Nitrogen activities at IVL

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Monitoring air and deposition (national, regional & local)

Emission inventories & reporting

Effects of nitrogen on ground vegetation

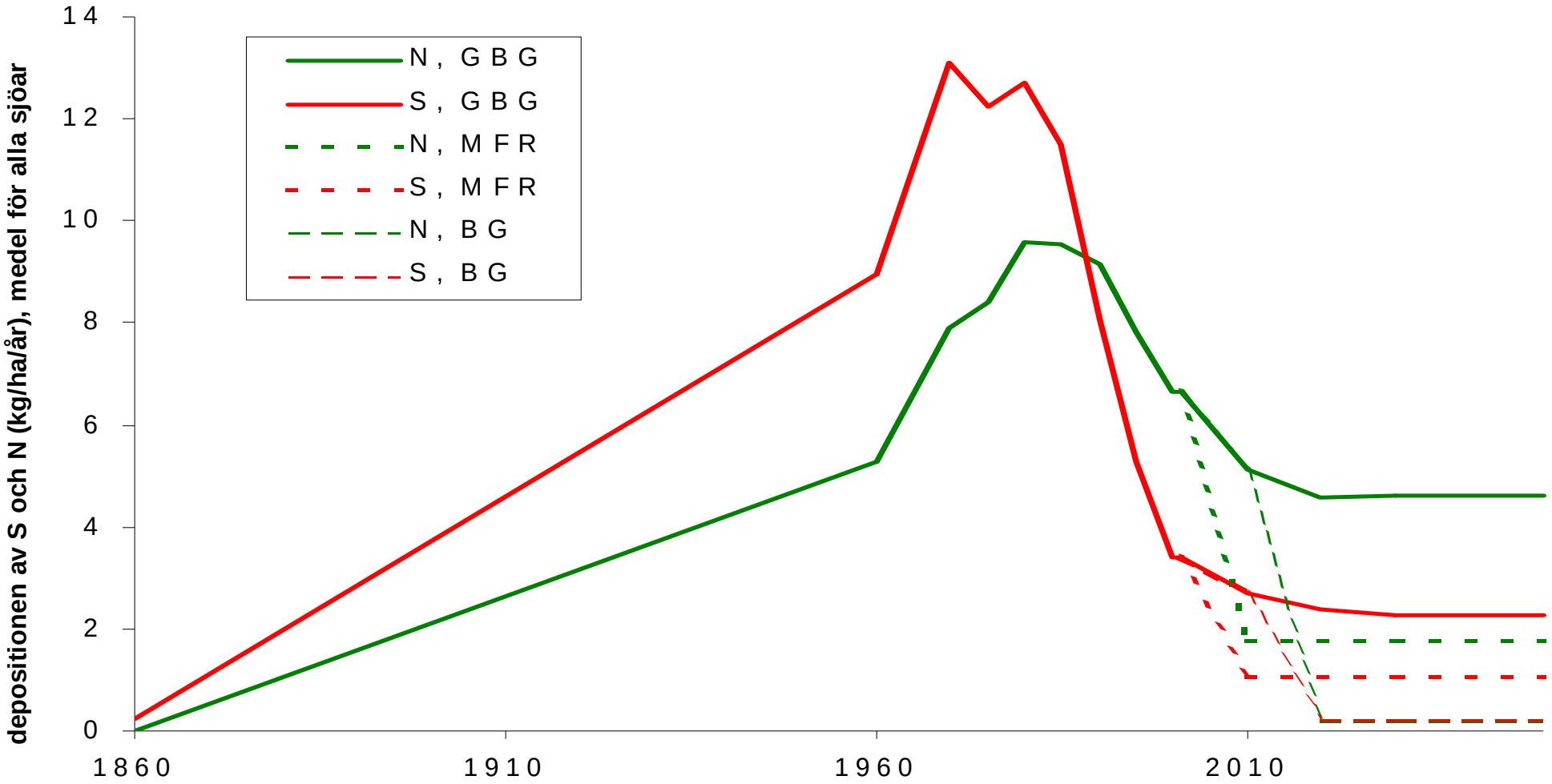
Effects of N-fertilisation in forestry.

N-contribution to acidificaion of soils and freshwaters.

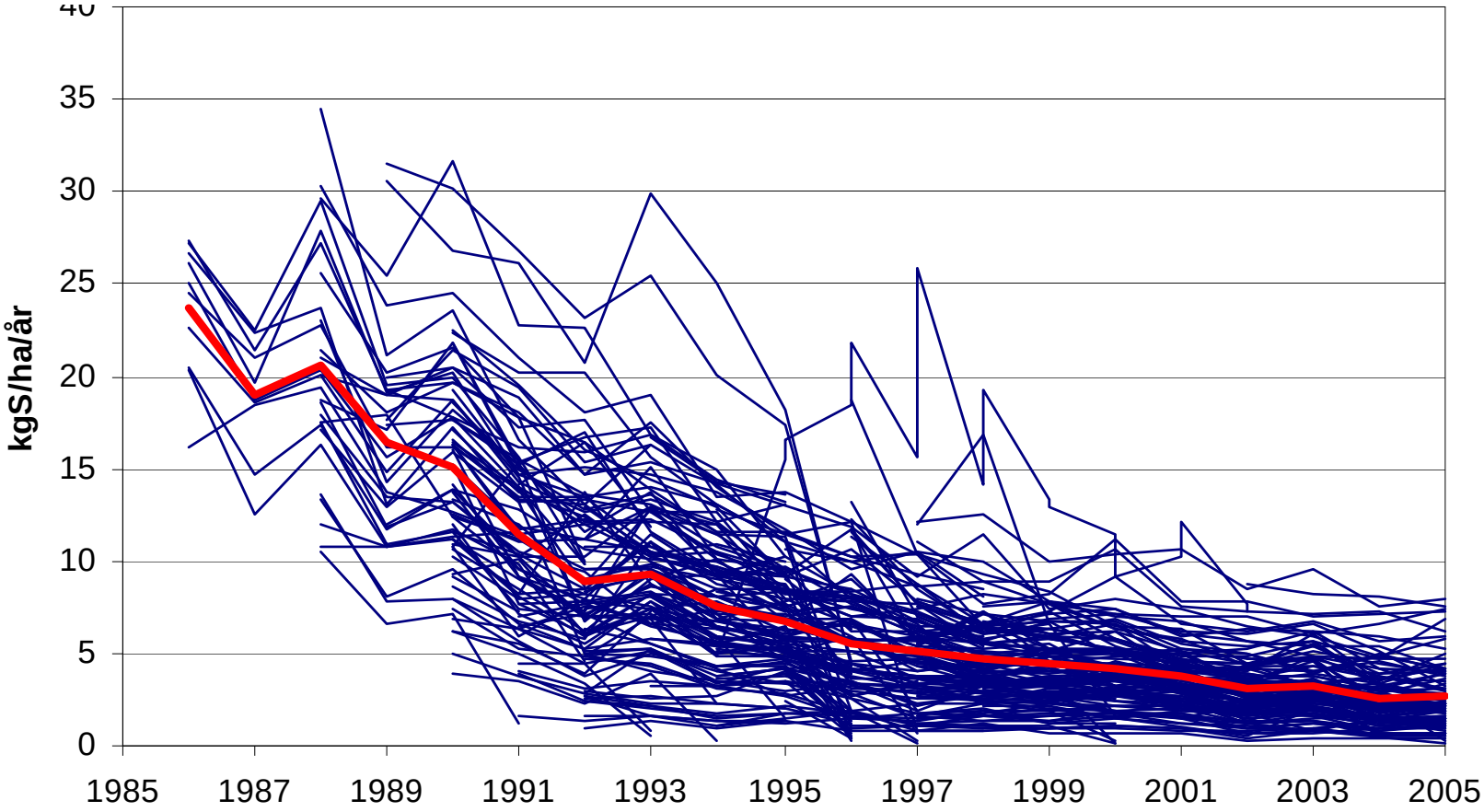
Environmental effects of forestry.


