ICP Integrated Monitoring
Progress report 2012

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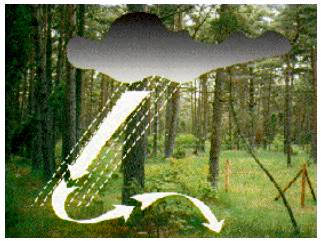
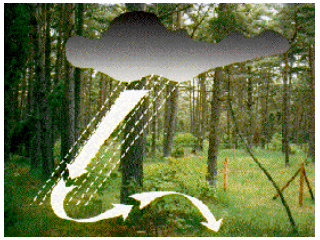
24.9.2012



LRTAP
Long-range Transboundary Air Pollution

SLU

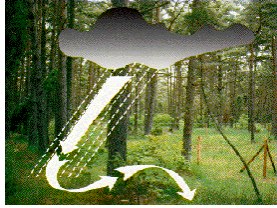
SYKE

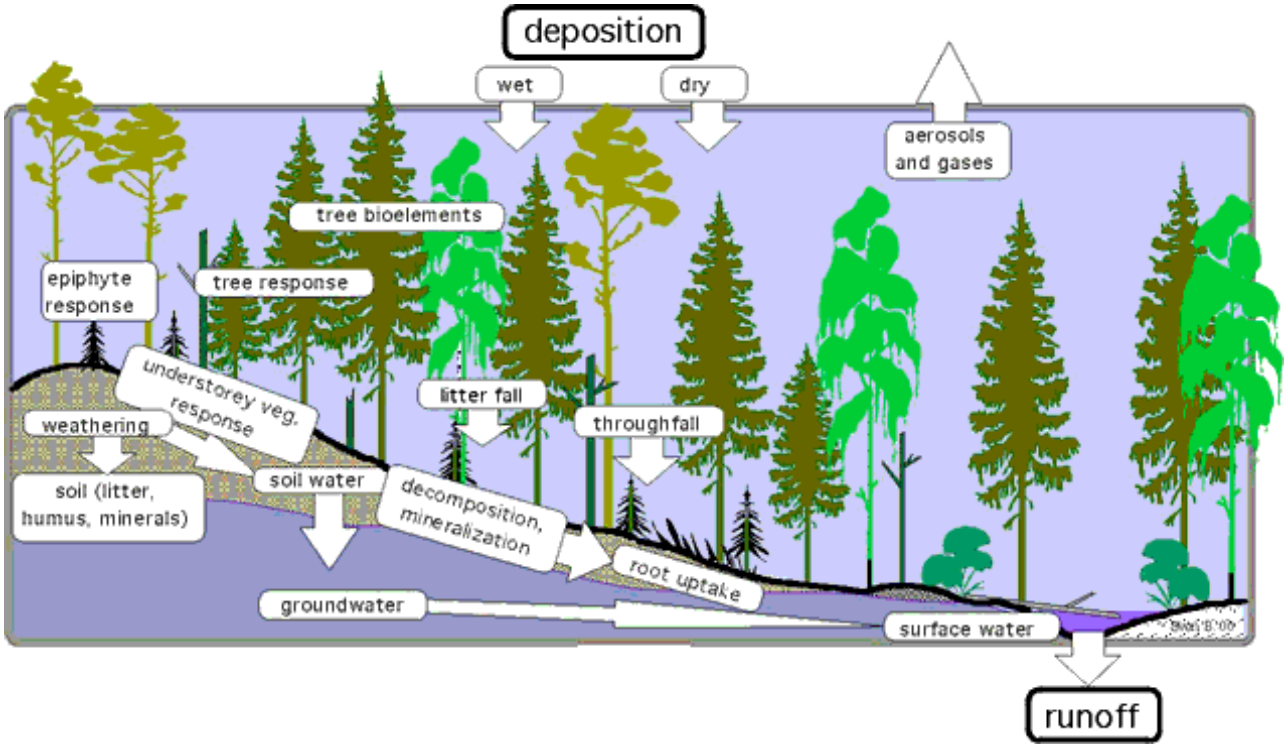


Contents

1. Brief overview of ICP IM activities
2. Key results from assessments
3. Future plans

Integrated Monitoring

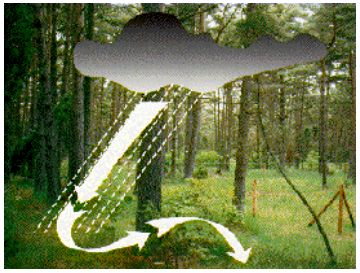




Catchment approach
Budget calculations
Process oriented

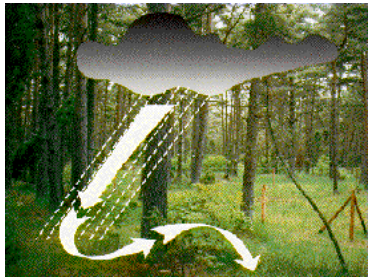
LRTAP
Long-range Transboundary Air Pollution

