Long-term changes in the inorganic nitrogen output fluxes in European ICP Integrated Monitoring catchments – an assessment of the role of internal N-related parameters

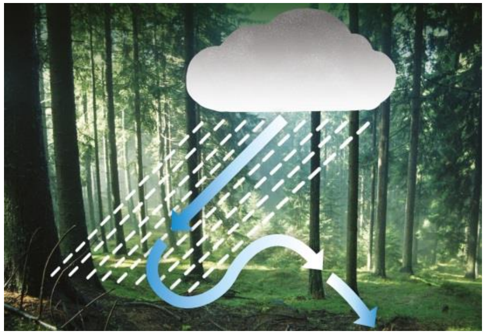
Data mapping

Jussi Vuorenmaa, Sirpa Kleemola, Martin Forsius + representatives of focal points…

Joint ICP Waters & ICP IM Task Force meeting,

8.5.2018

LRTAP
Long-range Transboundary Air Pollution



SYKE

The latest trend assessements at IM sites

Ecological Indicators 76 (2017) 15–29

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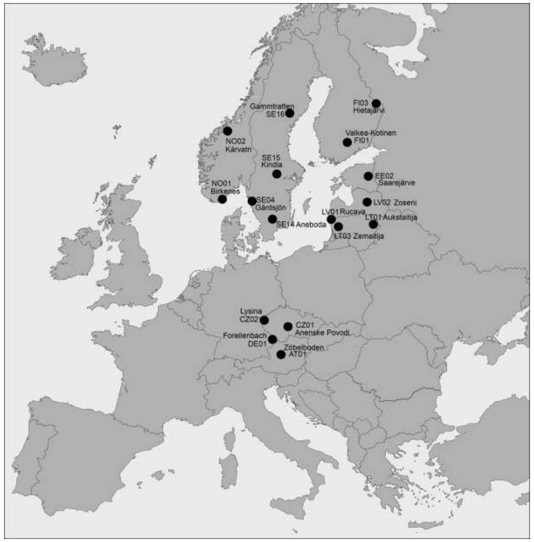
Long-term sulphate and inorganic nitrogen mass balance budgets in European ICP Integrated Monitoring catchments (1990–2012)

CrossMark

Jussi Vuorenmaa[a,*], Algirdas Augustaitis[b], Burkhard Beudert[c], Nicholas Clarke[d], Heleen A.de Wit[e], Thomas Dirnböck[f], Jane Frey[g], Martin Forsius[a], Iveta Indriksone[h], Sirpa Kleemola[a], Johannes Kobler[f], Pavel Krám[i], Antti-Jussi Lindroos[j], Lars Lundin[k], Tuija Ruoho-Airola[l], Liisa Ukonmaanaho[j], Milan Váňa[m]



Science of the Total Environment 625 (2018) 1129–1145

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Science of the Total Environment

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Long-term changes (1990–2015) in the atmospheric deposition and runoff water chemistry of sulphate, inorganic nitrogen and acidity for forested catchments in Europe in relation to changes in emissions and hydrometeorological conditions

Check for updates

Jussi Vuorenmaa[a,*], Algirdas Augustaitis[b], Burkhard Beudert[c], Witold Bochenek[d], Nicholas Clarke[e], Heleen A. de Wit[f], Thomas Dirnböck[g], Jane Frey[h], Hannele Hakola[i], Sirpa Kleemola[a], Johannes Kobler[g], Pavel Krám[j], Antti-Jussi Lindroos[k], Lars Lundin[l], Stefan Löfgren[l], Aldo Marchetto[m], Tomasz Pecka[n], Hubert Schulte-Bisping[o], Krzysztof Skotak[n], Anatoly Srybny[p], Józef Szpikowski[q], Liisa Ukonmaanaho[k], Milan Váňa[r], Staffan Åkerblom[l], Martin Forsius[a]

S Y K

The results from the ICP IM network show the positive effects of the S emission reduction measures in Europe

- Concentrations and deposition fluxes of xSO_4 (wet + dry) have decreased significantly almost at all (> 95%) studied IM sites

- xSO_4 concentrations and fluxes in runoff have consequently decreased (significant at 90% and 60% of the sites, respectively), and the IM catchments have increasingly responded to the decreases in deposition of xSO_4 during the last 25 years

- The most acid-sensitive IM catchments are experiencing a recovery from SO_4-driven acidification, although net release of SO_4 from soil may delay the recovery

