# ICP Integrated Monitoring of Air Pollution Effects on Ecosystems –

# ICP IM

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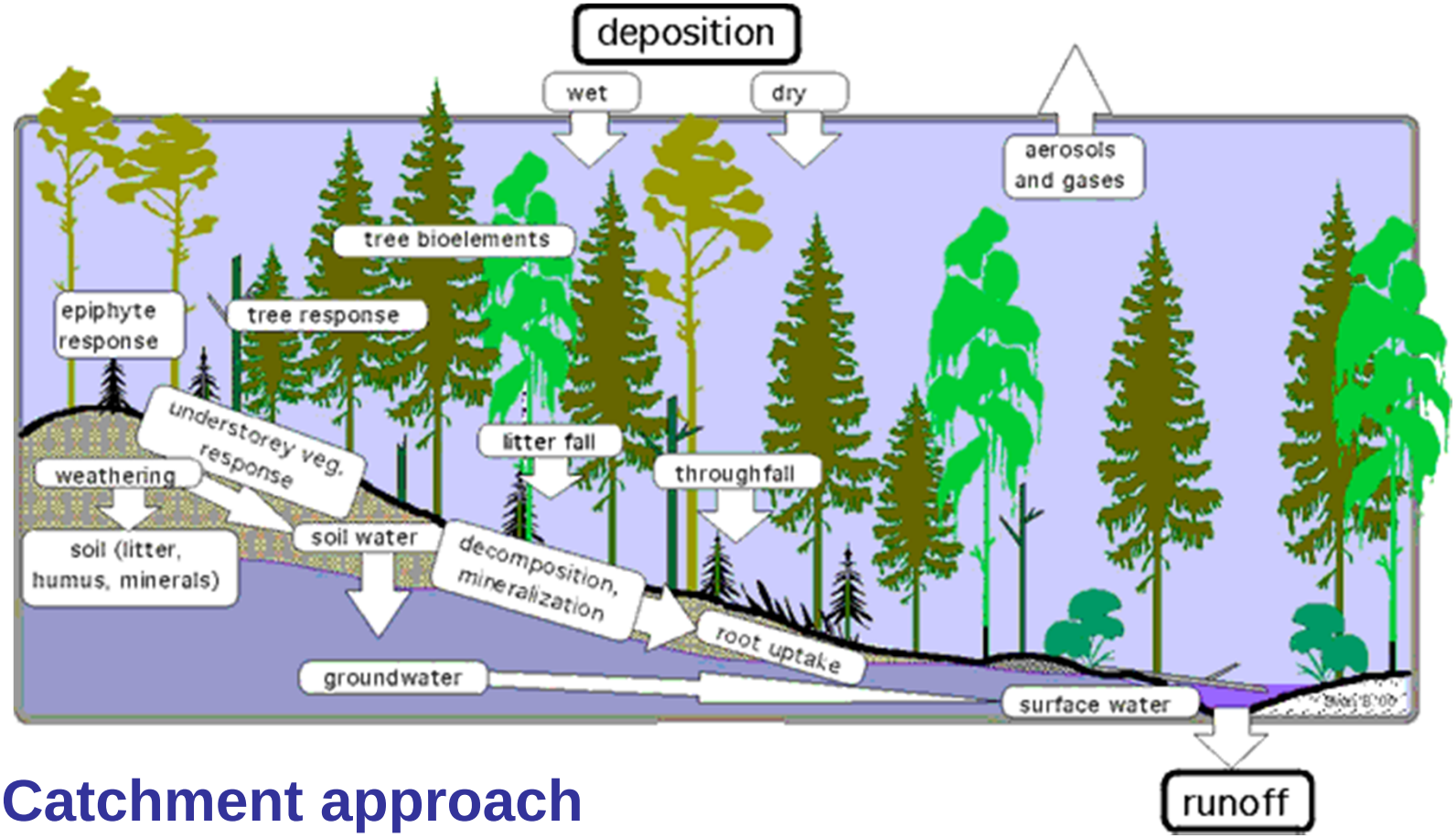
# ICP Integrated Monitoring




