2017 & view on future (sort of)

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Source: CCE Final Report 2017

Whereas 2017 CLs on acidity and eutrophication were approved by the WGE for use under the Convention (and with CIAM), **biodiversity CLs** were not …

More work on them was recommended …

European critical loads:
database,
biodiversity and
ecosystems at risk

CCE Final Report 2017

History

While 'classical' CLs (especially CLaci) have been investigated/used ≈30 years, biodiversity (CLs) were 'considered' only during the last 10 years …

At first, no biodiv CLs defined, but vegetation models linked to dynamic soil-chemistry models
(e.g., ForSAFE-Veg, VSD-Veg, MADOC-MultiMOVE, …)

Also, search for proper biodiversity indicators, i.e. measures to quantify biodiversity

Also, Dose(=N-load)-Response(=Sprich) functions investigated (e.g., C. Stevens et al.)

Sources: CCE Status Reports ≥ 2009; www.icpmapping.org leads to
https://www.umweltbundesamt.de/en/Coordination_Centre_for_Effects

First step: Modelling (probability) of occurrence of plant species ➔

Example: PROPS model (version PROPS2s):

Probability *y* for occurrence of a plant modelled as:

$$z = \text{logit}(y) = \log\frac{y}{1-y} = a_0 + \sum_{i=1}^{n} a_i \cdot x_i + \sum_{i=1}^{n} q_i x_i^{2}$$

Number of variables x_i is $n = 5$ (normalized/log-transformed):
soil solution pH, C:N ratio, N deposition, precipitation, temperature.

Probability *y* obtained as: $y = \dfrac{1}{1+\exp(-z)}$

The 11 coefficients needed are derived for many plant species from relevés with both biotic and abiotic observations and extrapolated …

Habitat Suitability Index

Agreed at the 2014 ICP M&M TF Meeting …

The HS index is defined as the arithmetic mean of the 'normalised' probabilities (suitabilities, possibilities) of occurrence of the species of interest:

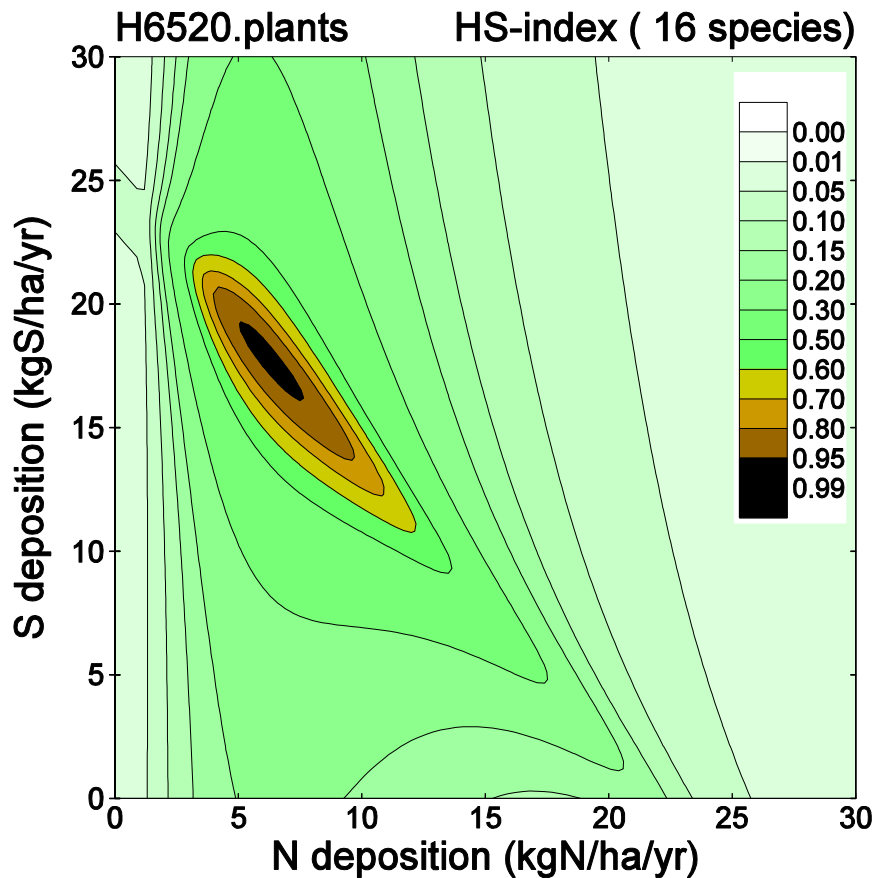$$HSI = \frac{1}{n}\left(\frac{p_1}{p_{1,opt}} + \frac{p_2}{p_{2,opt}} + \cdots + \frac{p_n}{p_{n,opt}}\right)$$

where n is the number of species, p_j the occurrence probability of species j, and $p_{j,opt}$ the optimum/maximum occurrence probability of species j.