Sweden – 450 000 km2
•51% covered with forest
•98 000 lakes (>1 ha)

Deposition of sulphur (sea salt corrected) and nitrogen in Sweden

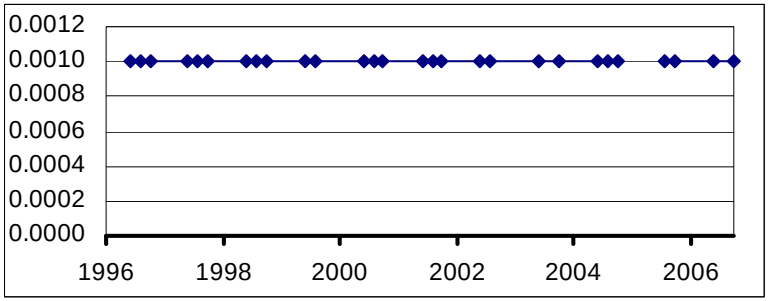


Deposition of sulphur (sea salt corrected) throughfall network, Sweden



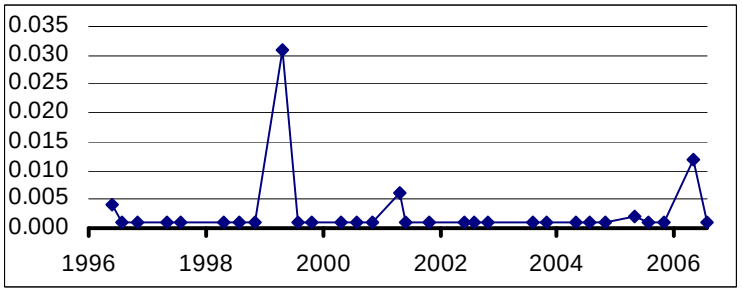
N in soil water

Brattfors

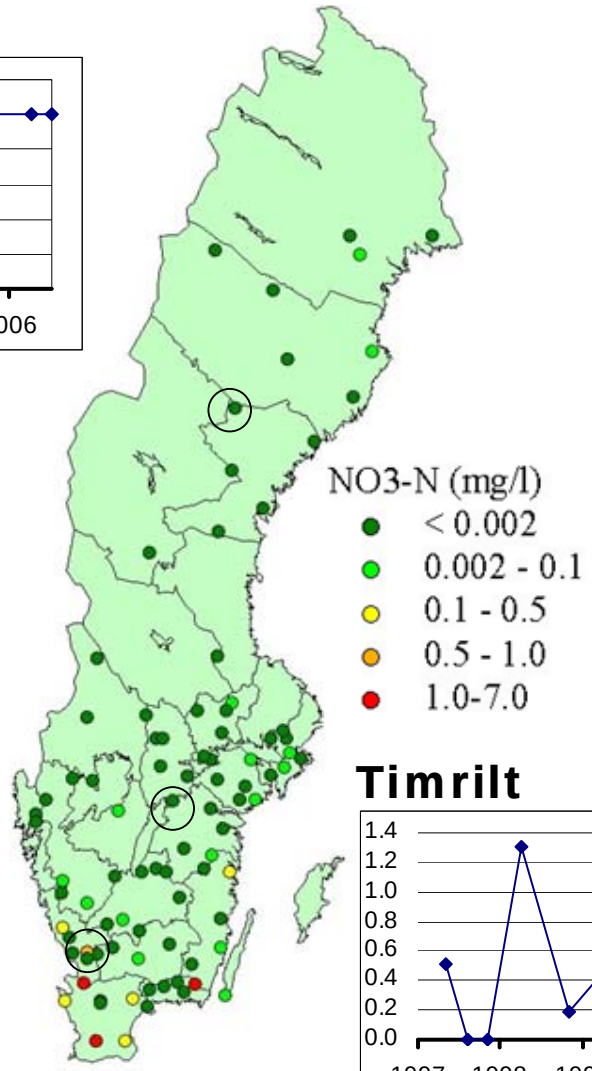


