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Working Group on Effects

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Progress in activities in 2020 and further development of effects-oriented activities

Effects of air pollution on rivers and lakes

Report of the Programme Centre of the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes

Summary

The present report is submitted for consideration by the sixth joint session of the Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe and the Working Group on Effects, in accordance with both the 2020–2021 workplan for the implementation of the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/144/Add.2, workplan items 1.1.1.7 and 1.1.1.8) and the revised mandate for the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes (Executive Body decision 2019/15).[1]

The report is a summary of the discussion and results presented at the thirty-sixth meeting of the Task Force of the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes (online, 11 and 12 May 2020).

[1] Available at http://www.unece.org/env/lrtap/executivebody/eb_decision.html.

I. Introduction

1. The present report of the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes (ICP Waters) is submitted for consideration by the sixth joint session of the Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) and the Working Group on Effects, in accordance with both the 2020–2021 workplan for the implementation of the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/144/Add.2, workplan items 1.1.1.7 and 1.1.1.8) and the revised mandate for the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes (Executive Body decision 2019/15).[2] The report is a summary of the discussion and results presented at the thirty-sixth meeting of the ICP Waters Task Force (online, 11 and 12 May 2020).

2. The lead country of the ICP Waters Task Force is Norway. The Chair and the Programme Centre of the Task Force are hosted by the Norwegian Institute for Water Research. ICP Waters national focal centres contribute with data and present national results related to assessment and monitoring of air pollution effects on surface waters. ICP Waters collaborates with all the International Cooperative Programmes under the Working Group on Effects, as well as the Joint Task Force on the Health Aspects of Air Pollution, which is a joint body of the World Health Organization (WHO) European Centre for Environment and Health and the Executive Body for the Convention.

3. The thirty-sixth meeting of the ICP Waters Task Force was attended by 36 experts from 15 Parties to the Convention. The thirty-sixth meeting was supposed to be held jointly with the Task Force of the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring) and would have been the fifth such joint meeting, aimed at improving collaboration between bodies under the Working Group on Effects (ECE/EB.AIR/133/Add.1, item 1.4.2). However, due to the coronavirus disease (COVID-19) pandemic, the thirty-sixth meeting was held remotely, separately from that of the ICP Integrated Monitoring Task Force. Currently, 25 countries participate in one or more of the activities of ICP Waters. The ICP Waters Task Force considered progress reports from the Programme Centre and the national focal centres on the results on trends, nitrogen, acidification, microplastics and drought effect. The presentations are available from the ICP Waters home page[3] and in the proceedings of the 2020 Task Force meeting, which will be produced before September 2020[4] and are summarized in the minutes.[5] A summary of the presentations and discussions at the meeting is presented below (section II).

II. Ongoing activities - report from the 2020 Task Force meeting

4. *Trends in recovery from acidification*. The trajectories of sulphate concentrations, acid-neutralizing capacity and pH between 1990 and 2016 demonstrate substantial recovery from acidification. However, recovery has slowed down in Europe and accelerated in North America since the early 2000s. Acidic episodes have become less severe in line with the recovery of average chemistry, but impacts of changing climatic extremes such as droughts and storms on acidic episodes could be substantial. Key questions on combined effects of climate and deposition on chemical and biological recovery remain to be answered.

5. *Nitrogen.* Catchments in North America and Europe have been exposed to elevated nitrogen deposition for many decades. Ecosystem nitrogen saturation, resulting in enhanced leaching of nitrate and associated acidification, is a concern but, so far, there are few signs of large-scale increases in nitrate concentrations. Recent trend assessments suggest that

[2] Available at http://www.unece.org/env/lrtap/executivebody/eb_decision.html.
[3] See www.icp-waters.no/meetings/.
[4] Øyvind Garmo and Kari Austnes, eds., "Proceedings of the thirty-sixth Task Force meeting of the ICP Waters Programme" (ICP Waters report in preparation).
[5] The minutes of the Task Force meetings, which include the agenda, the list of participants and the workplan, are available at www.icp-waters.no/meetings.

nitrate leaching is declining as a response to lower deposition in recent years. However, interactions of deposition, climate and catchment characteristics are likely, but poorly understood, controls of nitrogen leaching. ICP Waters is currently preparing a report with the aim of investigating nitrogen trends and levels in terms of interactions of deposition, climate and landcover. ICP Waters will also contribute to the ongoing revision of the empirical critical loads for nitrogen.