**Catchment approach**
**Budget calculations**
**Process oriented**

Policy

Modelling

Complexity

Validation

Application

Global m
policy rel

Catchment scale

pecific

Data requirement

Monitoring

Statistics

Assessment

Research intensity

IM

Other ICP:s

Regional monitoring

(Inter-) National monitoring

Number of sites

Complexity

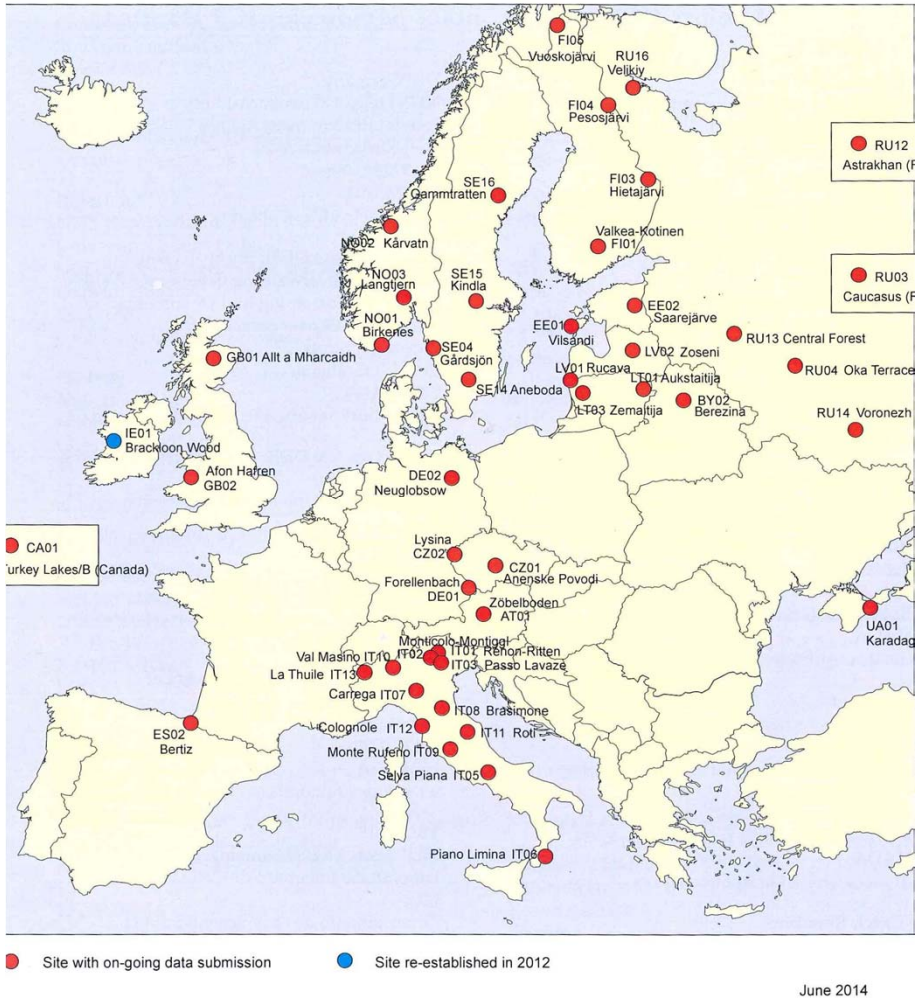
Process under-standing

Regional Temporal predictions

Momentary empirical status

Spatial coverage

# Integrated monitoring sites




**17 countries**

**42 active sites**

**Ireland to restart**

**Switzerland: one new site**

**Poland has indicated participation**

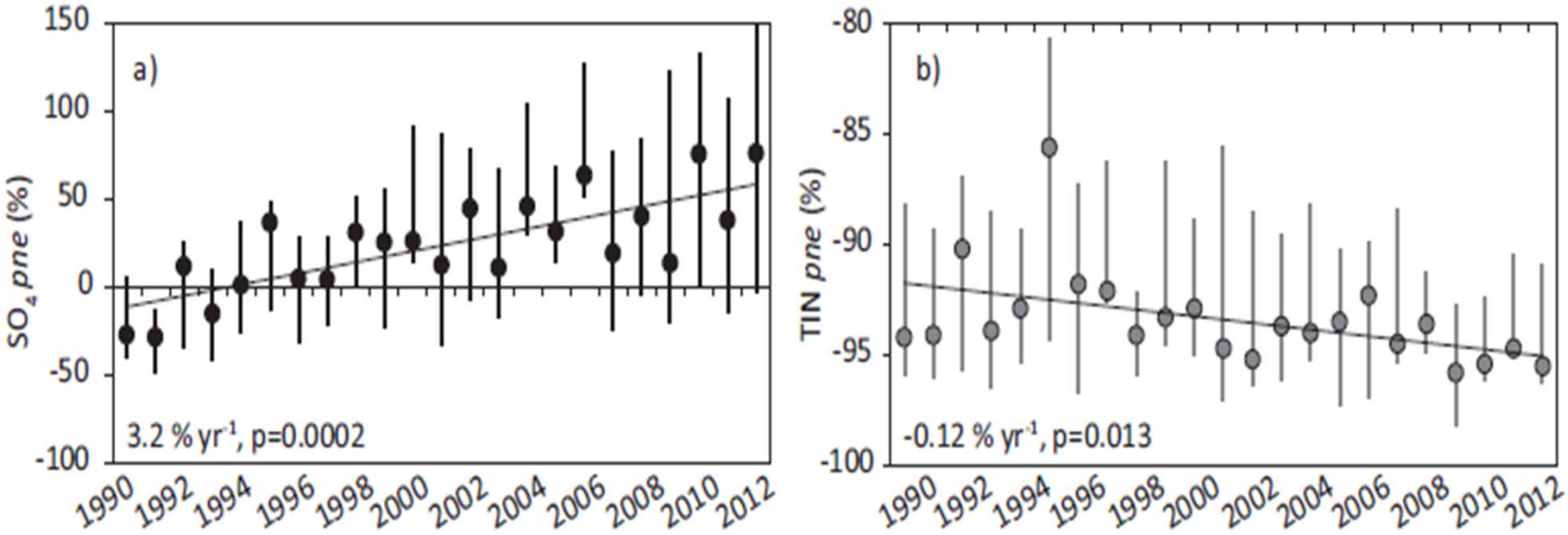