LRTAP
Long-range Transboundary Air Pollution



Priorities

1. Heavy metals
2. Dynamic modelling
3. Nitrogen critical loads and effects
4. IM biodiversity indicators
5. Budgets and trends in S, N, H and BC
6. Air pollution and climate change interactions



Database update – data from 2010 reported 2011-12-01

11 countries

15 countries for period 2006 – 2010

44 sites incl. one new Russian site

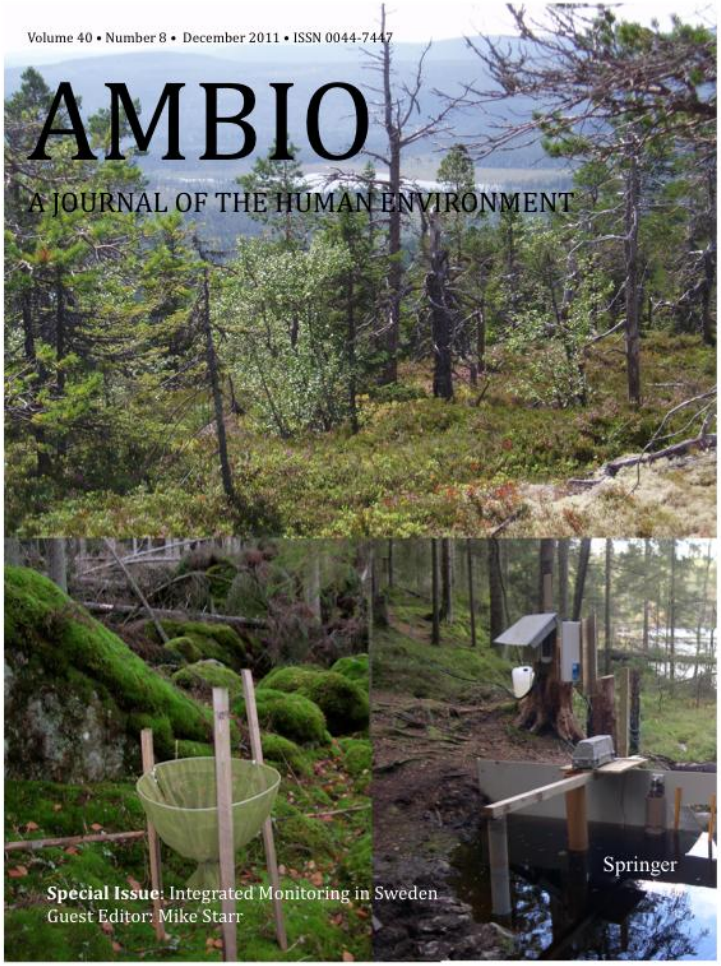
Poland shows interest in re-joining

Task Force meeting arranged in Kaunas, Lithuania, 23-25 May 2012

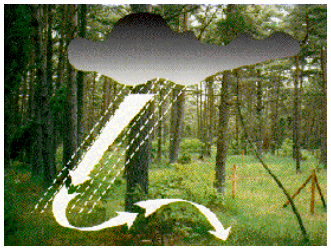
ICP IM Annual Report 2012 prepared

LRTAP
Long-range Transboundary Air Pollution

www.environment.fi/syke/im



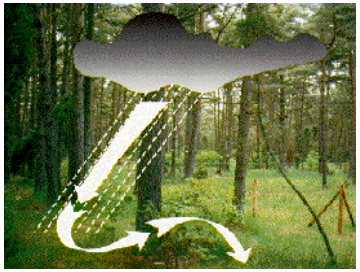
Special issue on Swedish IM
Ambio vol. 40, No 8, 2011



EC collaboration projects

FutMon – EnForMon

EnvEurope



ICP Integrated Monitoring of Air Pollution Effects on Ecosystems

Next ICP IM Task Force meeting

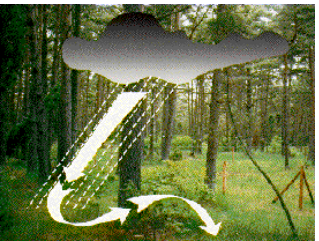
Moscow, Russia; tentatively 20-24 May 2013

Welcome!