0.001 mg/l

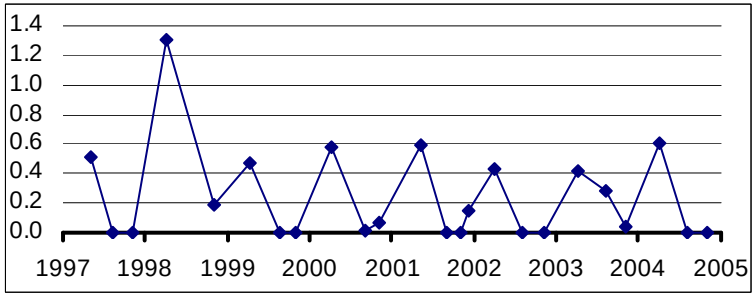
Höka



0.001 – 0.03 mg/l

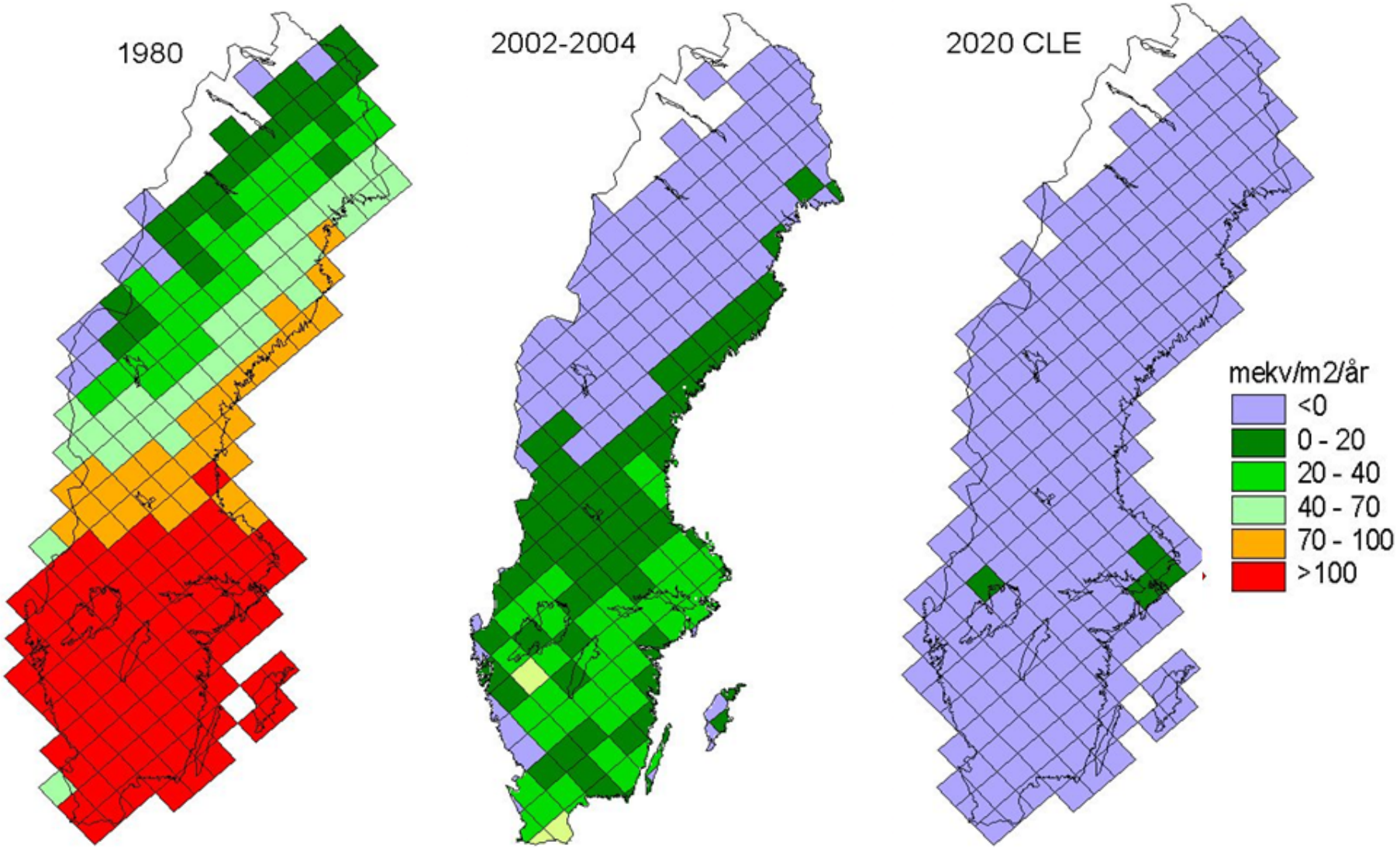


Timrilt

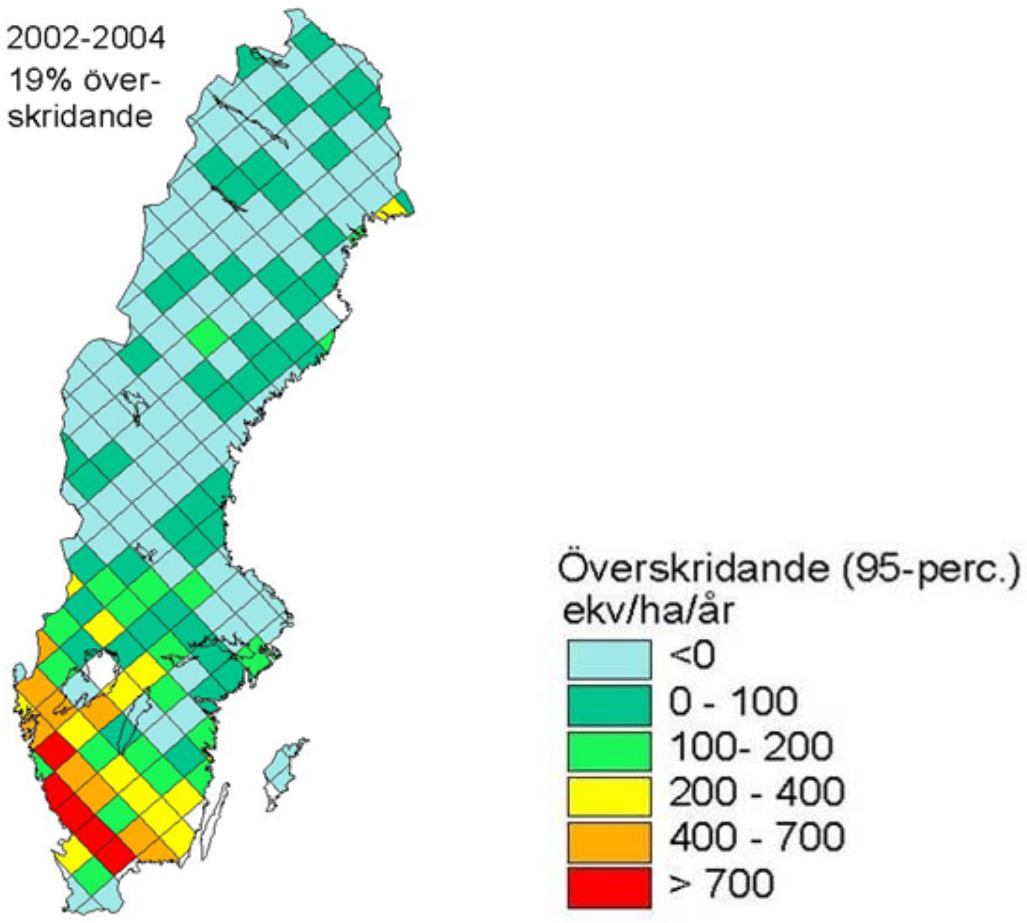


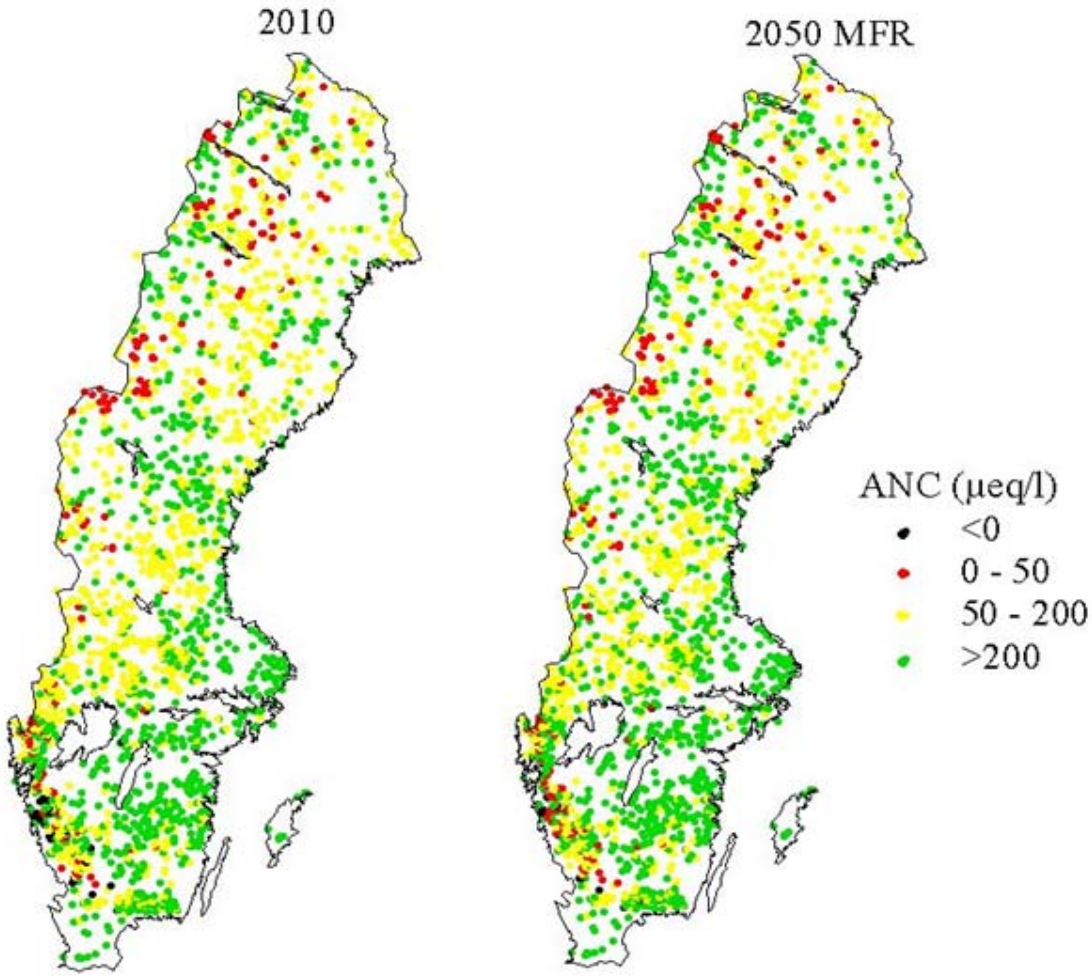
0.001-1.3 mg/l

Exceedance of critical load for forest soils, root-density weighted BC/Al>1, 0.95 percentiles



