# Critical loads for the Netherlands: combining modelled and empirical critical loads

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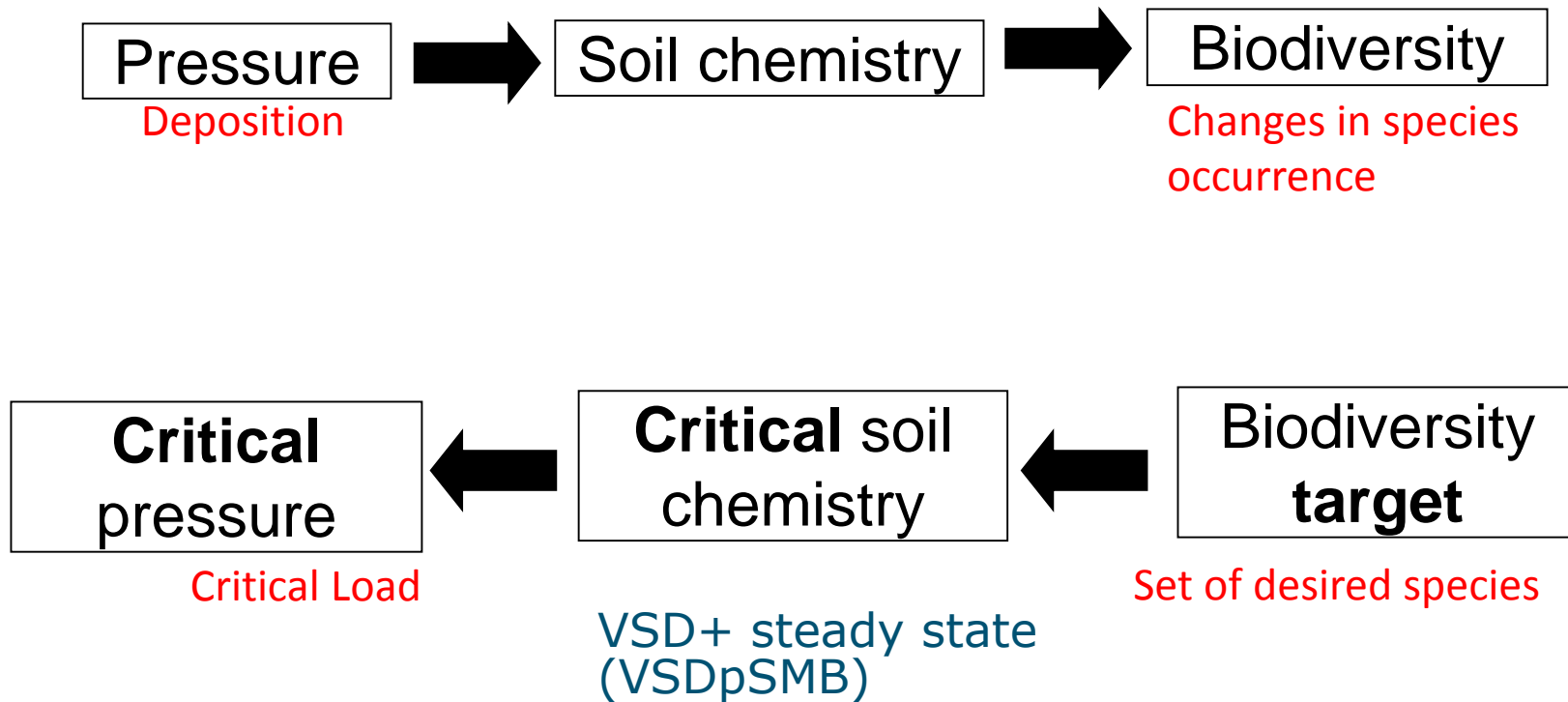
# Content