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The results from the ICP IM network document the positive effects also for the N emission reduction measures in Europe

- Bulk deposition of NO_3 and NH_4 decreased significantly at 60–80% (concentrations) and 40–60% (fluxes) of the sites
- Concentrations and fluxes of NO_3 in runoff decreased at 73% and 63% of the sites, respectively, and NO_3 concentrations decreased significantly at 50% of the sites
- In general, TIN (NO_3 + NH_4) was strongly retained (> 90%) in the catchments not affected by natural disturbances.
- As yet there are no widespread signs of a consistent increase in NO_3 concentrations or exports in sensitive undisturbed freshwater

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The N cycling is complex

- The present decreasing trend of TIN deposition at IM sites should generally lead to decreased NO_3 concentrations in runoff !?
- Routine monitoring variables do not explain variation/change in TIN output satisfactorily, because obviously not all potential drivers were included in the empirical models

  ➡ Further analysis with specific catchment and soil data is needed: **Data mapping on internal catchment N-related parameters at IM sites**

- No detailed research plan yet, but main questions will be: What is the present status of these N-related parameters? How these parameters explain the variation/trends of TIN at IM sites?

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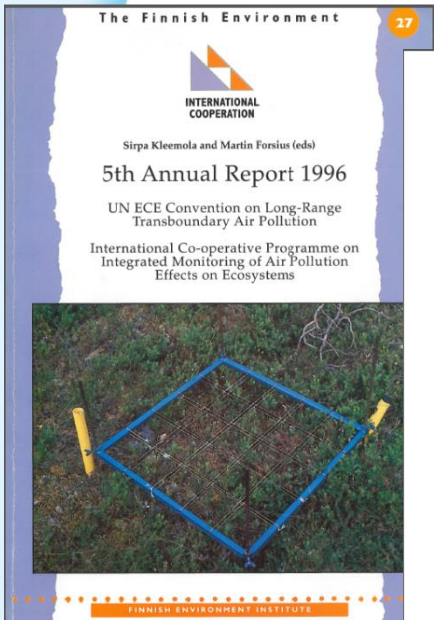
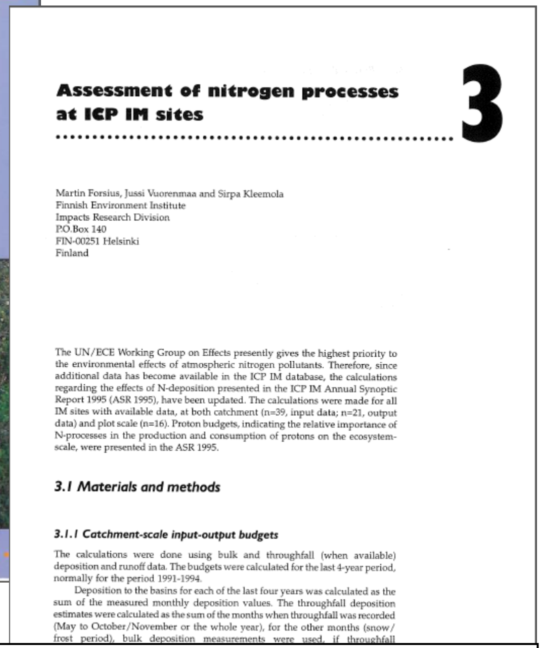
Previous N-assessment





Assessment of nitrogen processes at ICP IM sites 3

Martin Forsius, Jussi Vuorenmaa and Sirpa Kleemola
Finnish Environment Institute
Impacts Research Division
P.O.Box 140
FIN-00251 Helsinki
Finland