# Integrated Monitoring: Key tasks

- Assessment of concentrations, pools and fluxes of sulphur and nitrogen compounds and heavy metals
- Trend analysis of 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, including confounding effects of climate change processes
- Calculation of (site-specific) critical loads for sulphur, nitrogen and heavy metals
- Links between critical load exceedance and empirical impact indicators

# Examples from recent studies

- Analysis of long-term trends
- Cause-effect studies
- Dynamic modelling

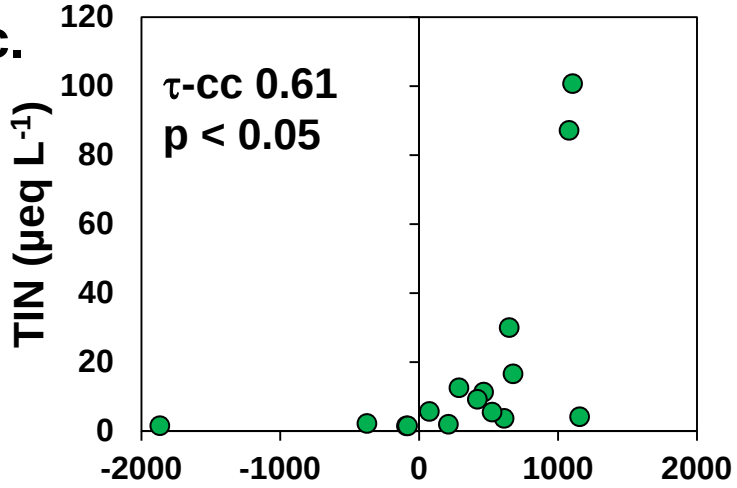
# Scientific paper on mass balances and indicators for sulphur and nitrogen in catchments