Exceedance of CL for lakes in Sweden 2002-2004 – 95 percentile

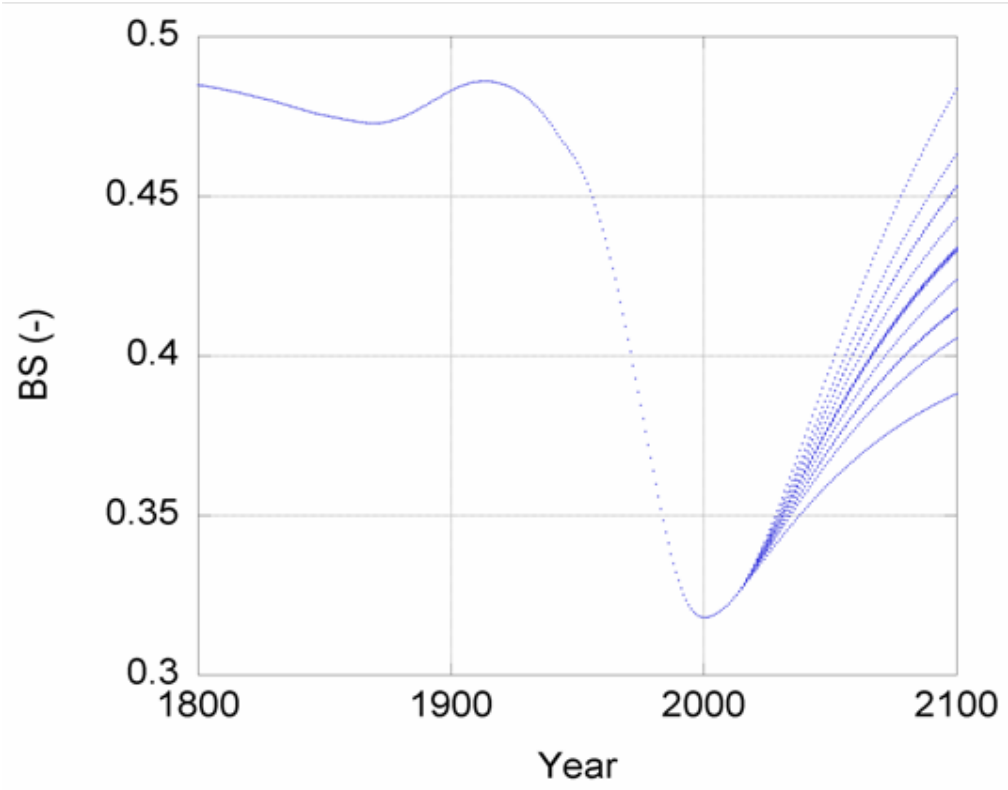




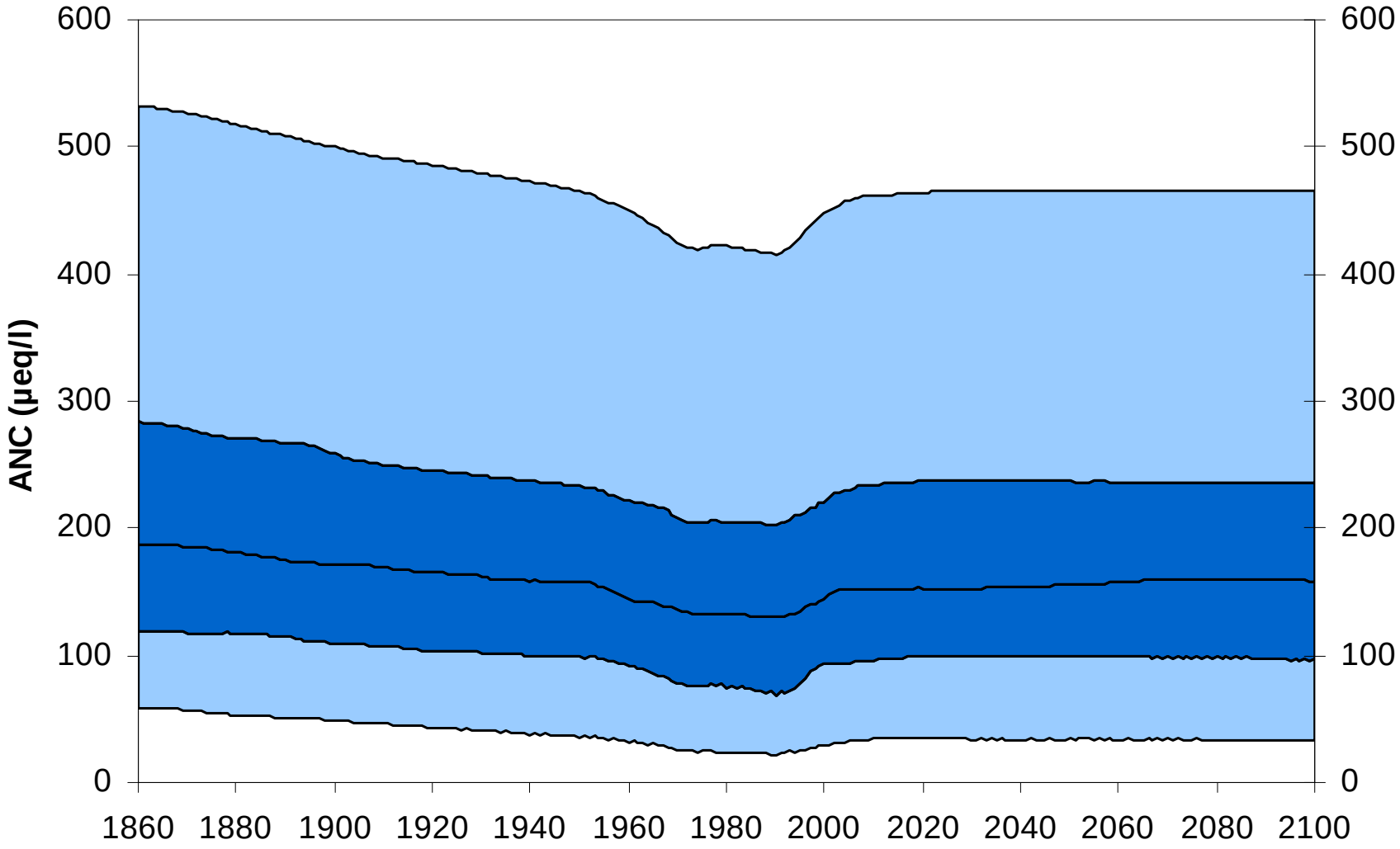
1974 lakes in Sweden marked with different colours according to their ANC values in 2010 (left) and in 2050 under the MFR scenario (right).

Dynamic modelling soil acidification

- 632 soil sites were modelled with SAFE
- 14 future scenarios were calculated
- For each of the 16120 soil sites with critical load calculations modelled results were obtained from the closest of the 632 sites



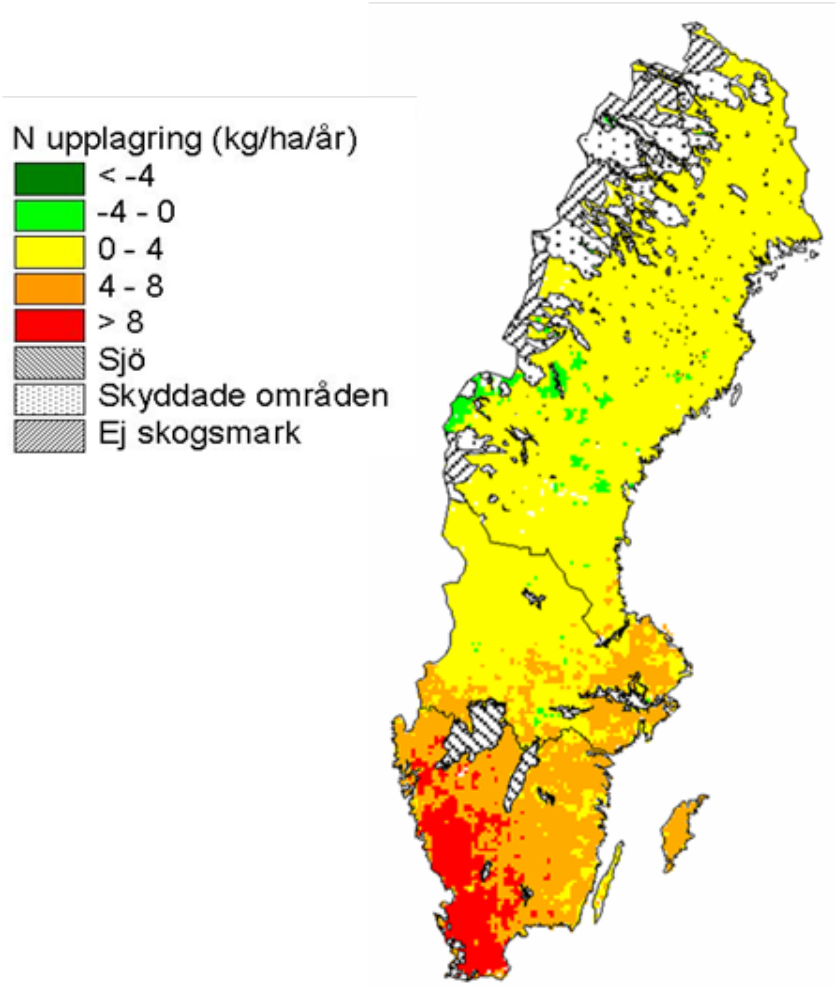
Dynamical modelling of lake acidification, MAGIC model



Critical loads (CL) and dynamic modeling (DM)

- a lot has been done with regards to Cl and DM in Sweden and in many other countries
- both Cl and DM outputs are available for forest soils and even for surface waters
- the three key components in achieving these results were monitoring, large scale experiments and modeling
- we are reasonably confident in the Cl calculations
- and even in DM outputs **except** for future effects of:
- **nitrogen deposition, climate change (and land use)**

N sequestration in the forest soils (2003)



- current NO_3 leaching is much smaller than that assumed in distant future by precautionary principle (applied when calculating CL)
- most of the currently deposited N ends up in soils, is harvested away from the forests or leaves in waters as DON associated with DOC
- Will this last forever???
- If nothing else changes?
- If the forest practices will change?
- Considering climate change?