6. *Biodiversity*. Linking water quality to functional biodiversity can provide further insight into the effects of air pollution in surface waters. The functional traits of aquatic organisms (here, macroinvertebrates) have direct consequences for ecosystem functioning, such as litter breakdown, water filtering and nutrient recycling. Initial work on data from selected stations indicate that this approach can elucidate the link between emission of air pollution and ecosystem services.

7. *New pollutants from long-range transboundary transport.* Microplastics and emerging contaminants associated with the urban environment have been found in remote waters in Ireland. The sources of these pollutants are unknown, but atmospheric deposition is possible. Monitoring data from other regions and from air quality would be useful for further exploration.

8. *Chemical intercomparison.* Results from the thirty-third chemical intercomparison were reported.[6] Thirty-six laboratories from 16 countries participated. The overall results from 2019 were good (acceptance rate higher than 75 per cent), but poor for total phosphorous. The chemical intercomparison was a valuable tool for quality assurance of laboratory analyses.

9. *Biological intercalibration.* Results from the twenty-third biological intercalibration of invertebrates were reported.[7] The goal was to evaluate the quality of, and harmonize, the taxonomic work. Two laboratories participated in 2019. With a mean Quality assurance index (Qi) of 92 and 98, the laboratories scored well above the threshold for acceptable taxonomic work (Qi 80). Results in the biological intercalibrations over time suggest that the taxonomists in the laboratories affiliated to ICP Waters are skilled.

10. *Participation in other groups under the Convention*. Representatives of the ICP Waters Programme Centre participated in the fifth joint session of the Steering Body to EMEP and the Working Group on Effects (Geneva, 9–13 September 2019), the Extended Bureaux meeting of those two bodies (online, 24–26 March 2020), the nineteenth meeting of the Joint Expert Group on Dynamic Modelling (Sitges, Spain, 30 October-1 November 2019), the fortieth anniversary of the Convention (Geneva, 11 and 12 December 2019), the thirty-sixth meeting of the Task Force of the International Cooperative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (ICP Modelling and Mapping) (online, 21–23 April 2020), the twenty-eighth meeting of the Task Force meeting of ICP Integrated Monitoring (online, 13 and 14 May, 2020), the thirty-sixth meeting of the Task Force of the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (online, 11 and 12 June 2020) and the kick-off meeting for the review and revision of empirical critical loads for nitrogen (online, 15 and 16 June 2020).

11. *Exploration of ways to combine activities of ICPs*. ICP Waters and ICP Integrated Monitoring had planned a fifth joint Task Force meeting (Riga, 12–14 May 2020), but those plans changed due to the COVID-19 pandemic. A fifth joint meeting was planned for 2021. Possibilities for joint work on thematic reports had been discussed during the Task Force meetings. Nitrogen was also seen as an obvious topic for collaboration, given the

[6] Cathrine Brecke Gundersen, *Intercomparison 1933: pH, Conductivity, Alkalinity, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Tot-P, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn*, ICP Waters report No. 141/2019 (Oslo, Norwegian Institute for Water Research, 2019). Available at http://hdl.handle.net/11250/2636990.

[7] Gaute Velle and others, *Biological intercalibration: Invertebrates 2019*, ICP Waters report No. 140/2019 (Bergen, Norwegian Institute for Water Research, 2019). Available at http://hdl.handle.net/11250/2634747.

combination of intensive monitoring at the ICP Integrated Monitoring sites and the large geographic extent of the ICP Waters monitoring sites.

III. Items related to the mandate of the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes

A. Further implementation of the Guidelines for Reporting on the Monitoring and Modelling of Air Pollution Effects

12. An overview of the monitoring effects reported by ICP Waters, according to the Guidelines for Reporting on the Monitoring and Modelling of Air Pollution Effects (ECE/EB.AIR/2008/11–ECE/EB.AIR/WG.1/2008/16/Rev.1) was provided (ECE/EB.AIR/GE.1/2019/12–ECE/EB.AIR/WG.1/2019/5).

B. Enhanced involvement of countries in Eastern and South-Eastern Europe, the Caucasus and Central Asia and cooperation with activities outside the Convention

13. With regards to the involvement of countries in Eastern and South-Eastern Europe, the Caucasus and Central Asia in ICP Waters work, Armenia, Belarus, Georgia, the Republic of Moldova and the Russian Federation all participated in ICP Waters activities or had been active in recent years. Armenia was present at the thirty-sixth meeting of the Task Force of ICP Waters and presented its work. Armenia and Georgia were positive regarding the submission of relevant data to the ICP Waters database and had been investigating the potential to do so in 2020.