- Modelling approach

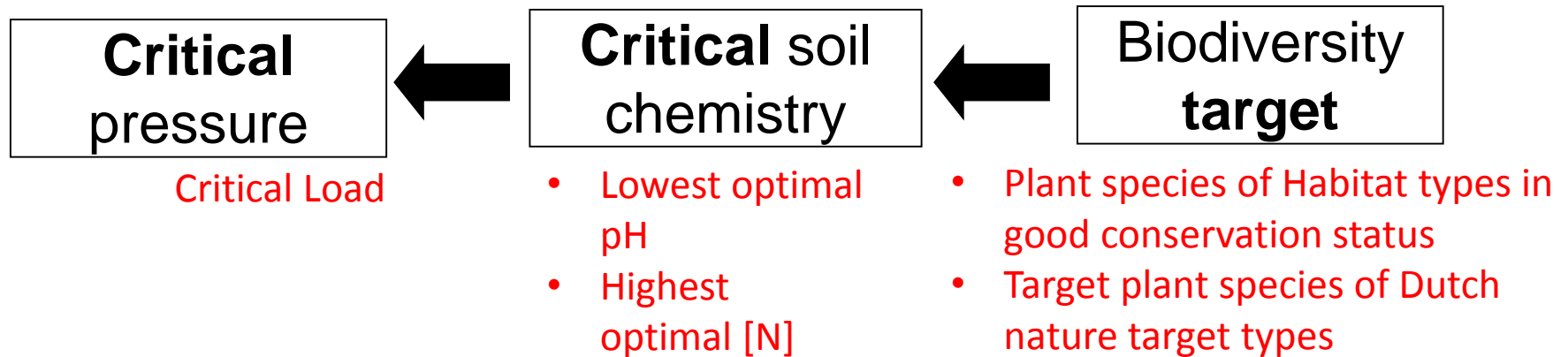- Data used

- Results

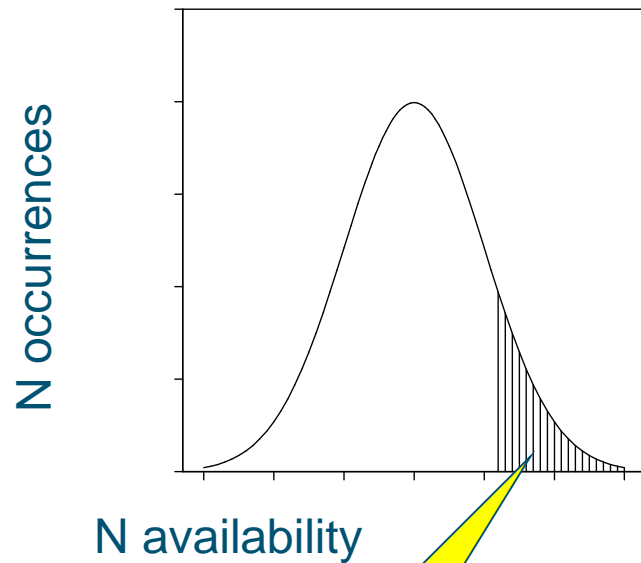- Conclusions

# General modelling approach

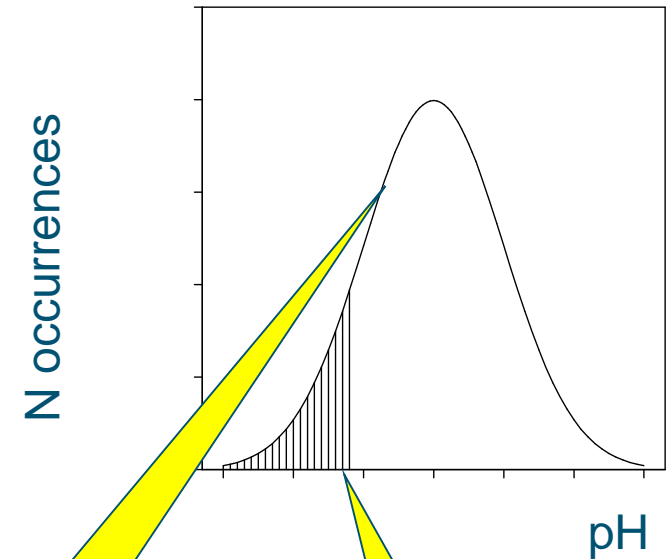VSD+                    PROPS

| Pressure | → | Soil chemistry | → | Biodiversity |

Deposition      Changes in species occurrence

| **Critical** pressure | ← | **Critical** soil chemistry | ← | Biodiversity **target** |

