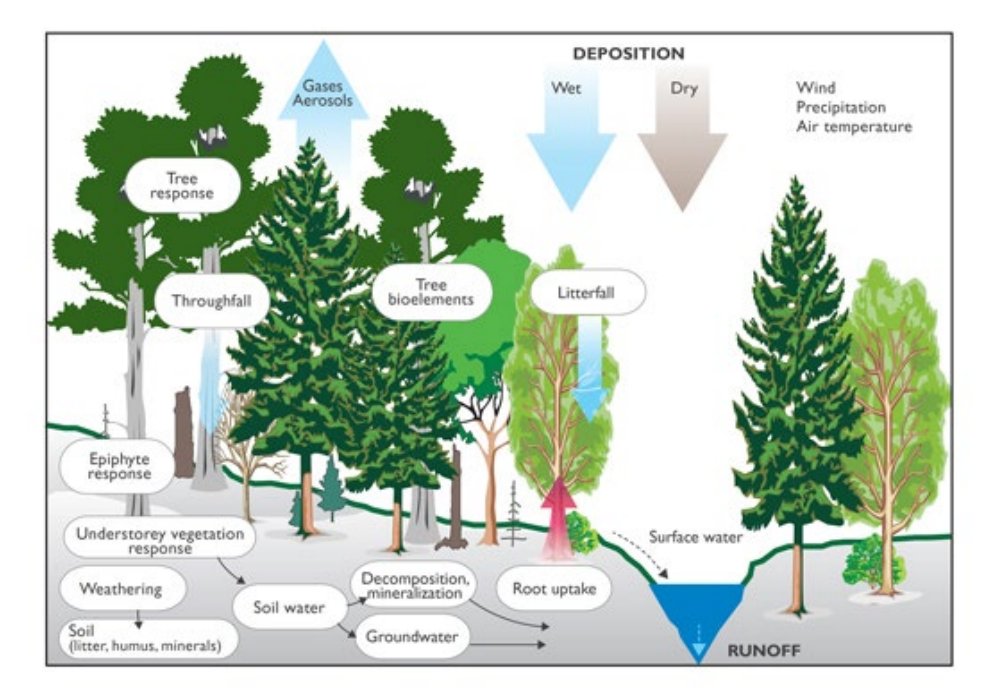
Clean Air 40 YEARS

wge Working Group on Effects of the Convention on Long-range Transboundary Air Pollution