C. Cooperation with programmes and activities outside the Convention

14. The Programme Centre has been taking an active part in the work of the Ecosystem Monitoring Subgroup under the European Union National Emission Ceilings Directive[8], and was represented at the online meeting held on 4 June 2020, as were the Working Group on Effects and the other ICPs: an event at which the analysis of the first reported data was presented. National focal centres that currently contribute to ICP Waters have acquainted themselves with national activities for implementation of the National Emission Ceilings Directive. ICP Waters will continue to be active in contributing expertise and activities in the work to implement the Directive.

15. Results from ICP Waters activities on mercury in fish has previously been used in the work of the Minamata Convention on Mercury. The Programme Centre has actively been following the progress of the Minamata Convention.

16. ICP Waters has been closely following the progress of the European Long-Term Ecosystem Research (LTER) network and the associated eLTER H2020 project. ICP Waters supports the effort and encourages the ICP Waters network to contribute with monitoring sites, although acknowledging that many sites do not meet the requirements for integrated, highly instrumented sites but could be very valuable for upscaling and giving a wider context for data collected in highly instrumented sites.

17. The Convention is about to establish a formal collaboration with the European Union LifeWatch European Research Infrastructure Consortium programme. In 2019, a proposal

[8] Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC, *Official Journal of the European Union*, L 344 (2016), pp. 1–31.

was submitted for a project on water and water management in the Guadalquivir catchment in southern Spain. ICP Waters will play an important role in this project.

D. Contribution to the joint annual report to the Working Group on Effects

18. ICP Waters contributed to the 2019 joint progress report on policy-relevant scientific findings (ECE/EB.AIR/GE.1/2019/3−ECE/EB.AIR/WG.1/2019/3) to the Working Group on Effects.

IV. Workplan items specific to the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes

A. Trend analysis of water chemistry (2018–2019 workplan item 1.1.1.11)

19. A report published in March 2020[9] presented trends in sulphate, nitrate, chloride, base cations, acid neutralizing capacity, pH and dissolved organic carbon at circa 500 ICP Waters sites in Europe and North America for the period 1990–2016. Time series were analysed for trends in annual median values, annual extreme values and change points that indicated years with sudden changes in trend or level. Also provided was a brief overview of possible implications of land use change for recovery of acidified surface waters. Sulphate and chloride concentrations had declined in most regions for the period (1990-2016), while nitrate decline in all regions. Change points were more prevalent in the time series for sulphate and nitrate in the 1990s than after year 2000, indicating smoother trends in recent years. On a regional scale, base cation concentrations had declined by approximately half the equivalent change in concentration of sulphate. Acid neutralising capacity increased in all regions, while pH had increased in most regions. The trajectories of sulphate, acid neutralising capacity and pH indicate that recovery had slowed down in Europe and accelerated in North America. This can be linked to different timing of regulatory measures that had led to strong reductions in emissions at both continents. Acidic episodes, i.e. the annual extremes, had become less severe in line with the recovery of average chemistry. Changes in climate and land use can have varied effects on recovery of acidified surface waters and may be viewed as categories of confounding factors. The report had given an overview of how intensified forestry, reduced summer farming and/or grazing in upland areas, increased vegetation growth/expansion or forest at higher altitudes, and temporary decline or dieback of forest due to drought or disease outbreaks can change the water chemistry.

B. Thematic report on reactive nitrogen (2020–2021 workplan item 1.1.1.7)

20. Progress on the thematic report on reactive nitrogen was reported under paragraph 5 above. At the thirty-sixth Task Force meeting of ICP Waters, it was decided to extend the scope of the report to include topics relevant to the ongoing revision of the empirical critical loads for nitrogen. A combined report would be finalized in 2021 and the report would be delivered for the consideration of the Executive Body at its forty-first session in 2021.

[9] Øyvind Garmo and others, *Trends and patterns in surface water chemistry in Europe and North America between 1990 and 2016, with particular focus on changes in land use as a confounding factor for recovery*, ICP Waters report No. 142/2020 (Oslo, Norwegian Institute for Water Research, 2020). Available at https://hdl.handle.net/11250/2649682.

C. Thematic report on biological recovery and responses to changing water chemistry (2020–2021 workplan item 1.1.1.8)

21. This report had originally been scheduled to be published in 2021, but at the thirty-sixth Task Force meeting of ICP Waters it was decided to postpone publishing to 2022, due to the expansion of the workplan item 1.1.1.7 report. The content will be further discussed at the thirty-seventh Task Force meeting of ICP Waters in 2021.