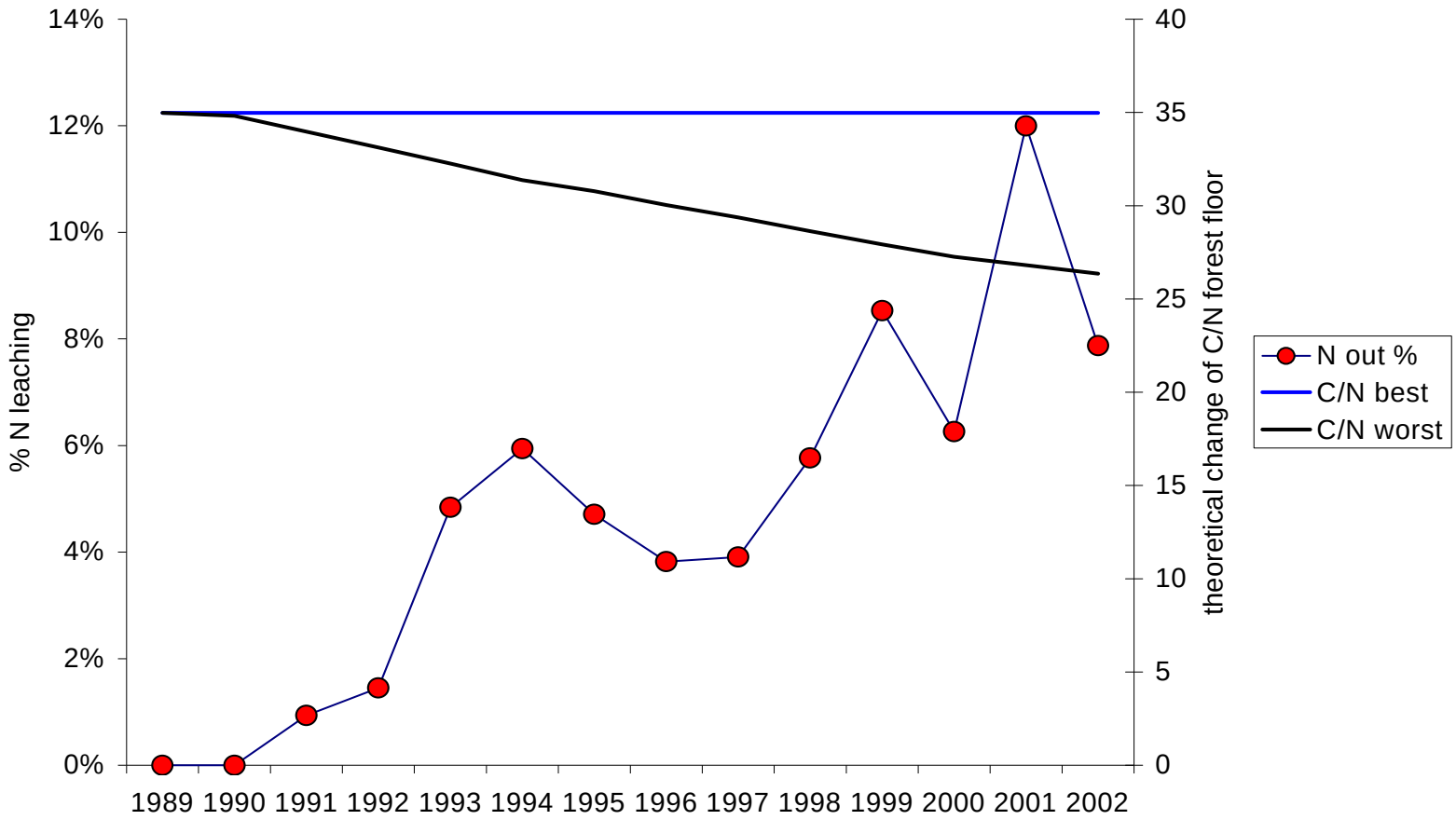
Gårdsjön NITREX, 12 years of fertilising 0.5 ha catchment with 40 kg NH_4NO_3-N/ha/yr since 1991

The catchment was N-poor. At ambient deposition ca 12 kg N/ha/yr it was not leaching any NO_3 before the start of the fertilisation

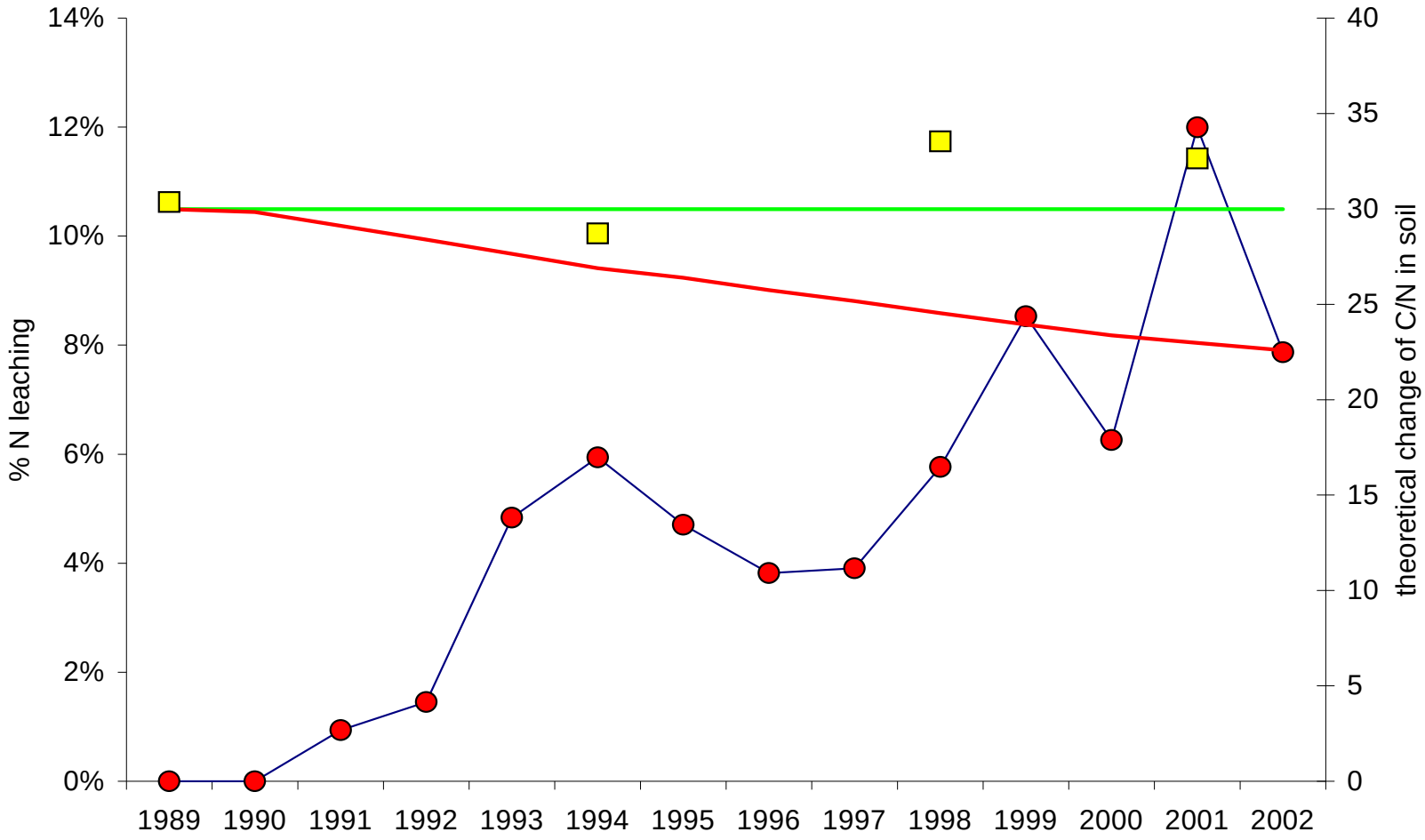
Monitoring of run-off water, soil composition (N, C), vegetation (1991 and again in 2008).