ICP Integrated Monitoring of Air Pollution Effects on Ecosystems –

ICP IM



U. Grandin
S. Valinia
M. Forsius

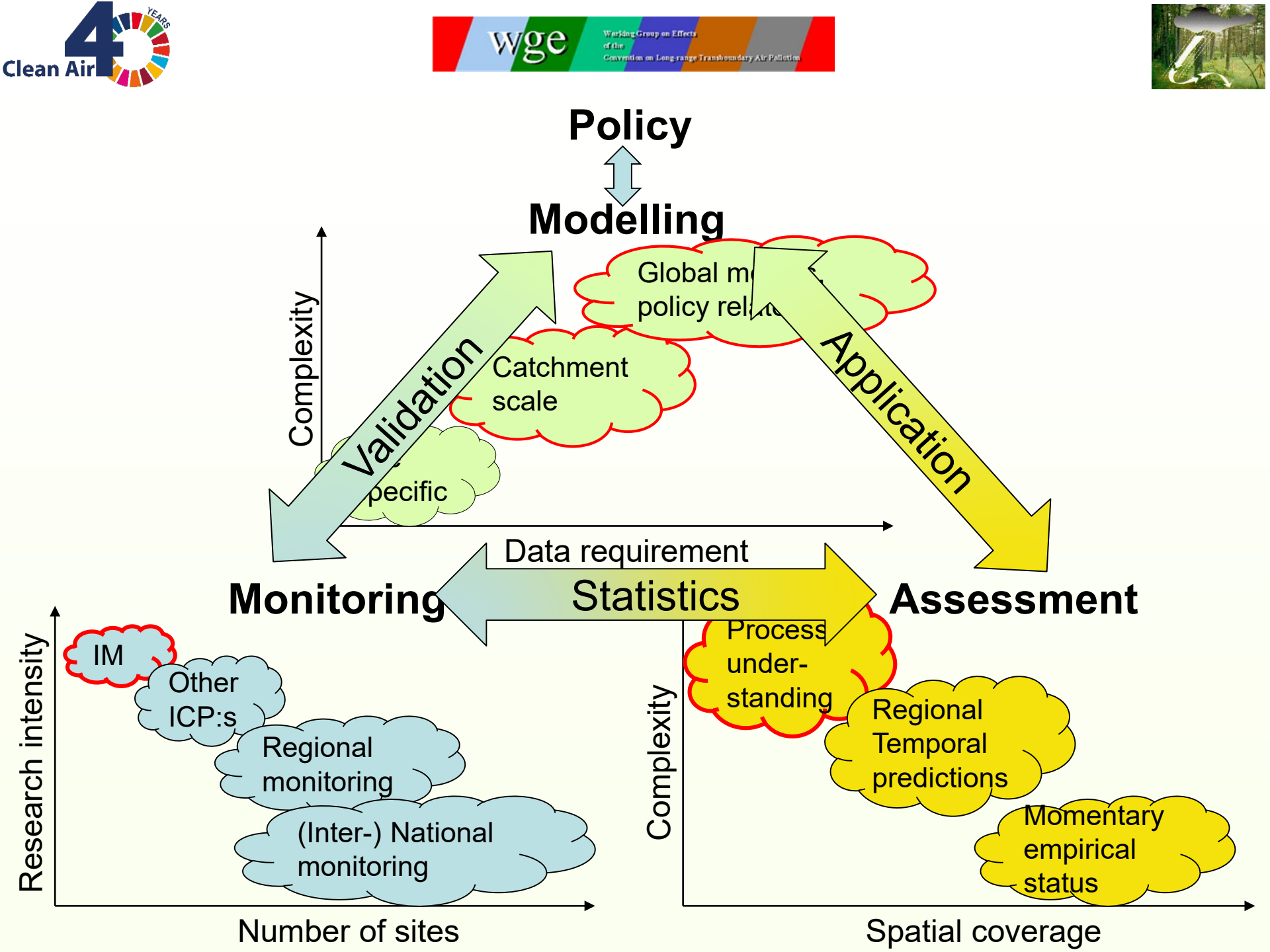
ICP Integrated Monitoring

Main objectives of ICP IM:

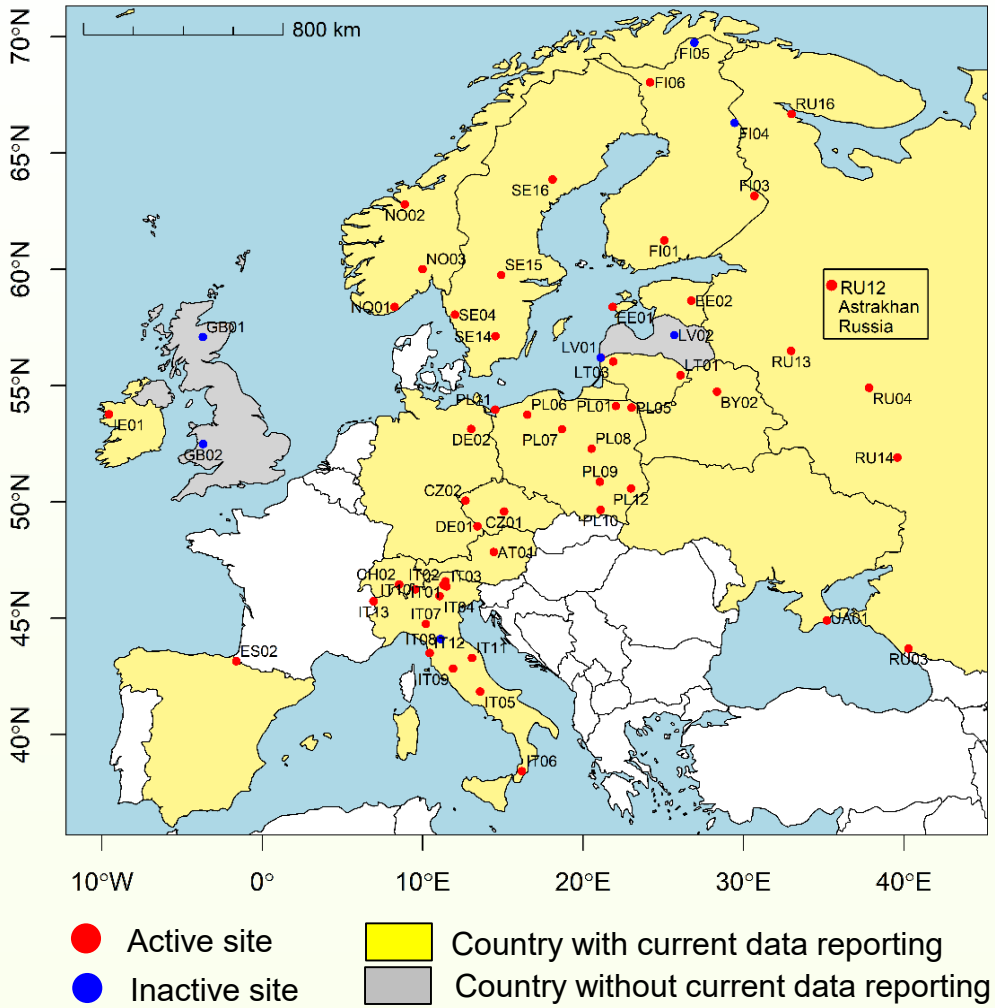
- Long-term **monitoring of** biological, chemical and physical state of ecosystems, to…
- provide an **explanation of changes** in terms of **causative environmental factors**, including:
  - natural changes,
  - air pollution and
  - climate change, to…
- **provide a scientific basis for emission control**.
- **Develop and validate models** for the simulation of ecosystem responses to e.g. **estimate responses** and to make **regional assessments**.