Swedish University of Agricultural Sceinces

Main topics for scientific work 2012

- Calculation of site-specific critical loads for N and S and their exceedances at ICP IM sites
- Assessment of relationships between critical load exceedances and empirical impact indicators
- Calculation of fluxes and trends of nitrogen and sulphur compounds
- Assessment of changes in catchment retention of S and N



Background

- European databases and maps of critical loads have been instrumental in effect-based protocols to the UNECE CLRTAP
- For testing and validation of the key concepts in the critical load calculations, it is important to study the link between critical thresholds of acidification and eutrophication of the ecosystems and empirical impact indicators
- Changes in catchment retention give empirical evidence on the capacity of ecosystems to cope with pollution loadings and about recovery processes

Materials and methods 1/4

- **Mass balance critical loads**
  - **Acidification** CL_A: *FAB-model (Posch et al. 2012)*
  - **Eutrophication** $CL_{nut}N$: *Mass Balance model for nutrient nitrogen (UBA 2004)*
  - For a selection of 18 IM sites from 10 countries (AT, CZ, DE, EE, FI, GB, LT, LV, NO, SE) for which runoff water chemistry and runoff measurement data were available
- **Exceedances: deposition estimates at IM sites**

$$ExCL_A = S\ dep\ \mathbf{NAT2000} - CL_A$$

$$ExCL_{nut}N = N\ dep\ \mathbf{NAT2000} - CL_{nut}N$$

Materials and methods 2/4

- **CL for eutrophication: empirical critical load of nutrient nitrogen $CL_{emp}N$**

  (Bobbink and Hettelingh 2011)

  - Based on empirical studies on the response of natural and semi-natural ecosystems to nitrogen deposition.
  - $CL_{emp}N$ are given for a groups of ecosystems, classified according to the EUNIS-European Nature Information System- habitat classification for Europe
  - 24 IM sites + 6 LTER-Europe sites

- **Exceedances:** $ExCL_{emp}N = N\ dep\ NAT2000 - CL_{emp}N$

  $ExCL_{emp}N = N\ dep1995 - CL_{emp}N$

Materials and methods 3/4

Empirical impact indicators

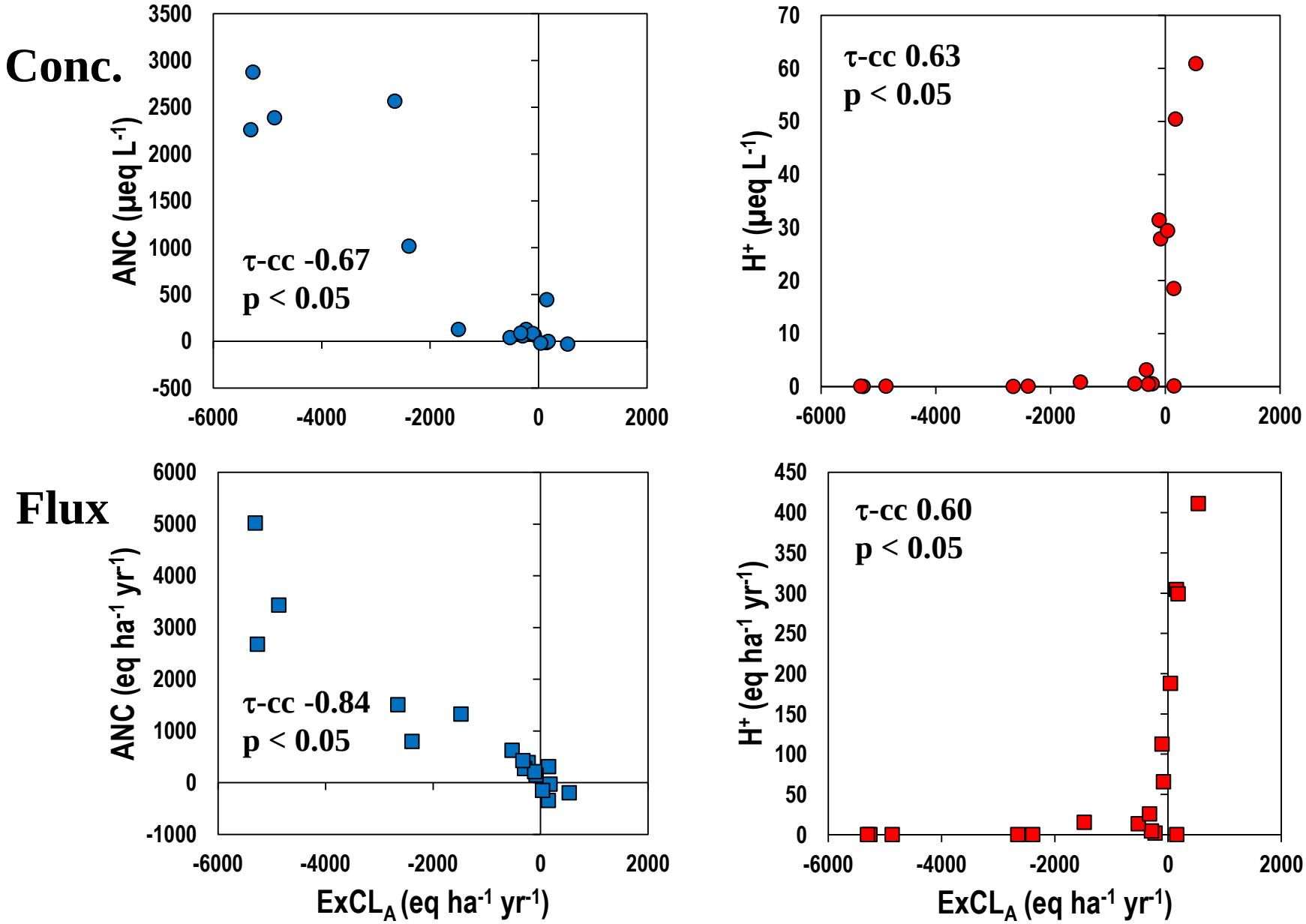
- **Acidification**: annual average runoff water concentrations and fluxes in the period 2000-2002 for key acidification parameters such as Acid Neutralising Capacity ANC = (Ca+Mg+Na+K) – (SO_4+Cl+NO_3), hydrogen-ion (H^+) and non-marine sulphate (xSO_4)
- **Eutrophication**:
- total inorganic nutrient nitrogen in runoff water (TIN= NO_3+NH_4)
- long-term changes in ground vegetation
  - 948 forest floor species
  - 8-42 years time records
  - generalized linear mixed models with binomial error distribution
  - deposition range 1-36 kg N ha^{-1} $year^{-1}$