V. Expected outcomes and deliverables over the next period and the longer term

22. ICP Waters would continue to deliver policy-relevant reports to the Working Group on Effects that addressed the 2020–2021 workplan and revised long-term strategy of the effects-oriented activities.[10] The topic for the 2021 report was reactive nitrogen in surface waters, a topic that had been supported by the Task Force meeting. Nitrogen was a relevant topic for the Convention, the European Union Water Framework Directive[11] and, possibly, the Marine Strategy Framework Directive.[12] Nitrogen was also a suitable topic for collaboration between ICP Waters and ICP Integrated Monitoring. Special attention would be given to nitrogen trends and the combined influence of deposition, land cover and climate and nitrogen saturation. A separate focus would be biological responses to nitrogen in aquatic systems as a contribution to the ongoing revision of empirical critical loads for nitrogen. The proposed topic for the 2022 report was biological recovery. Further details would be discussed at the Task Force meeting in 2021. ICP Waters contributed to the Strategy for scientific bodies under the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/GE.1/2020/18–ECE/EB.AIR/WG.1/2020/11). Relevant items for ICP Waters in the coming decade comprised – among other things – biological and chemical recovery and coupling to climate and land use change, mercury, continued monitoring and integrated assessments.

VI. Policy relevant issues, findings and recommendations

23 *Mercury*. Emission of the pollutant mercury were regulated and included in old and new international conventions and agreements (for example, the Convention, the Minamata Convention on Mercury and the Water Framework Directive). Documentation of levels of mercury in freshwater fish, recipients of mercury pollution, would be important in evaluating whether regulations of emissions had their intended effect. A general recommendation for monitoring of mercury in freshwater fish was to focus on repeated sampling of the same water body.

24. *Current status of ICP Waters monitoring network.* The ICP Waters monitoring network was tailored to document responses in water chemistry to changes in atmospheric loads of air pollution. New countries had considered contributing (Armenia, Georgia), while several other countries had reinitiated their participation (Ireland, Poland and Spain). Collaboration within the Convention had intensified through the organization of joint meetings with ICP Integrated Monitoring. Reports and results that were delivered continue to be of relevance both under the Convention and other instruments, such as the Minamata Convention and the National Emission Ceilings Directive.

[10] Available at www.unece.org/fileadmin/DAM/env/documents/2012/EB/Informal_document_no_18_Revised_Long-term_Strategy_of_the_effects-oriented_activities_clean_text.pdf.

[11] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, *Official Journal of the European Communities*, L 327 (2000), pp. 1–72.

[12] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for Community action in the field of marine environmental policy, *Official Journal of the European Union*, L 164 (2008), pp. 19–40.

VII. Issues for the attention and advice of other groups, task forces or subsidiary bodies, notably with regard to synergies and possible joint approaches or activities

25. The ICP Waters monitoring network was tailored to monitor effects of air pollution on surface waters and currently consisted of more than 500 sites in acid-sensitive areas in more than 20 countries in Europe and North America. The rivers and lakes were sampled regularly under national monitoring programmes. The data series were mostly 15–25 years in length. Some sites had over 30 years' worth of data. The data were frequently used in trend assessments. Effects-related work under the Convention could benefit from joint activities on trends in ecosystem responses between various bodies and groups under the Working Group on Effects. Monitoring of air pollution effects was mandatory under article 9 of the National Emission Ceilings Directive. ICP Waters had contributed to the preparation of guidelines for monitoring effects on surface waters under the Directive, had nominated an expert to serve on the Ecosystem Monitoring Subgroup of the Directive, and would continue to highlight the relevance and value of the ICP Waters network and expertise developed since the 1980s.

26. *Exploration of ways to combine activities of ICPs*. The Task Force meeting was held jointly with ICP Integrated Monitoring in four consecutive years, from 2016 onwards. A fifth joint meeting had been planned for 2020 but was replaced by an online meeting because of the pandemic. There was regular collaboration on thematic reports with ICP Integrated Monitoring and with other bodies under the Convention.

VIII. Relevant scientific findings: highlights

27. Highlights of recent scientific findings of ICP Waters are summarized in sections II and VI above.

IX. Publications

28. For a list of ICP Waters publications and references for the present report, please refer to the ICP Waters website.[13]

[13] See www.icp-waters.no/publications/.