Integrated Monitoring: Key tasks

- **Concentrations, pools and fluxes** of sulphur and nitrogen and heavy metals
- Bulk and throughfall **deposition** and **runoff** water chemistry
- Assessment of **ecosystem responses** using **biological data**
- Dynamic modelling and assessment of the **effects of emission/deposition scenarios**
- Calculation of **critical loads** for sulphur, nitrogen and heavy metals
- Establish links between **critical load exceedance and empirical impact indicators**


Policy
Modelling
Complexity
Validation
Application
Catchment scale
Data requirement
Monitoring
Statistics
Assessment
Research intensity
IM
Other ICP:s
Regional monitoring
(Inter-) National monitoring
Number of sites
Complexity
Process under-standing
Regional Temporal predictions
Momentary empirical status
Spatial coverage

Integrated monitoring sites, 2019



16 active countries

49 active sites

Soon new sites in Russia and UK

Plans:

- contact ”white” counties for invitation to join.
- launch “IM light” for encouraging more sites to join.

Summary of recent activities

- Four scientific papers in priority topics

IOP Publishing Environ. Res. Lett. 13 (2018) 125010 https://doi.org/10.1088/1748-9326/aaf26b

Environmental Research Letters

LETTER

Currently legislated decreases in nitrogen deposition will yield only limited plant species recovery in European forests

OPEN ACCESS

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ORIGINAL RESEARCH

WILEY Ecology and Evolution

Major disturbances test resilience at a long-term boreal forest monitoring site

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Abstract

1. The impact of disturbances on boreal forest plant communities is not fully understood, particularly when different disturbances are combined, and regime shifts to alternate stable states are possible after disturbance. A long-term monitored semi-natural forest site subject to intense combined storm and bark beetle dam-

Science of the Total Environment 640–641 (2018) 387–399

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Modelling study of soil C, N and pH response to air pollution and climate change using European LTER site observations

Maria Holmberg [a,*], Julian Aherne [b], Kari Austnes [c], Jelena Beloica [d], Alessandra De Marco [e], Thomas Dirnböck [f], Maria Francesca Fornasier [g], Klaus Goergen [h,i], Martyn Futter [j], Antti-Jussi Lindroos [k], Pavel Krám [l], Johan Neirynck [m], Tiina Maileena Nieminen [k], Tomasz Pecka [n], Maximilian Posch [o], Gisela Pröll [f], Ed C. Rowe [p], Thomas Scheuschner [q], Angela Schlutow [r], Salar Valinia [c,s], Martin Forsius [a]