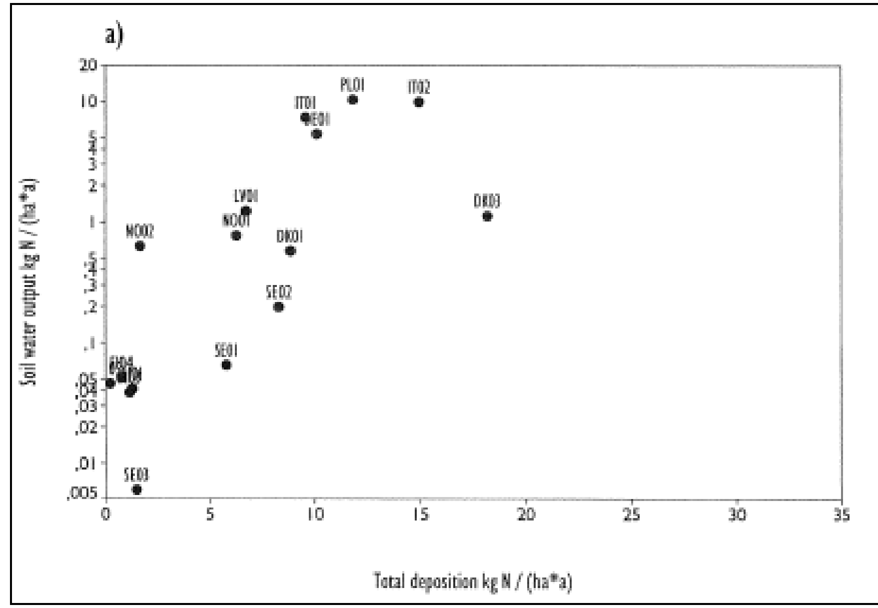
The UN/ECE Working Group on Effects presently gives the highest priority to the environmental effects of atmospheric nitrogen pollutants. Therefore, since additional data has become available in the ICP IM database, the calculations regarding the effects of N-deposition presented in the ICP IM Annual Synoptic Report 1995 (ASR 1995), have been updated. The calculations were made for all IM sites with available data, at both catchment (n=39, input data; n=21, output data) and plot scale (n=16). Proton budgets, indicating the relative importance of N-processes in the production and consumption of protons on the ecosystem-scale, were presented in the ASR 1995.

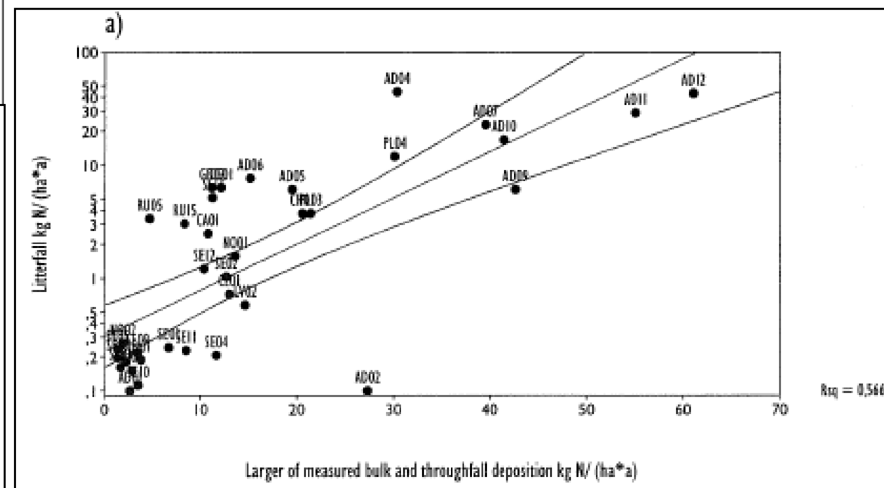
3.1 Materials and methods

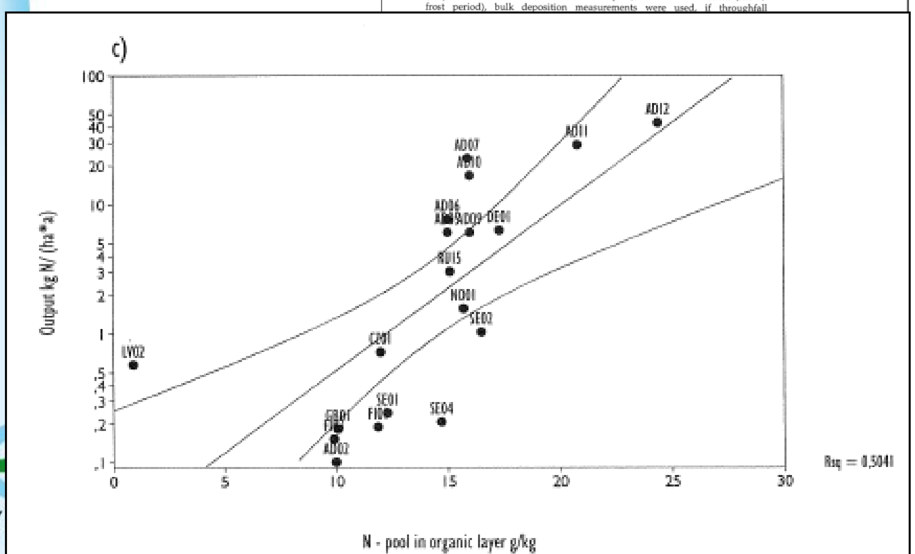
3.1.1 Catchment-scale input-output budgets

The calculations were done using bulk and throughfall (when available) deposition and runoff data. The budgets were calculated for the last 4-year period, normally for the period 1991-1994.