Materials and methods 4/4

Changes in catchment retention:

- Annual input-output budgets for S and N compounds for the period 1990-2010 calculated for a selection of 17 ICP IM sites
- Bulk and throughfall deposition, runoff water quality and hydrological measurements used
- Percent net export *pne* = (output–deposition)100/deposition
- Positive *pne* values indicate release and negative *pne* values indicate retention in the catchment

Good agreement between $ExCL_A$ and ANC and H^+



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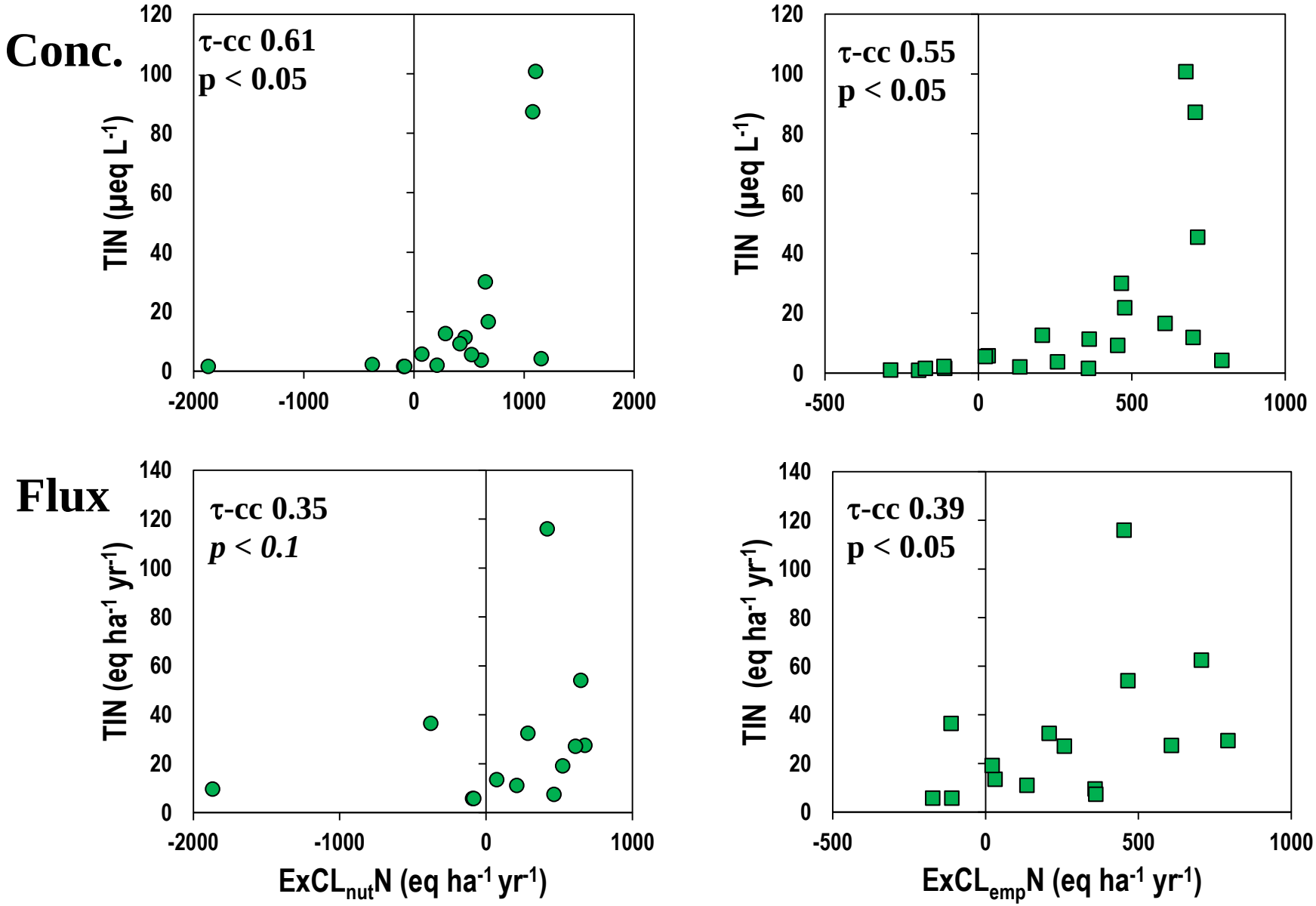
$ExCL_{nut}N$ / $ExCL_{emp}N$ vs. TIN (NO_3 + NH_4)