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

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

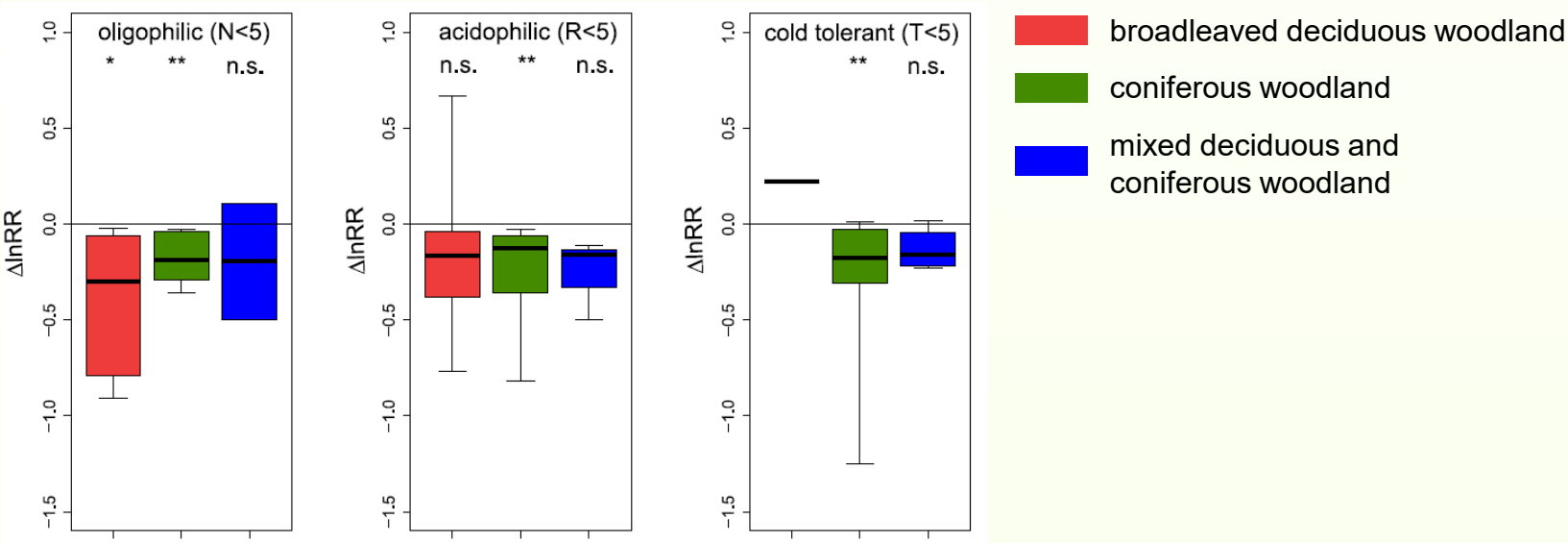
Long-term changes (1990–2015) in the atmospheric deposition and runoff water chemistry of sulphate, inorganic nitrogen and acidity for forested catchments in Europe in relation to changes in emissions and hydrometeorological conditions

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]

Dirnböck et al., 2018

Title: Currently legislated decreases in nitrogen deposition will yield only limited plant species recovery in European forests

Result: The model indicate that diversity of oligophilic forest understory plant species will continue to decrease



Dirnböck et al., Environ. Res. Lett. (2018), DOI: 10.1088/1748-9326/aaf26b

Weldon & Grandin, 2019

- **Question**: Test of ecological resilience in the vegetation at one IM site severely affected by storm and bark beetles.