HSI isolines for habitats (BioScore):
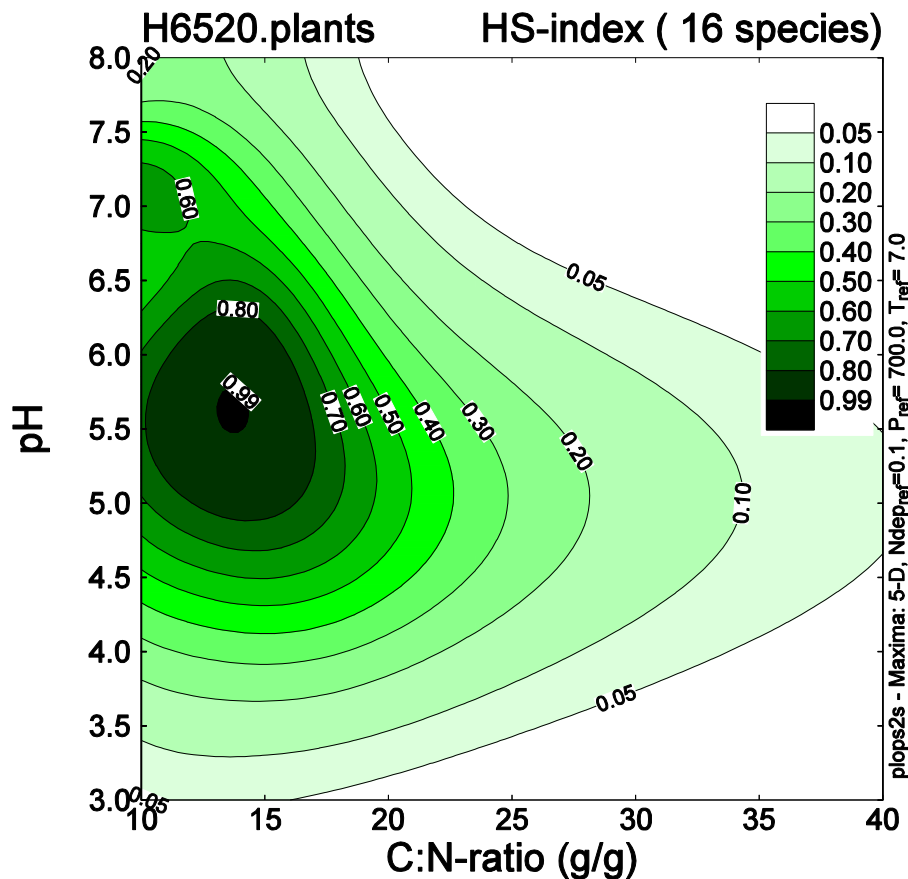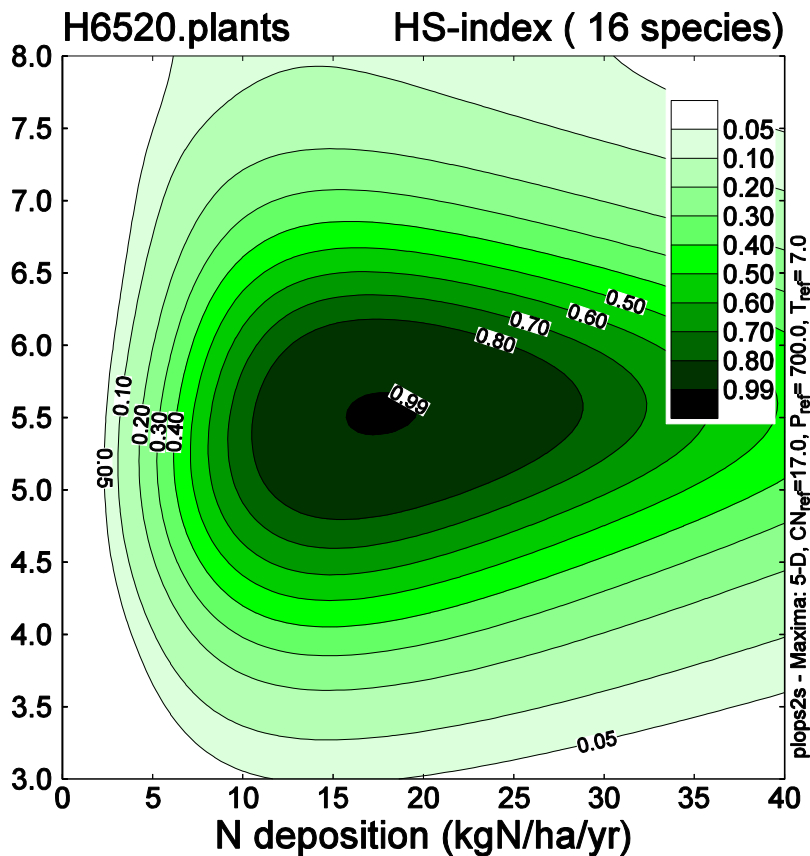