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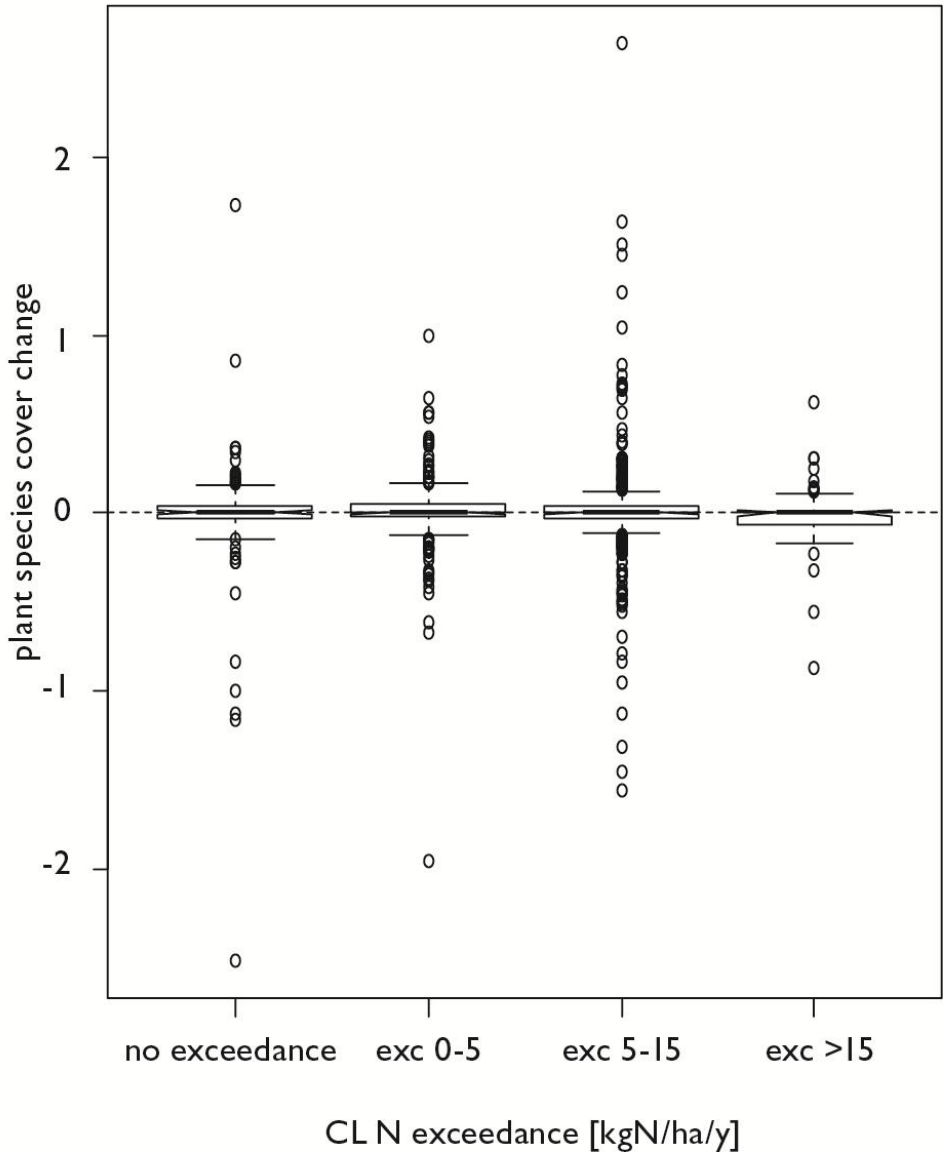