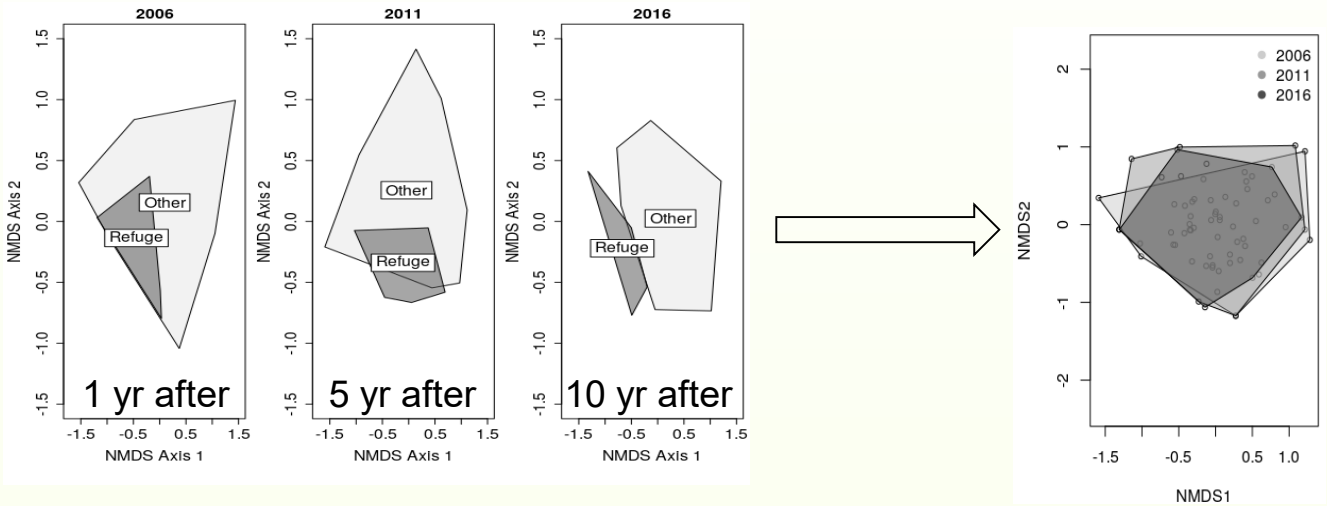
IM site SE14 , “Aneboda”

Approximate watershed

Weldon & Grandin, Ecol. Evol. (2019), DOI: 10.1002/ece3.5061

Weldon & Grandin, 2019

- **Results:** Increasing divergence in understory species composition between affected and unaffected areas, but not to shift species composition or dominance.

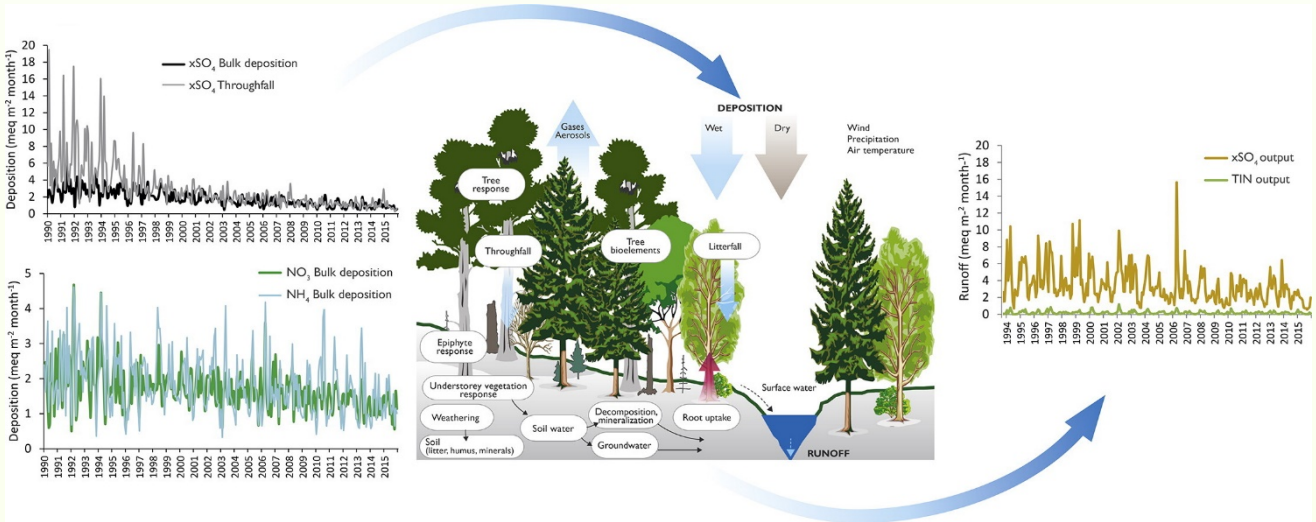


- **Conclusion**: Resilience in the plant community is increased by refuge areas functioning as a form of conservative ecological memory.