Fluxes of N_2O, CO_2, CH_4 1992 and 2007 (NitroEurope)

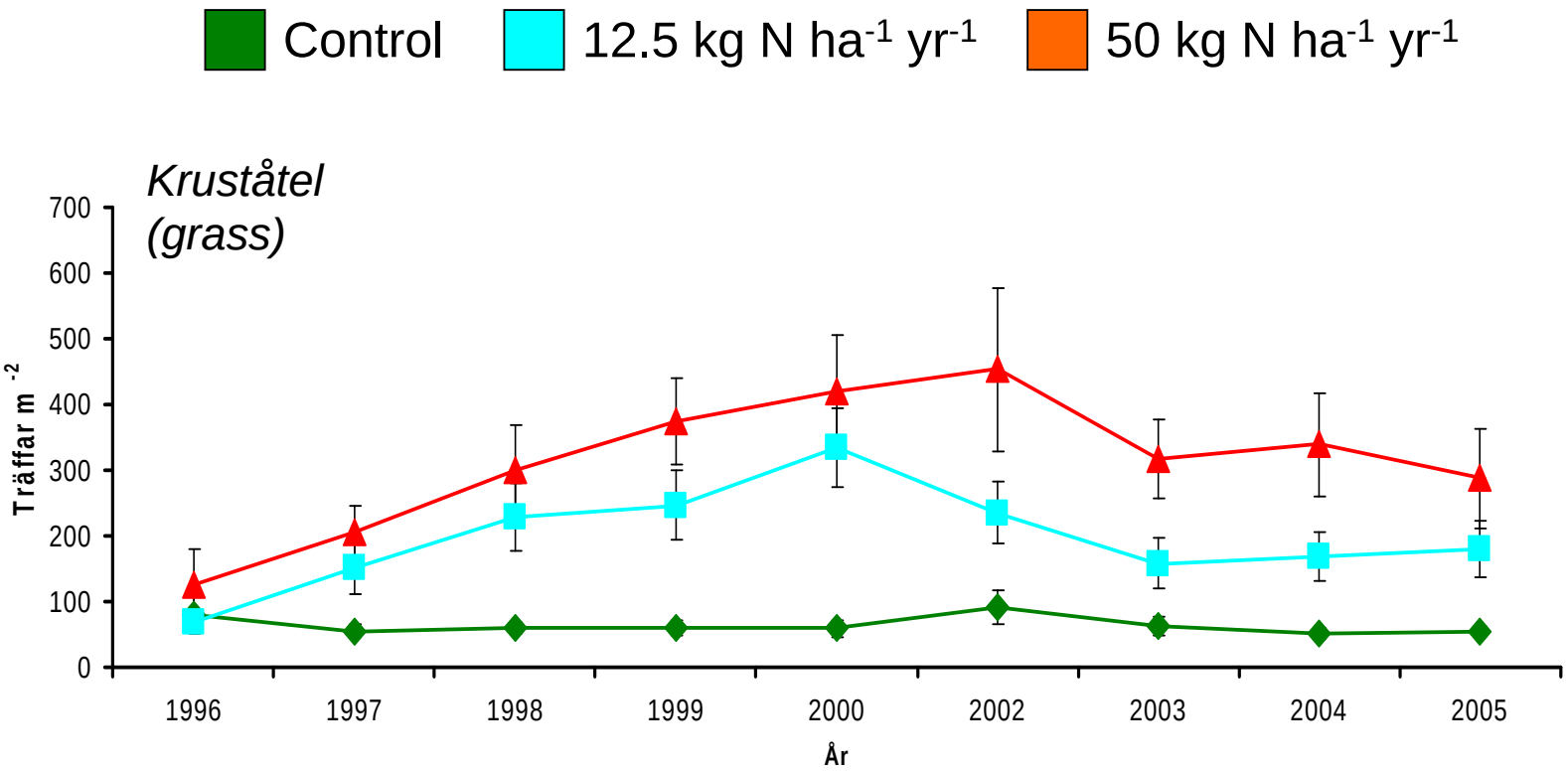
N leaching at Gårdsjön NITREX catchment and theoretical change of C/N forest floor. C/N best = 100% N bound to soil, C/N Worst = 100% N leached



N leaching at Gårdsjön NITREX catchment (50 kg N ha/yr since 1991) and change of C/N forest floor



Empirical research on dose-response. Nitrogen fertilisation, 10 yr experiment (Annika Nordin, SLU).



Species composition change in forests

From blueberries to grass

Critical loads of N in terrestrial ecosystems – Workshop in Stockholm, March 2007

- Report available under convention web site (WGE):
- ”The workshop believed current empirical critical loads for nutrient N for boreal and arctic ecosystems were set too high. Several presentations indicated effects at lower deposition levels than currently recommended.”
- ”The workshop recommended that the critical load for boreal forest should be 5–10 kg N ha–1 year–1 compared to current recommendation of 10–20 kg N ha–1 year–1 for both boreal and temperate forest.”

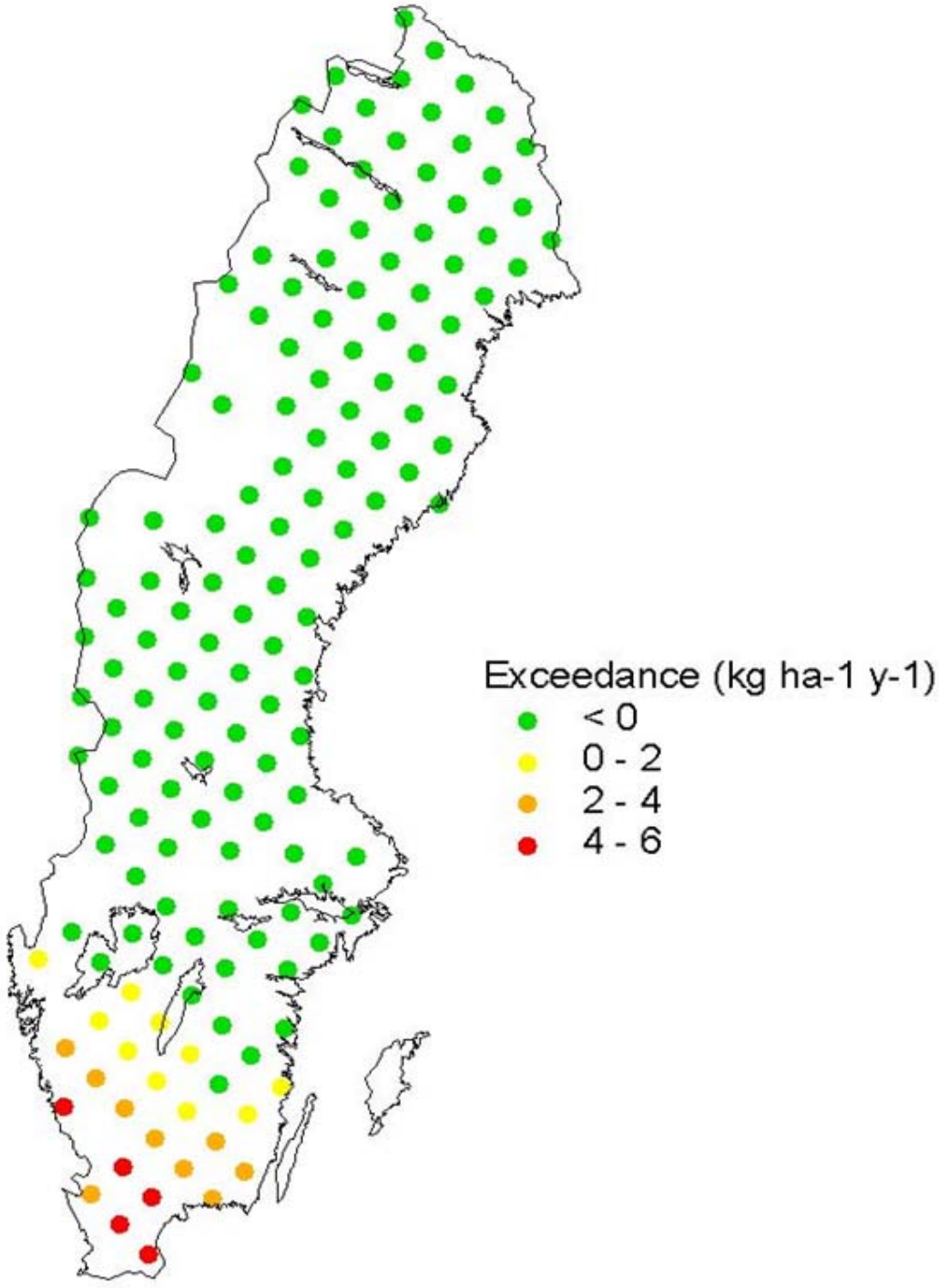
- http://www.unece.org/env/documents/2007/eb/WGE/ece.eb.air.wg.1.2007.15.e.pdf