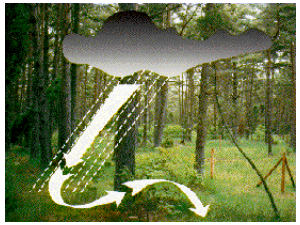
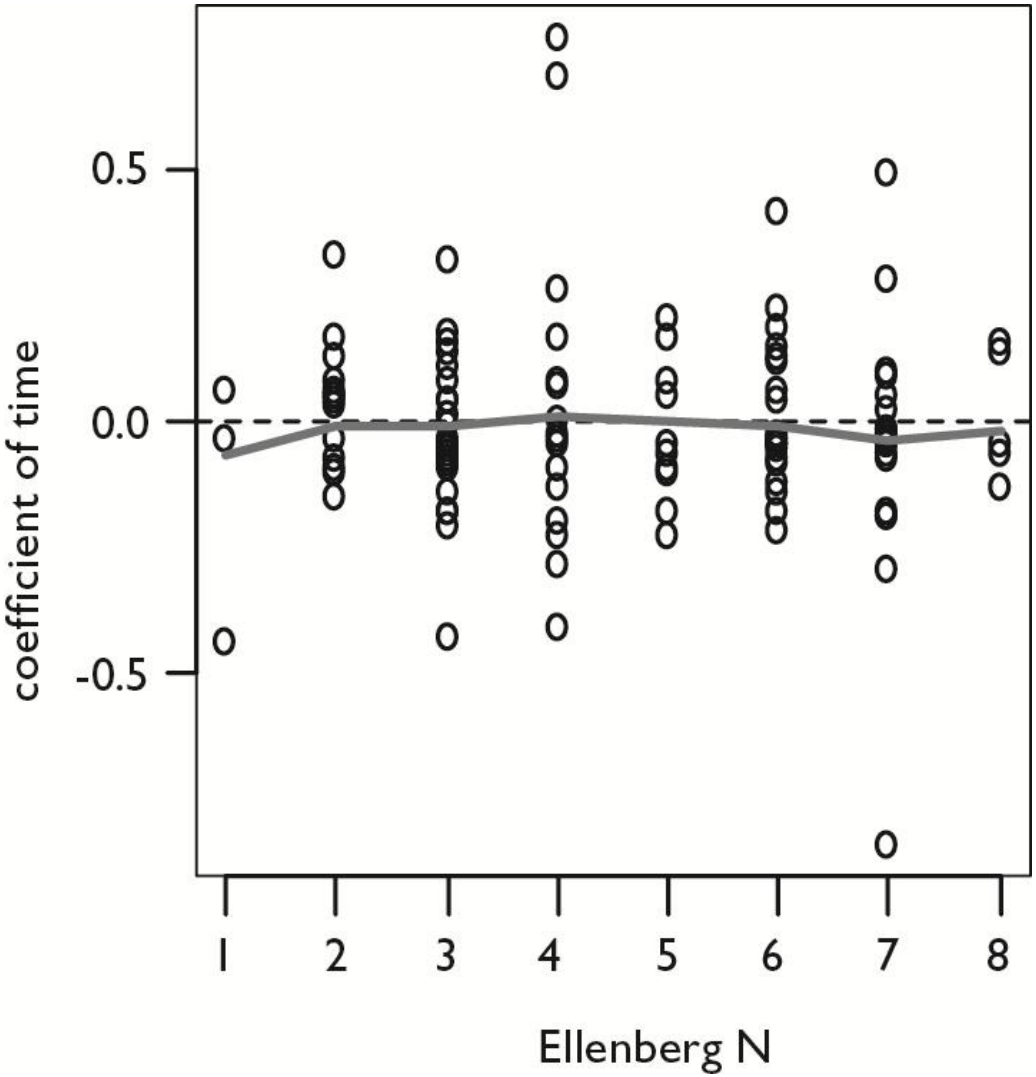
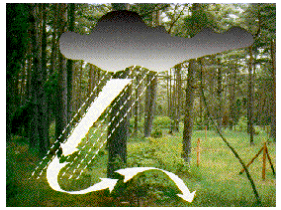