Weldon & Grandin, Ecol. Evol. (2019), DOI: 10.1002/ece3.5061

Vuorenmaa et al. 2018

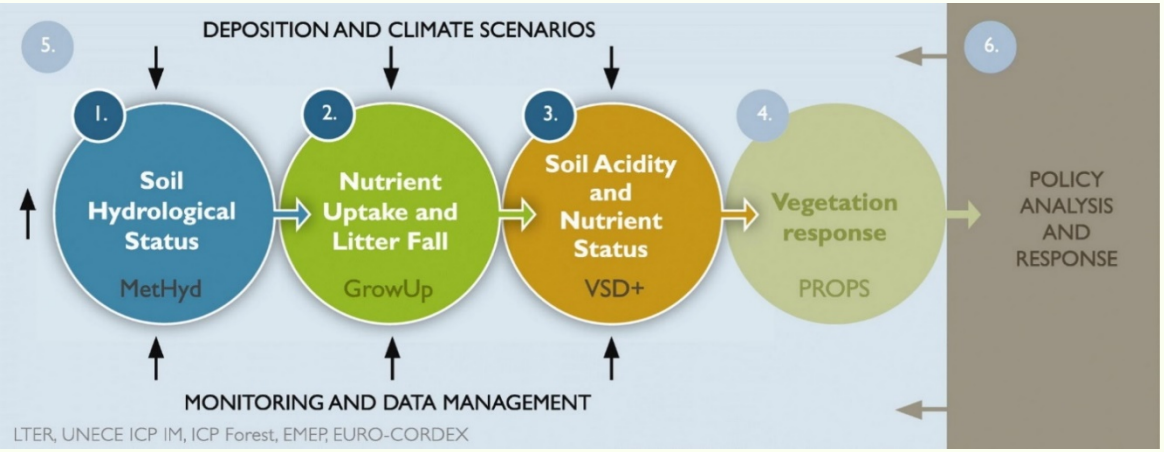
- Trends in runoff fluxes of SO_4 respond to the decrease in S emissions.
- Decreasing trends in NO_3 concentrations in deposition and runoff.
- Still highly variable trends in inorganic N output fluxes.
- Deposition pattern explain variation of SO_4 in runoff.
- No clear signs of a consistent climate-driven increase in inorganic N loss.



Vuorenmaa et al. 2018, https://doi.org/10.1016/j.scitotenv.2017.12.245

Holmberg et al. 2018

- VSD+ dynamic soil model, data from LTER, ICP IM and Forests.
- Soil pH and base saturation were projected to increase under decrease in S, N deposition.
- Simulations with climate warming gave more variable results.
- Climate warming led to higher soil C:N at half of the sites, lower at one third.



Holmberg et al. 2018, https://doi.org/10.1016/j.scitotenv.2018.05.299

Summary of recent activities

- Four scientific papers in priority topics
- New key person for mercury and heavy metals issues!
- Successful scientific workshop back-to-back with the 2019 TF meeting.
- Other priority activities by ICP IM
  a) The 2018 joint progress report on policy-relevant scientific findings
  b) The 2018 Technical report to WGE
  c) The 2018 ICP Integrated Monitoring annual report

Deliverables 19/20, related to work plan

Scientific papers

a) Impacts of internal catchment-related nitrogen parameters on nitrogen leaching;

b) The relationship between critical load exceedances and empirical ecosystem impact indicators (possibly a report);

c) Trends in recovery in the epiphytic lichen community at ICP IM sites, after the abatement of sulphur deposition;

Deliverables 19/20, related to work plan

Reports

a) Trends in concentrations and fluxes of mercury and heavy metals across ICP Integrated Monitoring sites in Europe;

b) The 2019 joint progress report on policy-relevant scientific findings;

c) The twenty-ninth annual ICP Integrated Monitoring report.

Further development and the future

- Further work along with the Long Term Strategy, for example multiple stressors
- Increased cooperation and use of EMEP data in evaluations of IM data
- Participation in the potential revision of the Gothenburg Protocol
- Participation in the development of the European LTER-network to an ESFRI Research Infrastructure (www.lter-europe.net).
- Invite more countries in Europe to join ICP IM
- Investigate possibilities for allowing “IM light” sites for a wider network. Other ecosystem types for biodiversity assessments.
- Encourage countries to expand their IM monitoring; more variables.