Deposition to the basins for each of the last four years was calculated as the sum of the measured monthly deposition values. The throughfall deposition estimates were calculated as the sum of the months when throughfall was recorded (May to October/November or the whole year), for the other months (snow/frost period), bulk deposition measurements were used, if throughfall







Submitted/existing data 2000-2016

Site	Country	Hydrometeorology			Deposition		Runoff	Litterfall	Foliage	Soil		Soil water
		Prec.	Runoff	Air temp.	Bulk	Throughfall	Conc./flux			(chemistry)	(physics)	
		PC	RW	AM	BD	TF	RW	LF	FC	SC	SC	SW
AT01	Austria	x	x	x	x	x	x	x	x	x	x	x
BY02	Belarus	x	x	x	x	n.d.	x				x	
CH02	Switzerland	x	x		x	n.d.	x					
CZ01	Czech R.	x	x	x	x	x	x				x	x
CZ02	"	x	x	x	x	x	x	x				x
DE01	Germany	x	x	x	x	x	x	x	x	x	x	x
DE02	"	x	n.d.	x	x	x	n.d.	x	x	x	x	x
EE01	Estonia	x	n.d.	x	x	x	n.d.	x	x	x	x	x
EE02	"	x	x	x	x	x	x	x	x	x	x	x
ES02	Spain	x	x	x	x	x	x	x	x	x	x	x
FI01	Finland	x	x	x	x	x	x			x	x	x
FI03	"	x	x	x	x	x	x			x	x	x
FI06	"	x	x	x	x	x	x					x
IE01	Ireland	x			x	x						x
IT01	Italy	x	x	x	x	x	x	x	x	x	x	x
IT03	"	x	n.d.		x	x	x		x			x
IT07	"	x	n.d.		x	x	n.d.		x	x	x	
IT09	"	x	n.d.		x	x	x		x	x	x	x
LT01	Lithuania	x	x	x	x	x	x	x	x	x		x
LT03	"	x	x	x	x	x	x	x	x	x		x
LV01	Latvia	x	x		x	x	x	x	x			x
LV02	"	x	x		x	x	x	x	x			x
NO01	Norway	x	x	x	x	x	x				x	x
NO02	"	x	x		x	x	x					x
NO03	"	x	x		x	n.d.	x					x
PL01	Poland	x		x	x	x				x	x	x
PL06	"	x	x		x	x	x	x	x			x
PL10	"	x	x		x	x	x	x	x			x
SE04	Sweden	x	x	x	x	x	x	x	x		x	x
SE14	"	x	x	x	x	x	x	x	x		x	x
SE15	"	x	x	x	x	x	x	x	x		x	x
SE16	"	x	x	x	x	x	x	x	x		x	x
										N tot	Soil temp.	NO3, NH4, N tot
N=32	**N=15**									pH	Bulk density	pH
										TOC		DOC
										C:N		Flow

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Empirical data needed

- If TF agrees & willingness to share national data
  - Soil chemistry (SC): N tot, TOC, C/N, pH
  - Soil water chemistry (SW): NO_3, NH_4, N tot, TOC/DOC, pH, flow
  - Litterfall chemistry (LF): N tot, TOC, litterfall amount (d.w.)
  - Foliage chemistry (FC): N tot, TOC, sample weight (d.w.)
  - Other parameters? Soil moisture and temperature, stand age…

- Time schedule and work plan
  - Data submitted by 30.9.2018
  - Draft Material and Methods by 31.10.2018
  - Manuscript submission by 31.12.2019

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Thank you


Valkea-Kotinen IM catchment (FI01)
Photo: Jorma Keskitalo

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Percentage of IM sites with a significant decreasing (black), insignificant decreasing (dark grey), significant increasing (white) and insignificant increasing (light grey) trend in concentrations and fluxes in 1990–2015