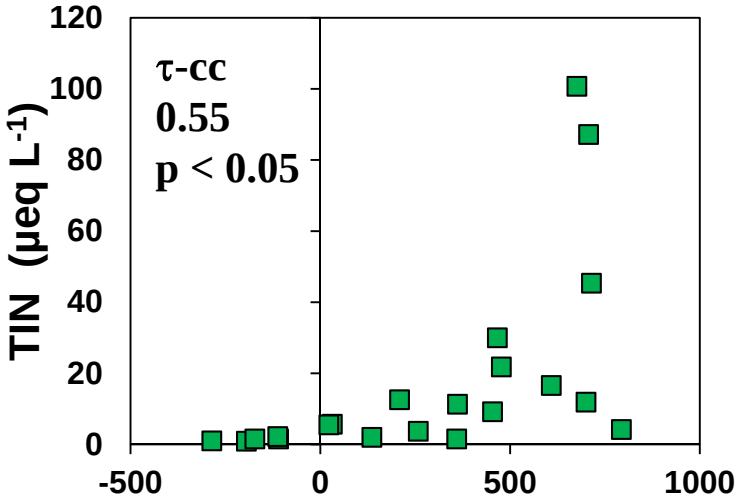



(Vuorenmaa *et al.* 2017, *Ecological Indicators* 76: 15–29)

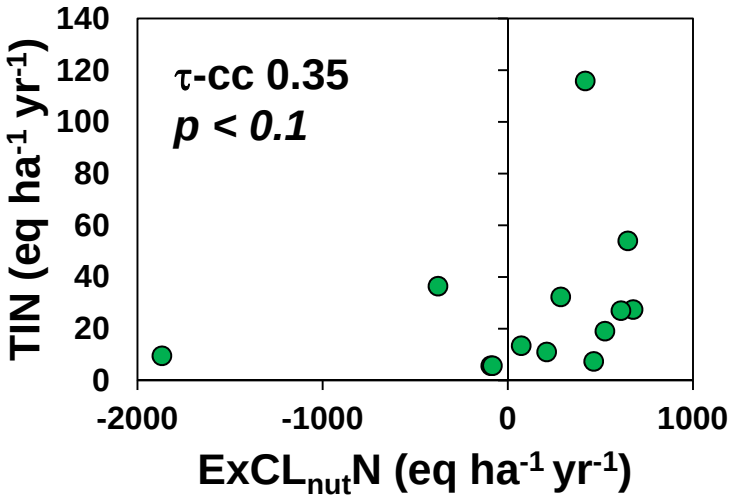
# Exceedance of critical loads vs. observed N in waters

