ICP Integrated Monitoring of Air Pollution Effects on Ecosystems – ICP IM
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
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

Environmental Research Letters

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

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Original Research

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

James Weldon | Ulf Grandin

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 damage restoration 2010 was used to assess the resilience of boreal forest plant communities.
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

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![Graphs showing changes in lnRR for oligophilic, acidophilic, and cold tolerant plant species across different woodland types.](image-url)
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

After storm + bark beetles
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.
Vuorenmaa et al. 2018

- Trends in runoff fluxes of SO₄ respond to the decrease in S emissions.
- Decreasing trends in NO₃ concentrations in deposition and runoff.
- Still highly variable trends in inorganic N output fluxes.
- Deposition pattern explain variation of SO₄ in runoff.
- No clear signs of a consistent climate-driven increase in inorganic N loss.

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
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;

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.