Critical Load      Set of desired species

VSD+ steady state
(VSDpSMB)

# Used modelling approach

| **Critical** pressure | ← | **Critical** soil chemistry | ← | Biodiversity **target** |
|---|---|---|---|---|

Critical Load

- Lowest optimal pH
- Highest optimal [N]

- Plant species of Habitat types in good conservation status
- Target plant species of Dutch nature target types

# Example



N occurrences / N availability
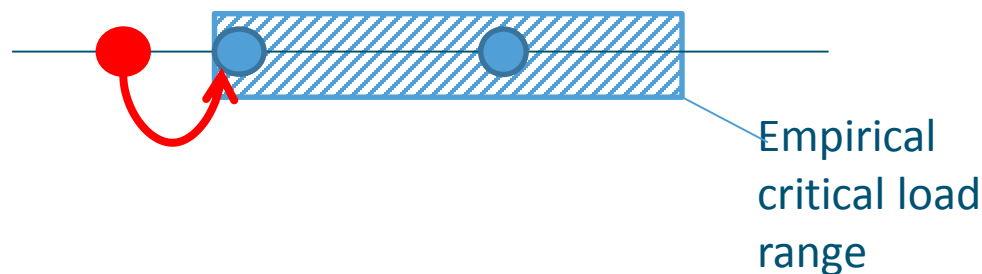
P$_{80}$ of N availability

N occurrences / pH

critical conditions per vegetation type

P$_{20}$ of pH

# However, models not always suitable

- Ecological unrealistic CL's or high uncertainty ranges

- For more robust local use in The Dutch Programmatic Approach to Nitrogen:

  - use model output within the empirical critical N load ranges
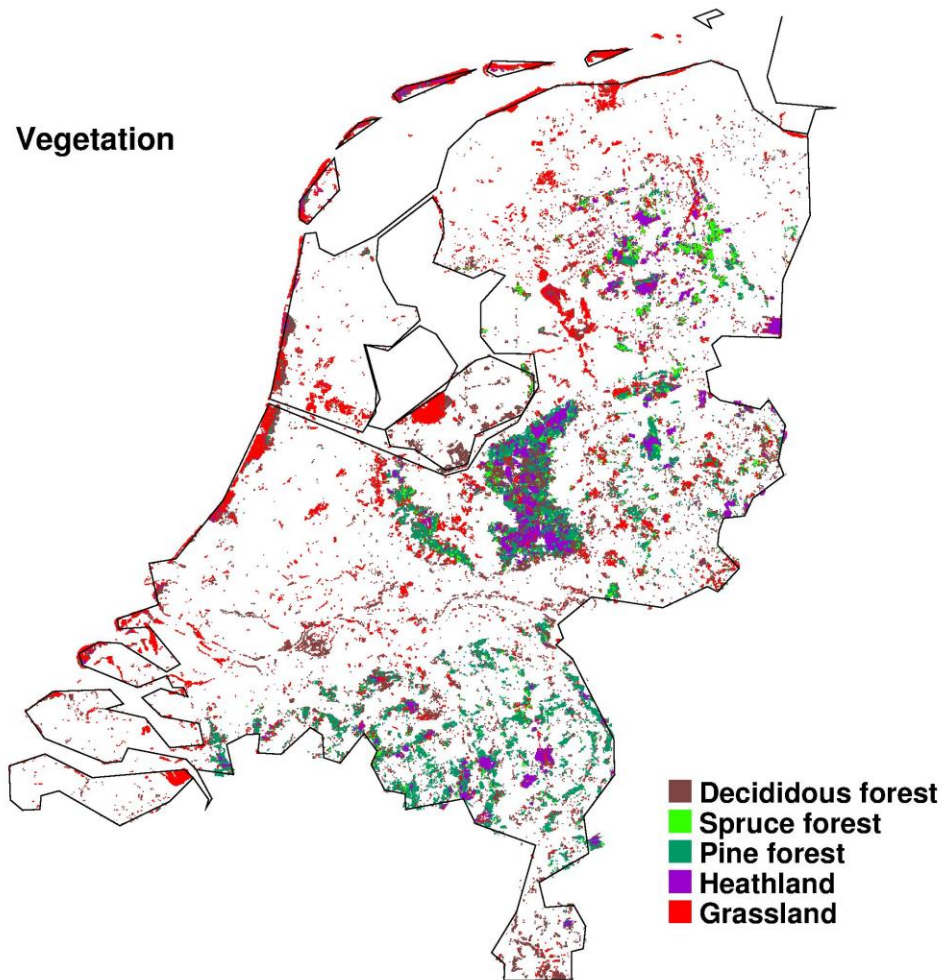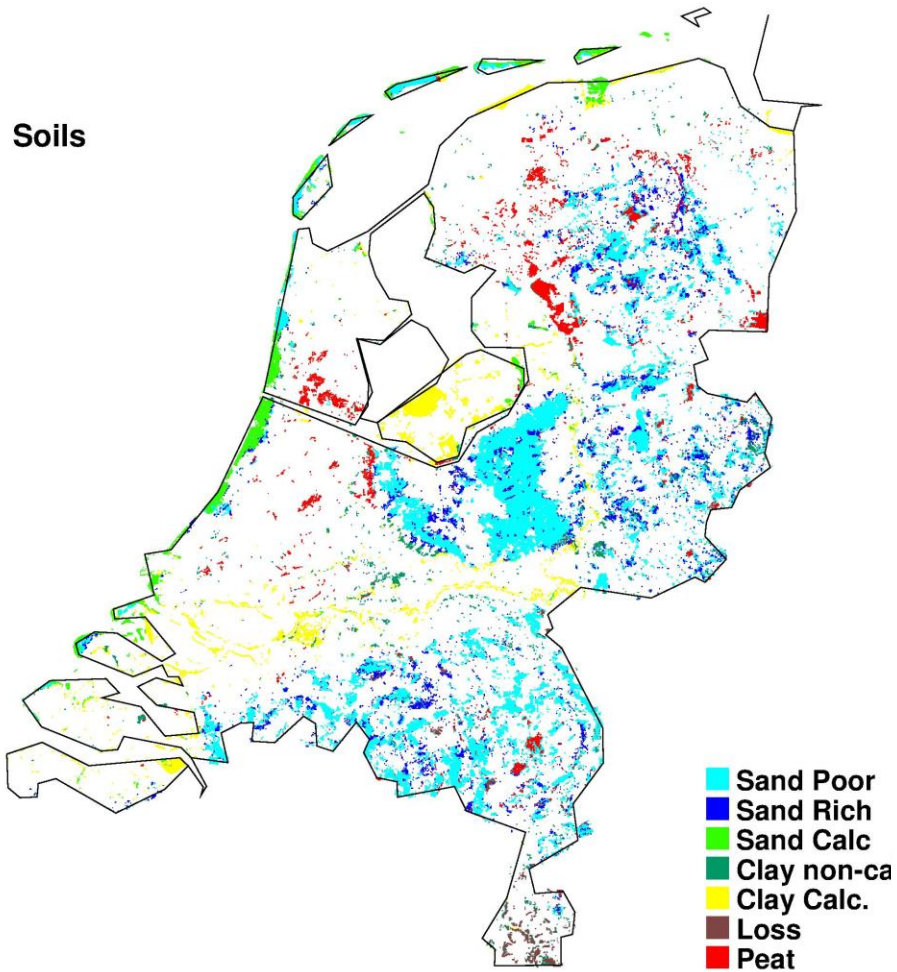


Empirical critical load range

Modelling:
- Calibration (extra litterfall in forests by ground vegetation, less litterfall in managed grasslands) is needed

- We model because empirical ranges can be broad (5-10, 10-20 kg N)

# Modelling: geographical data

- Base Maps Used:
  - Soil maps 1:50.000 aggregated in to 7 soil types (sand poor, sand rich, sand calcareous, clay non-calcareous, clay-calcareous, peat, löss)
  - Vegetation maps aggregated into 5 classes (pine, spruce, deciduous, heathland, natural grasslands)
  - Hydrology: upwards seepage (quantity, quality), precipitation
  - Habitat map (within N2K), map with nature target types
  - Map with base cation depositions