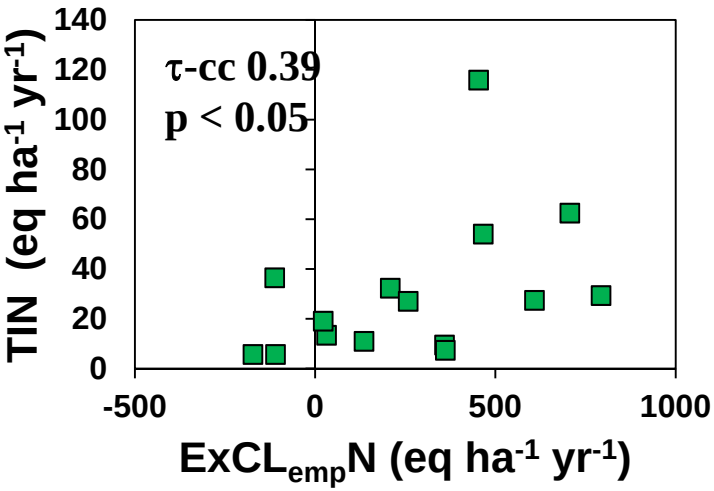
**Conc.**



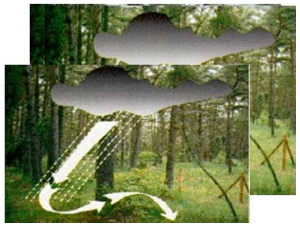




**Flux**

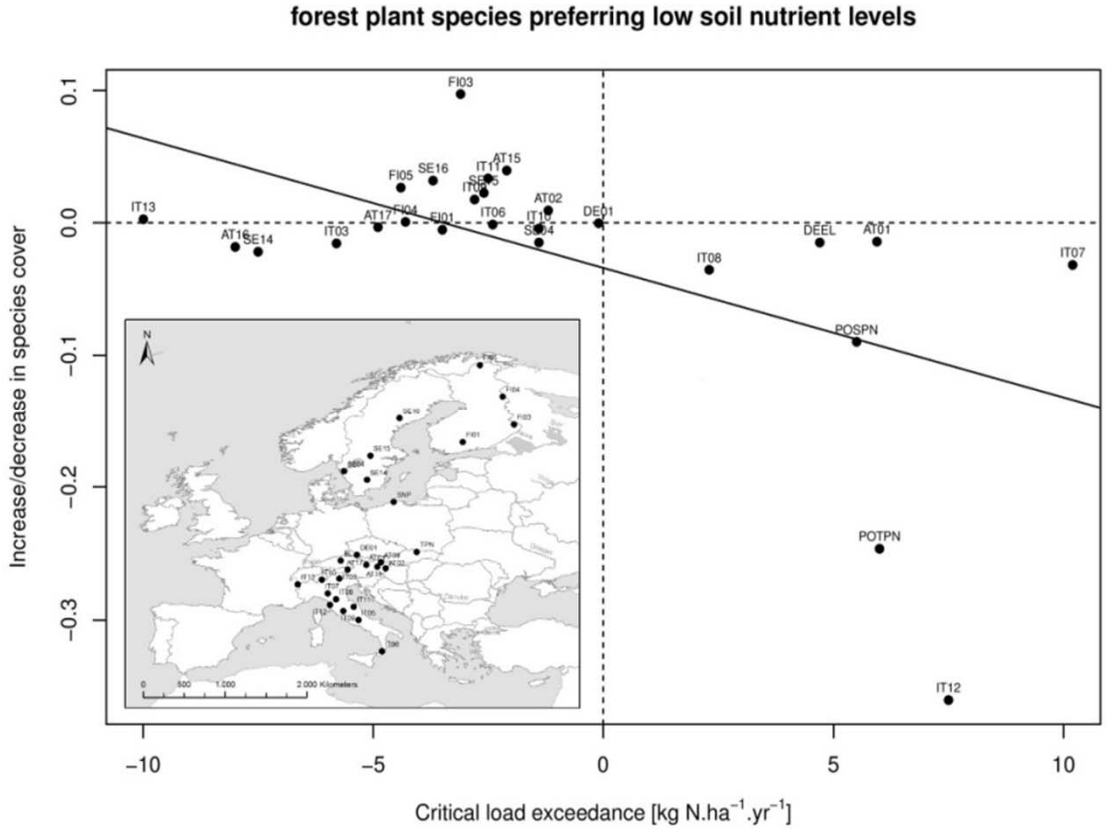



(Holmberg *et al.* 2013, *Ecological Indicators* 24:256–265)