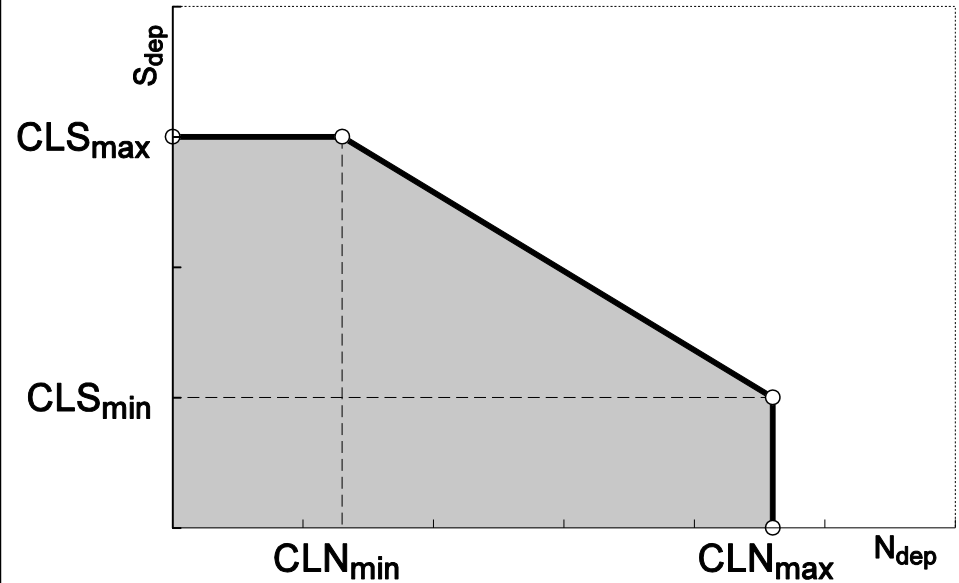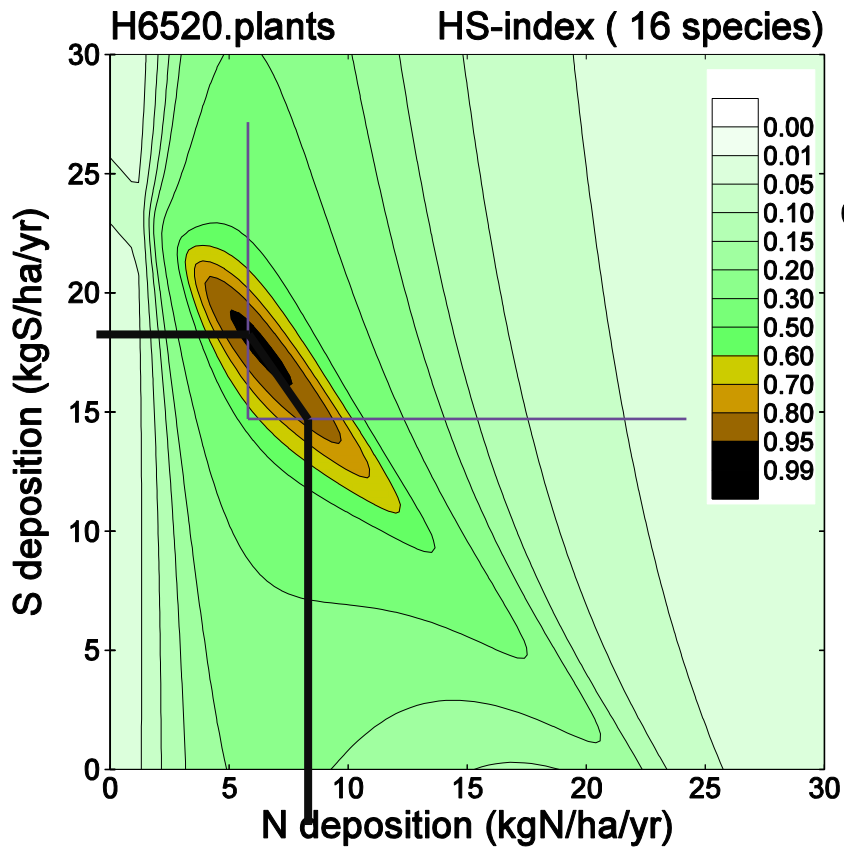# … for CLRTAP applications link to N and S deposition!