# Soils and vegetation

**Soils**



**Sand Poor**
**Sand Rich**
**Sand Calc**
**Clay non-ca**
**Clay Calc.**
**Loss**
**Peat**

**Vegetation**



**Decididous forest**
**Spruce forest**
**Pine forest**
**Heathland**
**Grassland**

# Modelling

- Overlay of maps to create cells of 250×250 m with one (dominant) combination of soil/vegetation/hydrology

- Critical loads computed for each cell with VSD+ steady state

- Criteria: pH and N availability
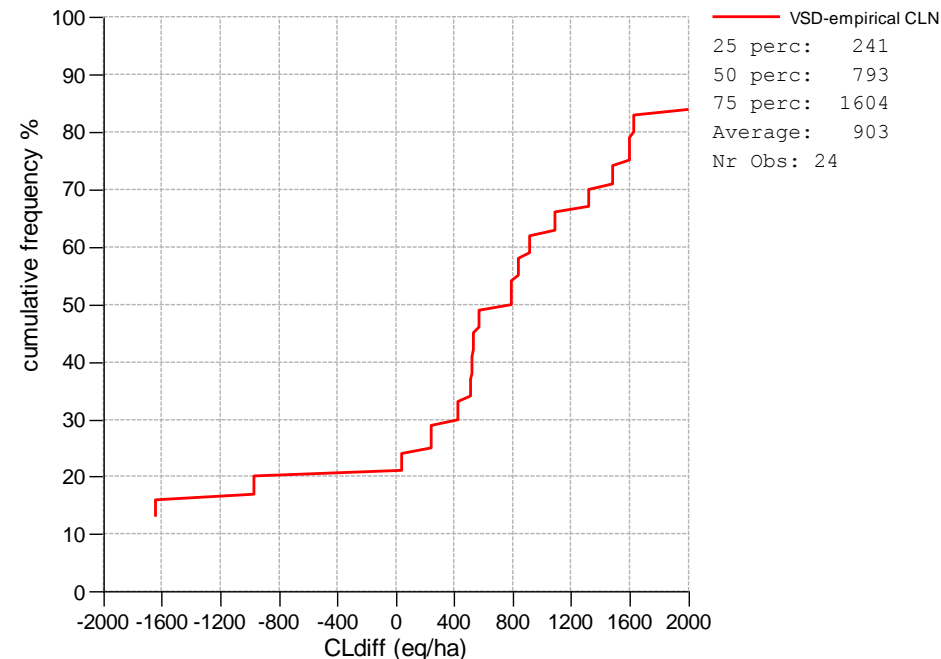  - CLmaxN and CLnutN on basis of Navail
  - CLmaxS on basis of pH

# Results: percentage of simulations within empirical range

- For about 60% of the habitats the computed CL(N) lies within the empirical range

The difference *for those systems where the VSD CL(N) lies outside the empirical range* varies, but in 50% of the cases is below 800 eq/ha (5.7 kg).

In 20% of the cases VSD CL(N) is lower than the empirical CL(N), in 80% it is higher

Habitats & Nature Target Types



| VSD-empirical CLN | |
|---|---|
| 25 perc: | 241 |
| 50 perc: | 793 |
| 75 perc: | 1604 |
| Average: | 903 |
| Nr Obs: | 24 |