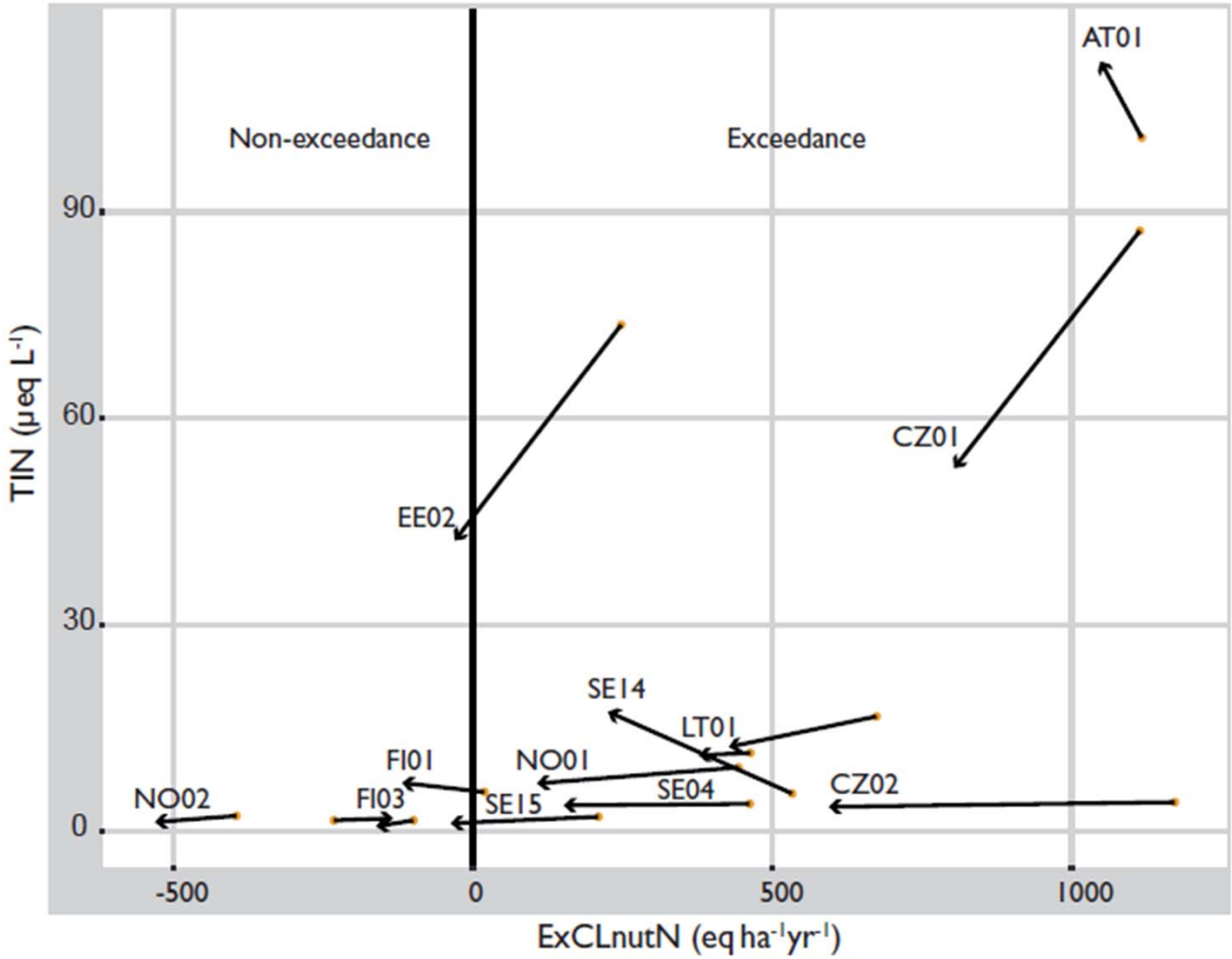


Forest plant species that prefer low soil nutrient levels have decreased during the last 10-50 years in 28 ICP IM and ICP Forests sites across Europe owing to the exceedance of the nitrogen critical loads.