Second workshop: “Criteria for modelling critical loads of N based on changes in the ground vegetation”

1. To propose a definition for a reference level for the composition of the ground vegetation, i.e. the ground vegetation composition which we strive towards protecting or re-establishing. This definition should account for the simultaneous changes caused by land use practices and changes in other environmental factors.
2. To suggest specific and testable criteria for using the ground vegetation as an indicator for ecosystem response to N deposition.
3. Report available on www.scarp.se

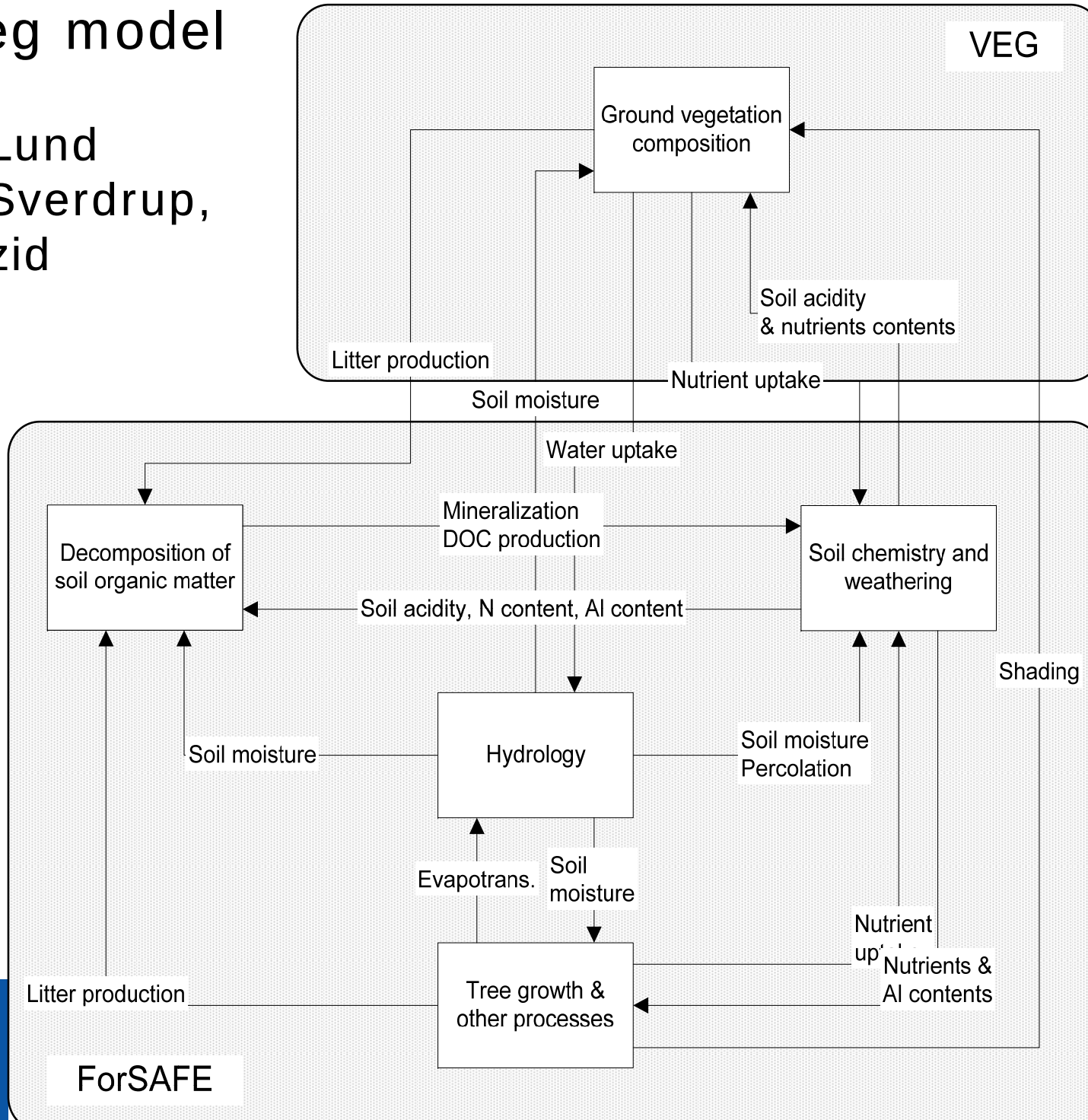
Empirical critical loads of N (2008 report)

- Two types of ecosystems were considered: forest and mires
- Each site was given an empirical critical load of nutrient N
- The value of the CL was set to 8 kg ha^{-1} yr^{-1} for both ecosystems
- 16% of EMEP 50x50 squares exceede



