ICP Waters
International Cooperative Programme on Assessment and Monitoring Effects of Air Pollution on Rivers and Lakes

Aims

• Assess the degree and geographic extent of the impact of atmospheric pollution, in particular acidification, on surface waters

• Collect information to evaluate dose/response relationships

• Describe and evaluate long-term trends and variation in aquatic chemistry and biota attributable to atmospheric pollution

Progress & results

• Status participation

• Report from Task Force meeting

• Recent and planned reports

• Relevant results in light of unofficial document Gothenburg Protocol Review Group
### Status participation

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<th>Chemical data (last year with data)</th>
<th>Biological data (last year with data)</th>
<th>Participation in TF meetings 2018-2020</th>
<th>Participation in chemical intercomparison 2017-2019</th>
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- **Virtual Task Force meeting joint with ICP Integrated Monitoring**
  - Remote organization allowed for easier participation from other ICPs
- **Stable participation overall, new contacts with Georgia and Armenia**
Task Force meeting

- Trends in recovery of acidification (new report)
- Trends and impacts of nitrogen in surface waters; contribution to empirical critical loads (ongoing report)
- Biodiversity
- Climate impacts on recovery
- Microplastics in remote lakes

- Long-term scientific strategy
- NEC Directive
- Call for land cover data
- Recent scientific publications
- Minutes are available at www.icp-waters.no
Trends in water chemistry (1990-2016)

Reduced emissions of S and N lead to:
• Strong declines in sulphate in lakes and rivers, most clearly in Europe
• Declines in nitrate in lakes and rivers, although climate confounds these patterns
Trends in water chemistry - 2

- Widespread increases in acid-neutralizing capacity and pH of lakes and rivers
- Episodic acidification has become less severe

![Trends in buffer capacity (ANC)](image)

Europe

North America
Trends in water chemistry – 3

• Rates of decline in SO4 are changing
  • Note the difference in trend between Europe and North America

• Most likely related to changes in deposition
Trends in water chemistry - 4

• Time series of circa 500 lakes and rivers in Europe and North America (1990-2016) document improved water chemistry, which implies improved conditions for fish and other aquatic life.

• Land use and climate (forest management, forest dieback from bark beetle attacks) can delay chemical and biological recovery.
Mercury in fish – affected by emissions of sulfur?

Braaten et al 2019, ES&T

Braaten et al 2020, Stoten
Nitrogen report (ongoing)

• Nitrate trends are mostly negative, but smaller than trends in sulphate
• Possibly because declines in N deposition are smaller than declines in S deposition
  • The nitrogen cycle is sensitive to climate and land use change (more than the sulfur cycle)

• Update of empirical critical loads for nitrogen
  • Update of literature
  • Data analysis – looking for effects of nitrate on algal growth in freshwaters
Nitrogen report - 2

• Nitrogen deposition declines significantly
• Nitrate in surface waters does not show a simple response to deposition
  • Climate, land use and land cover all determine how surface waters react to changing N deposition
• Algal growth in lakes and rivers is mostly limited by phosphorus availability
  • Changes in nitrogen can impact algal biomass, productivity and algal blooms and species composition (diversity)
Review of Gothenburg protocol

2.2b exceedance of critical loads
• Lack of critical load exceedance is not equivalent to ‘no ecosystem damage’ because of delays in recovery

Regional assessment of current extent of surface water acidification in Europe and North America

• Trends and prognosis (for 2020)
  • Requires use of models and projections of deposition (collaboration with the EMEP)
2.2c ‘change in water quality indicators’

- Regular trend assessments, data until 2016

2.7 ‘is monitoring system sufficient’?

- Regional assessment of current extent of surface water acidification in Europe and North America
  - Lack of data in some regions. Monitoring under NEC directive might help
2.8 ‘protection of marine ecosystems’

Not part of our mandate, but riverine export of nitrogen (originating from deposition) is clearly a relevant topic

- Marine ecosystems are limited by nitrogen. Coastal ecosystems are especially sensitive to nitrogen inputs from rivers
Workplan 2020-2021

• WGE joint items
  • Review and revision of the Gothenburg protocol
  • Inputs to the Scientific Strategy

• ICP Waters specific
  • Contribution to empirical critical loads for nitrogen
  • Nitrogen report (2020+2021)