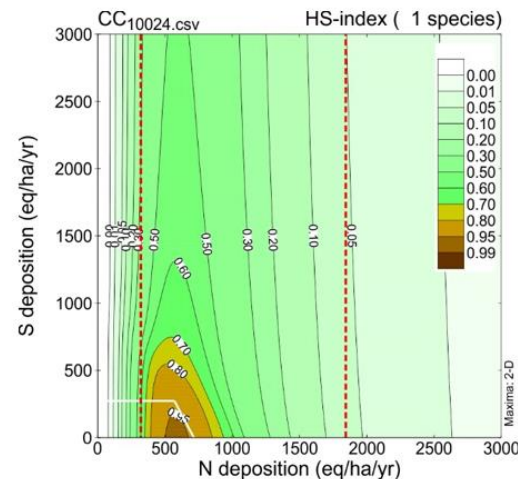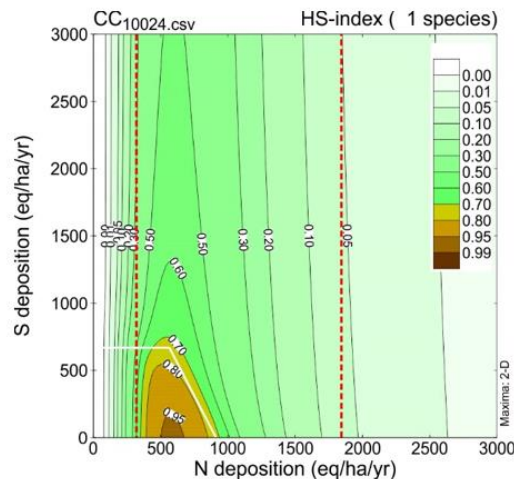# Some ecosystems where computed CL lies outside the empirical range

- Windblown sands (almost without vegetation)
  - N uptake?
- Wet heathlands
  - N denitrification?
- Part of the raised bogs
  - N denitrification / non-oxidized system?
- Part of the forests
  - Protecting another part of the ecosystem?

# Conclusions

- Combining VSD+ critical loads and empirical critical loads increases robustness

- Parametrization of VSD+ is key for plausible results
  - Some systems need an update of inputs

- Using pH and N availability provides 'biodiversity' based critical loads which for pH are based on field measurements

# Future work

- Replace N availability by another N parameter, but attempts to replace critical N-availability by nitrate concentration have failed so far

- Use PROPS derived functions to define the abiotic requirements (PROPSclf)? Over the last year this has been tested and applied for the USA together with ES Environmental (Todd McDonell) and IIASA (Max Posch)

# End

## Questions?

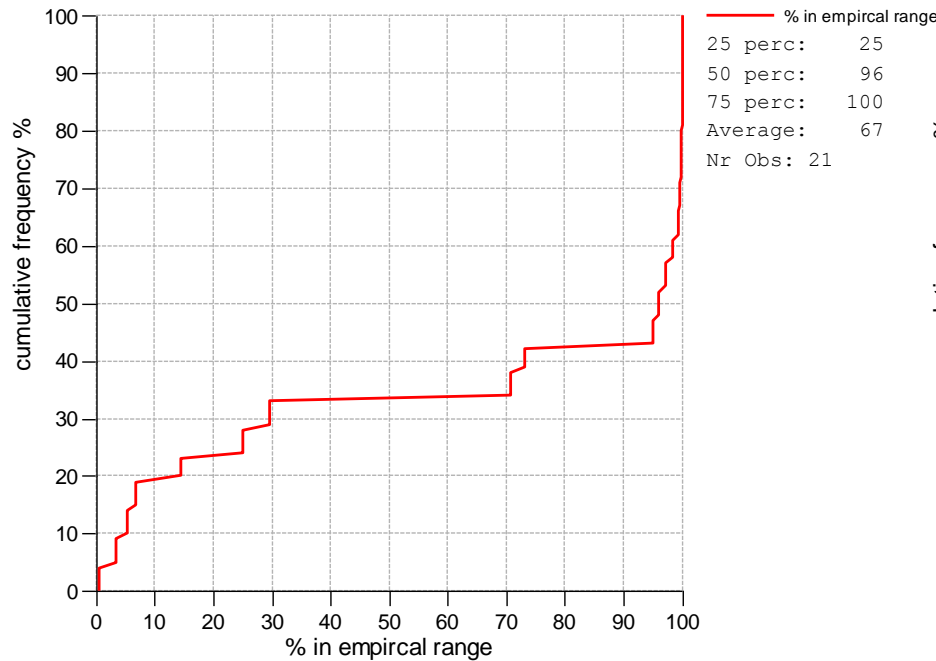# Results: percentage of simulations within empirical range



Habitats



Nature Target Types