ICP IM and the (potential) review The Gothenburg Protocol

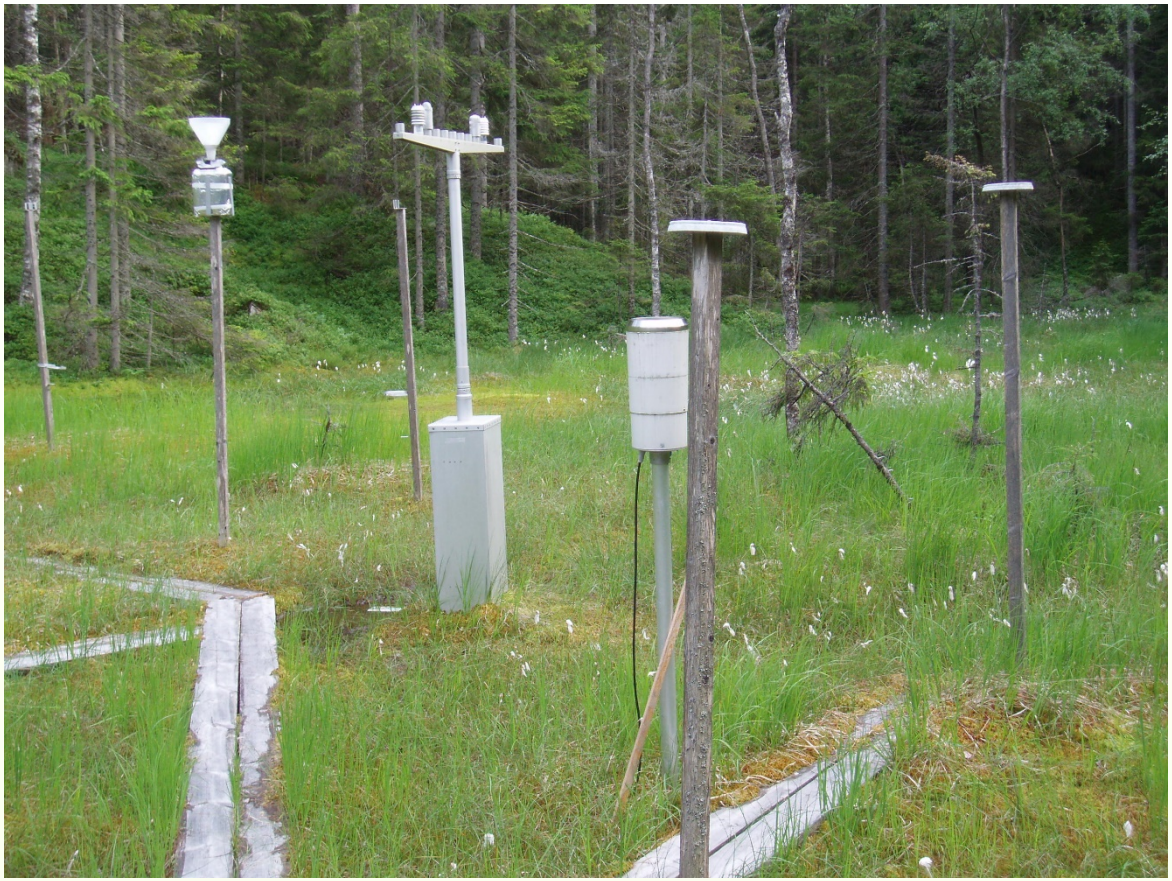
WGSR conclusions are in line with the ICP IM work plan and strategy of work coming years, for instance:

- "*An integrated approach to addressing air pollution through a **multi-pollutant**, **multi-effect approach**, that includes the potential interaction with **climate change**, the **nitrogen cycle** and **biodiversity**, that can achieve multiple goals and benefits, and avoid potential unintended consequences of proposed actions for other environmental problems*".

Data from the ICP IM database is essential for the GP update, e.g.:

- *"Update of the **critical loads** for the analysis of the efficiency of policies;*
- *Effects of air pollution on **biodiversity** as a basis for critical levels/loads calculations;*
- *Accounting for linkages with **climate change** and land use in **effects indicators**"*

Thanks for your attention



Meteorological station at IM site SE15. Photo Ulf Grandin.