- N_{dep} primary variable (fine!)
- S_{dep} computed from pH & N_{dep} with SMB *using site properties*

Due to dependence on site properties, it varies from place to place

… How to get CLs from that?

# Define critical/acceptable value of index … and simplify

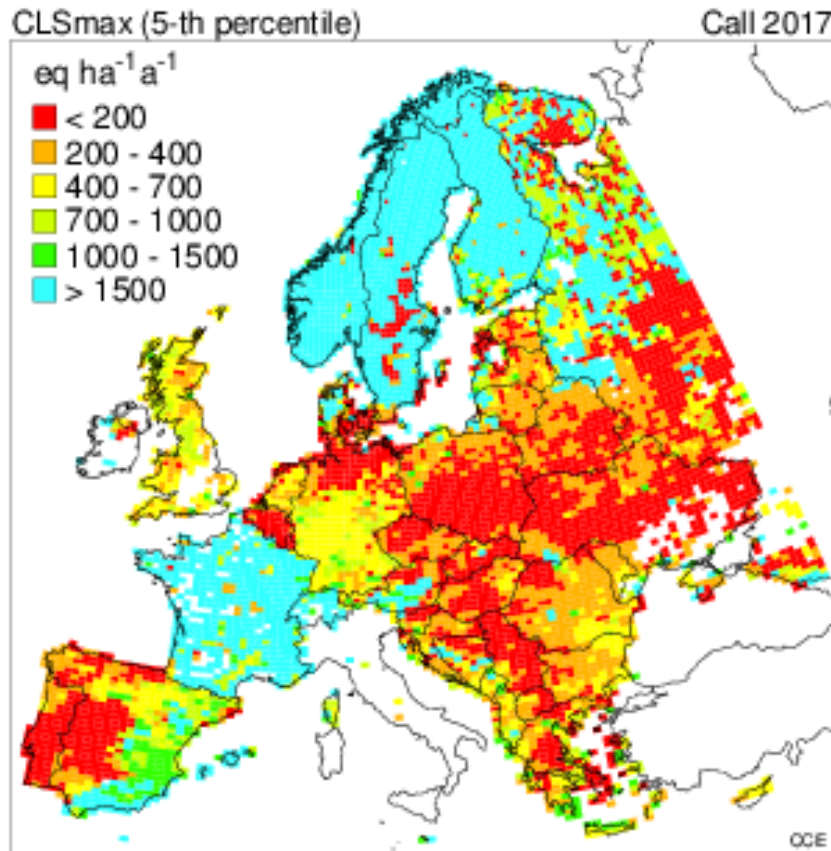H6520.plants   HS-index (16 species)

4 numbers (CLs): $0 \leq CLN_{min} \leq CLN_{max}$
and $0 \leq CLS_{min} \leq CLS_{max}$

Note: 'Similar' procedures to derive CLFs from other biodiv. models, such as **Veg, BERN, MultiMOVE, US-PROPS(v2)**, etc …