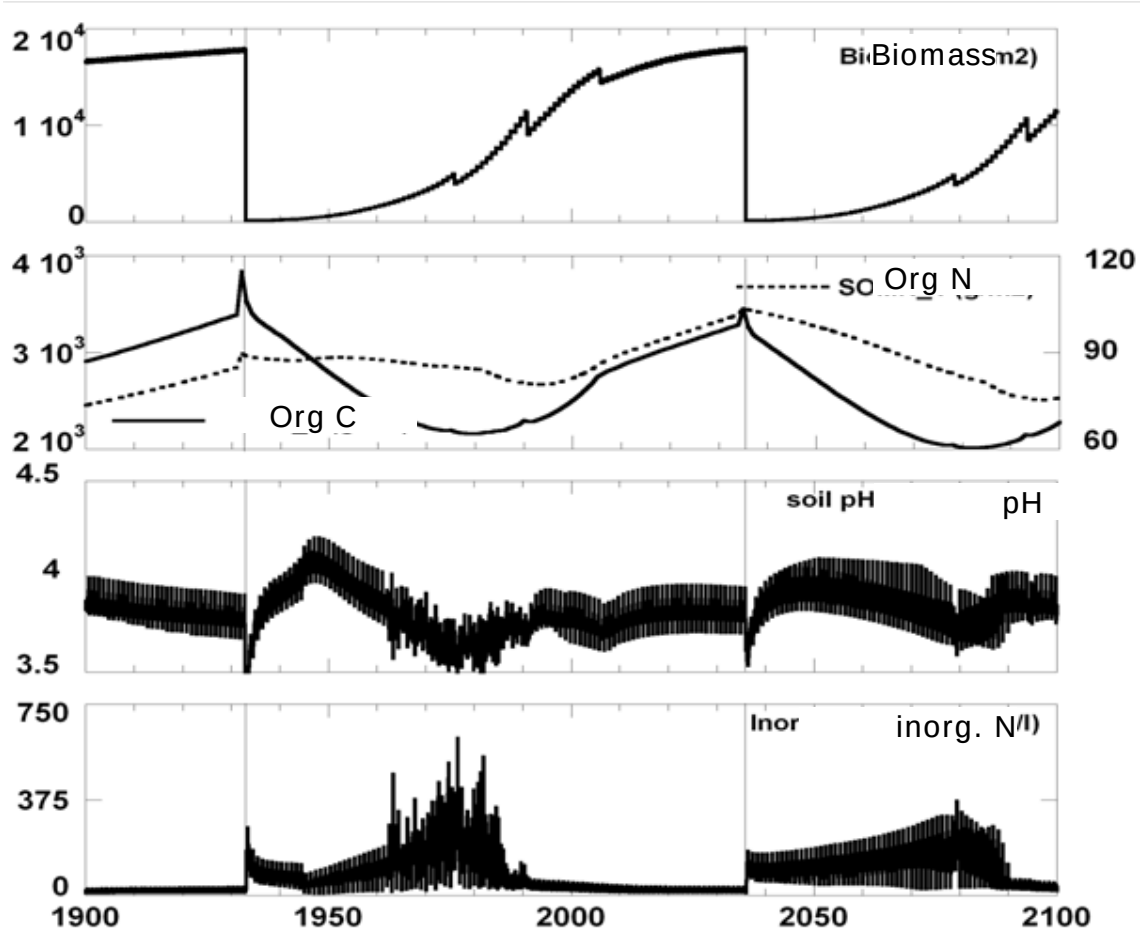
The ForSAFE- Veg model

Developed at Lund University, Harald Sverdrup, Salim Belyazid

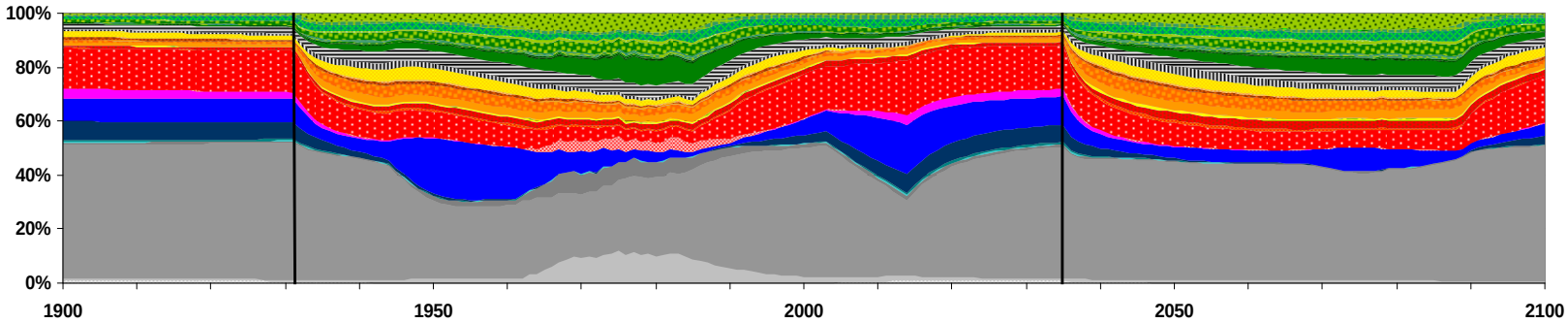


ForSAFE-VEG: Model for soil chemistry, growth and vegetation composition

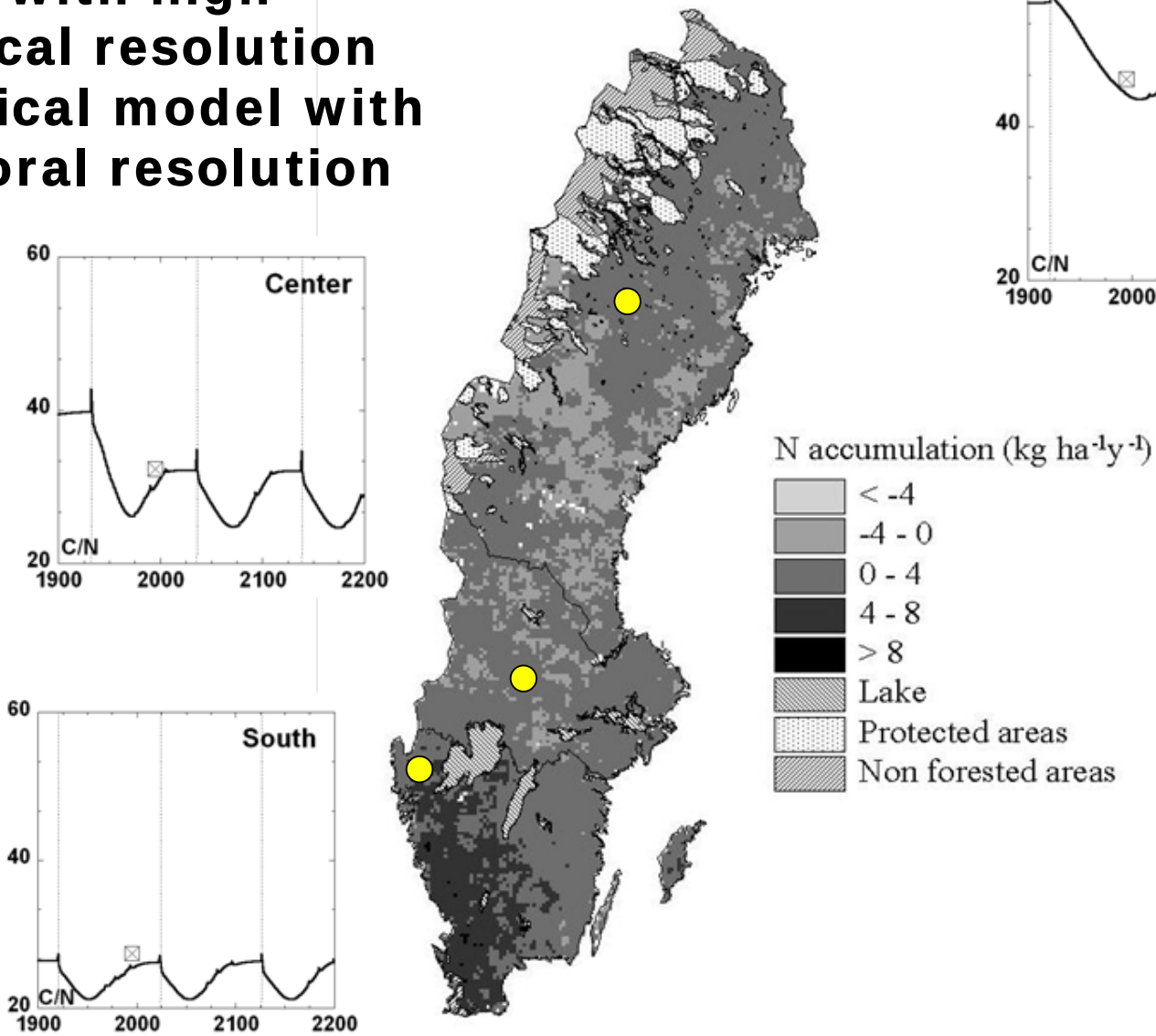
Scenarios for forestry, climate and deposition



Vegetation composition:



Combine mass balance model with high geographical resolution with dynamical model with high temporal resolution



Additional activities

- SCARP Research Programme (www.scarp.se)
- SCARP ECOSYSTEM:
  - Literature survey of N-addition and forest fertilisation experiments.
  - Improvement of N-process description in dynamical models (MAGIC, SAFE, FORSAFE-Veg)
  - Model testing using NITREX results
  - Additional vegetation survey in NITREX + Vindeln (North Sweden)

Additional activities

- SCARP Research Programme (www.scarp.se)
- SCARP Integrated Assessment Modelling:
  - National IAM Network
  - Swedish version of GAINS
  - First priorities to test and include new control measures and strategies (e.g. transport sector)
- SCARP aim: National GAINS version where we integrate SCARP results on health impacts, particles and ecosystem impacts (N!!)
- Long-term plan to develop assessment tools for air pollution, land-use, impacts on C, N-balances, vegetation....

Nitrogen and forestry – conflicts of interest

+ increased production of wood
+ increased production of biomass for energy production
+ increased carbon sequestration

- effects on ground vegetation
- acidification
- eutrophication

The IVL N-group

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- Nitrogen: Filip Moldan, Cecelia Akselsson, Sofie Hellsten, Veronika Kronnäs, Therese Zetterberg, Per-Erik Karlsson, Gunilla Pihl-Karlsson
- IAM: Stefan Åström, Mohammed Belhaj
- National cooperation:
  Salim Belyazid,
  Harald Sverdrup, LTH
  Annika Nordin, SLU;
  Lars Högbom, Skogforsk