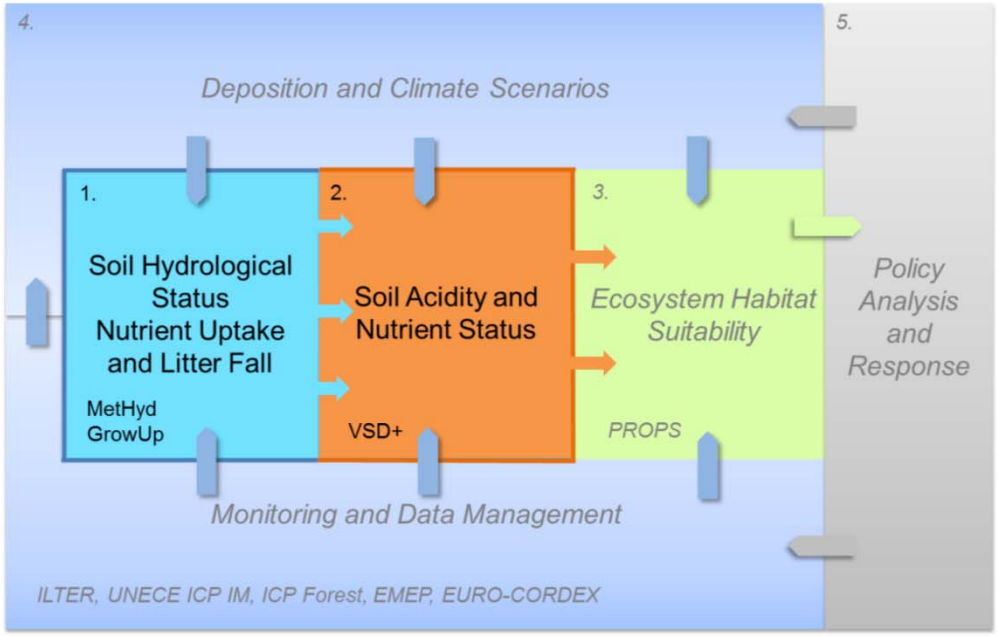

(Dirnböck et al. 2014, Global Change Biology 20: 429–440)

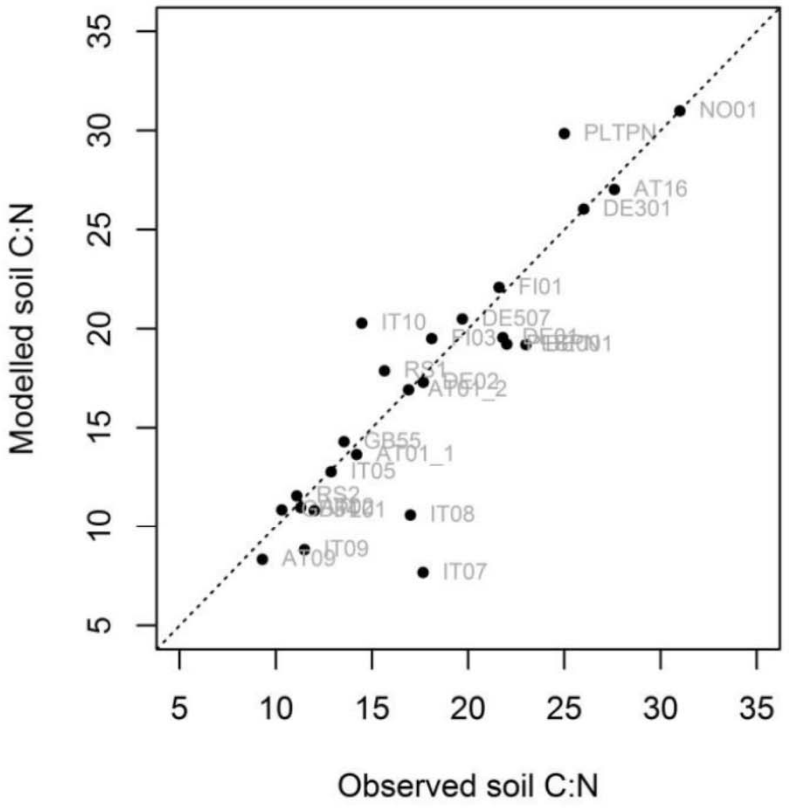
# Change in exceedance of critical loads vs. observed N in waters




(Holmberg et al. 2017, ICP IM Annual Report)

# Work in progress: Modelling of ecosystem habitat suitability




(Holmberg et al, submitted)

# ICP IM Strengths

- Long-term intensive datasets available from many undisturbed sites across Europe
- Possibilities to do detailed studies on cause-effect relationships, including effects on biota
- Links between different ecosystem compartments assessed
- Calibrated dynamic models available for scenario analysis
- Strong links to scientific institutions and networks (LTER-Europe)
- Documentation of impacts of emission reductions and ecosystem recovery, and links to climate change

# ICP IM threats and areas for improvement

- Comprehensive monitoring expensive to carry out
- Long-term funding not guaranteed for many sites
- Site data not available from many countries → gaps in coverage
- Complete data sets not available from many sites → limits possibilities for comprehensive analysis
- Standardisation of methods and data collection incomplete → challenge for data quality
- How can ICP IM monitoring sites be used for future policy development

# Conclusions

- ICP IM is expanding
- Results are used in research
- Data widely used for model calibration
- Increasing cooperation with other ICP:s (particularly ICP Waters and ICP M&M)
- A sequence of monitoring and assessment on different spatial and temporal scales is needed – current ICP structure of the WGE covers this approach