European database of CLs of biodiversity
Call for Data 2015-2017

NFC data (FR,GE,IE,IT,NL,CH,UK)**+ CCE background data** for other Parties
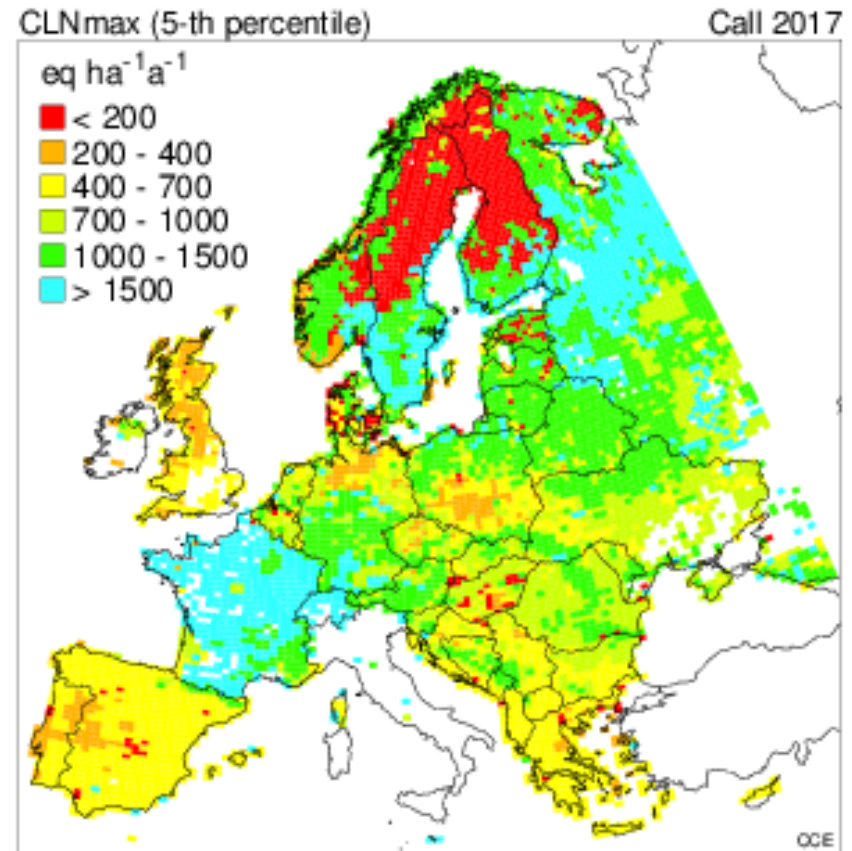
Summarising:

- 'Plant occurrence' models exist …
- … but data often lacking, esp. for some 'remote' areas
- 'Easy' to link to dynamic soil chemistry models (if no feedbacks!)
- Biodiv. indicator not necessarily a CL, but how to link it otherwise to CIAM work (N_{dep} and S_{dep})?
- Deriving CLs from biodiversity indicators non-trivial (but done)
- Biodiv. CLs for Europe have been derived, but not many national contributions (and not yet 'in use')

What next ('way forward')?

- Continue pushing biodiv. indicators (CLs), since biodiversity is now a 'hotter' issue than, e.g., acidification.
  TFIAM/CIAM would like to incorporate a 'biodiversity indicator' into the GAINS model.

- Seek links (also on national level!) to other international organisations working on biodiversity … (CBD, EU policies)

- Encourage all modelling activities in that direction
  (e.g. also Dose-Response functions?)

- Alternative: Translate biodiversity change/loss into chemical criterion/criteria for classical SMB CLs

- Note: Biodiversity as endpoint not entirely new:
  Many empirical CLs have it as endpoint …

Thank You! ☺

…

Comments? 😐
Questions? ☹

All on CLs, and much more, to be found in:

De Vries W, Hettelingh J-P, Posch M (eds), 2015.
Critical Loads and Dynamic Risk Assessments:
Nitrogen, Acidity and Metals in Terrestrial and Aquatic Ecosystems.
Environmental Pollution Series Vol. 25, Springer, Dordrecht, xxviii+662 pp.;
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Environmental Pollution   25

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Jean-Paul Hettelingh
Maximilian Posch
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