(Dirnböck et al. 2012)

Comparison of increasing (positive values at the y-axis) and decreasing (negative values) cover of forest floor species within sites with the exceedance of empirical N Critical Loads





(Dirnböck et al. 2012)

Comparison of increasing (positive values at the y-axis) and decreasing (negative values) cover of forest floor species across Europe with their nutrient preferences (the higher the Ellenberg N value the more a species prefers nutrient-rich soils)

Concluding remarks on CL studies1/2

- At the majority of the IM sites (72%), CL_A was **not** exceeded
- Instead, $CL_{emp}N$ and $CL_{nut}N$ were exceeded at 75–78% of the sites
- There was a relatively good agreement between $ExCL_A$ and ANC and H^+ in runoff water
- Leaching of N was higher for sites with higher $ExCL_{emp}N$ and $ExCL_{nut}N$
- Out of tested 948 forest floor species, 254 showed a significant positive or negative time trend. Of these species, 141 decreased and 113 increased their plot cover

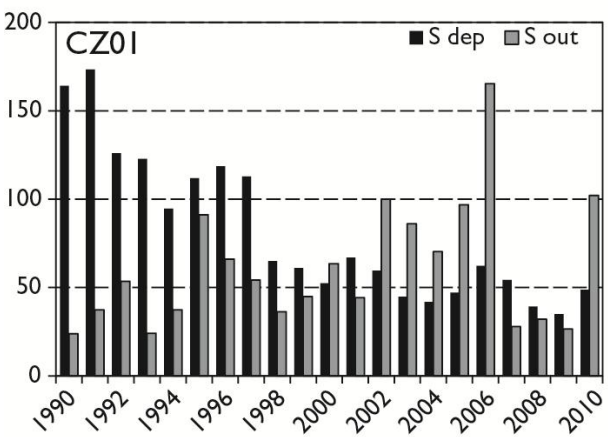
Concluding remarks on CL studies 2/2

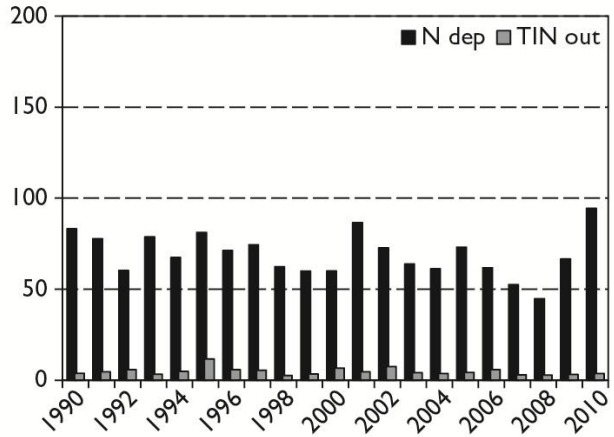
- Weather a species increased or decreased was not related to their nutrient preferences according to Ellenberg indicator values
- The variation of species cover changes seemed to be highest in sites with a considerable exceedance of 5-15 kg N ha^{-1} $year^{-1}$

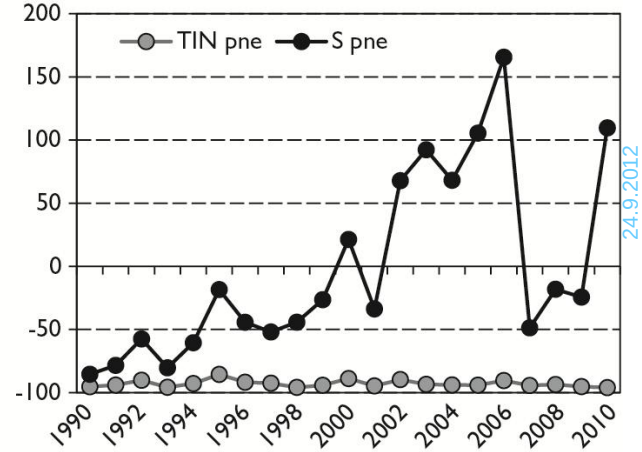
→ Clear evidence on the link between critical load exceedance and empirical impact indicators for runoff water but weaker for ground vegetation

- Scientific paper prepared and in press (Holmberg et al. 2013), 2nd manuscript in prep. (Dirnböck et al.)

Changes in catchment retention



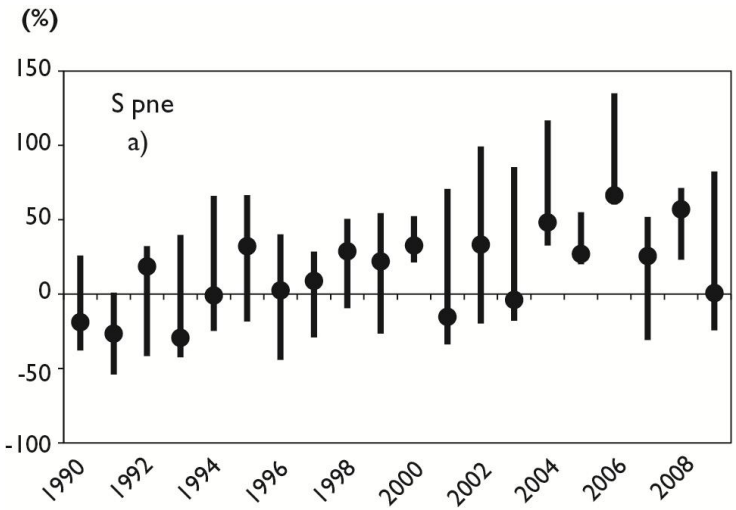


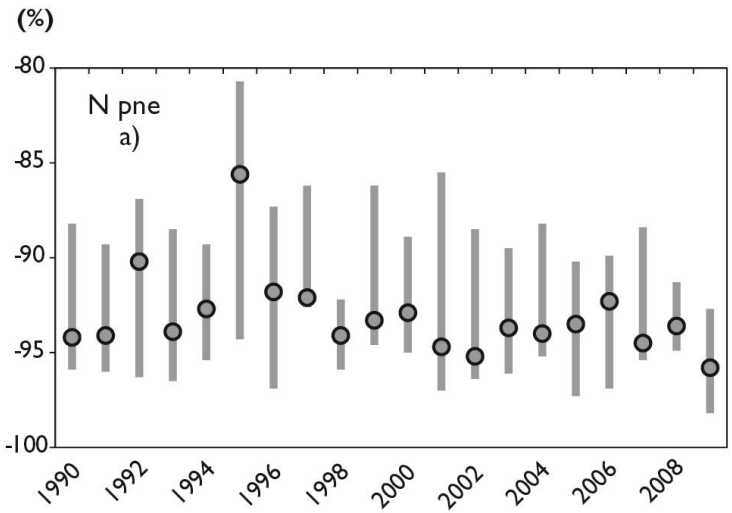


(Vuorenmaa et al 2012)

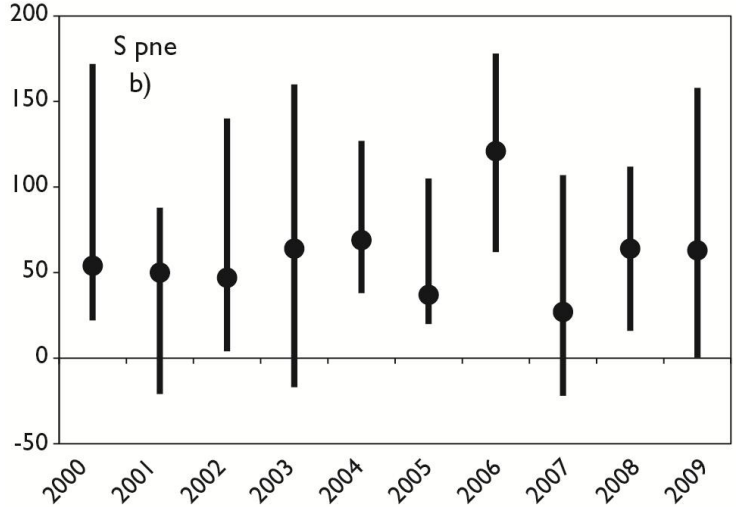
S and N budgets and retention for ICP IM site CZ01

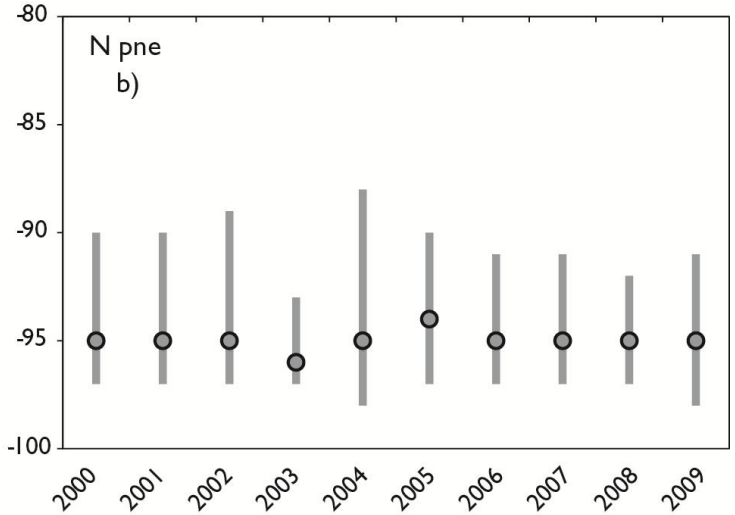
Changes in catchment retention





1990-2009





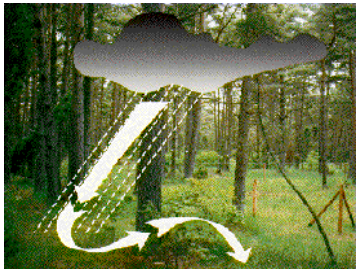
2000-2009

Concluding remarks on mass balance studies

- The more efficient retention of N than S results in generally higher leaching fluxes of SO_4 than those of NO_3 in European forested ecosystems
- Estimated SO_4 budgets indicated a release of SO_4 at most sites, particularly during the 2000s

  → forest soils are now releasing S that had accumulated in the past

  → soils recover but surface water recovery delayed
- No large changes in N-retention observed
- Continued N-accumulation may still cause N-saturation in the long term



Tentative reports/publications and activities 2013

ICP IM 22th Annual Report 2013

Final report and scientific publication on changes in catchment retention of N and S

Report on VSD modelling (soils, waters, biodiversity)

Scientific publication on CL exceedances and links to indicators

Report on HM approaches

21st ICP IM Task Force


Thank you