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Executive Body for the Convention on Long-range Transboundary Air Pollution

Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

Working Group on Effects

Ninth joint session
Geneva, 11–15 September 2023
Item 9 (b) (iv) of the provisional agenda
Progress in activities and workplan for 2024–2025 of effects-oriented activities: air pollution effects on materials, the environment and crops: air pollution effects on waters

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 ninth 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 2022–2023 workplan for the implementation of the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/148/Add.1, workplan items 1.1.1.11 and 1.1.1.12) 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).

The report is a progress report on activities, including a summary of the discussion and results presented at the thirty-ninth meeting of the Task Force of the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes which was held jointly with the Task Force of the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (Austria, 9-11 May 2023).

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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 ninth 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 2022–2023 workplan for the implementation of the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/148/Add.1, workplan items 1.1.1.11 and 1.1.1.12) 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 progress report on activities, including a summary of the discussion and results presented at the thirty-ninth meeting of the ICP Waters Task Force which was held jointly with the Task Force of the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring) (Austria, 9-11 May 2023).

2. The lead country of the ICP Waters Task Force is Norway. The Programme Centre of ICP Waters is 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 on Long-range Transboundary Air Pollution. ICP Waters also collaborates with other bodies of the Convention where relevant, such as the Meteorological Synthesizing Centre - West (MSC-W).

3. The ICP Waters monitoring network is tailored to monitor effects of air pollution on surface waters and currently consists of more than 500 sites in acid-sensitive areas in more than 20 countries in Europe and North America. The rivers and lakes are sampled regularly under national monitoring programmes. The data series often start during the 1990s, while some sites have over 40 years' worth of data. Data calls are issued regularly, and the data are used in assessments of trends and spatial patterns.

4. The thirty-ninth meeting of the ICP Waters Task Force was also the sixth joint meeting with the ICP Integrated Monitoring Task Force. It was a hybrid meeting, held in Lunz, Austria, and was attended by 58 experts from 17 Parties to the Convention. Currently, 26 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 biodiversity, acidification, nitrogen and heavy metals; trends, recovery, confounding factors and dynamic modelling. The presentations are available from the ICP Waters home page[2] and are summarized in the minutes.[3] Highlights from the presentations and discussions at the meeting are presented below (section VI).

II. Outcomes and deliverables during the reporting period

5. During the reporting period, ICP Waters produced or contributed to the following publications and reports:

(a) Report 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 on their eighth joint session (ECE/EB.AIR/GE.1/2022/2−ECE/EB.AIR/WG.1/2022/2). The report contains information on data, activities and results generated by ICP Waters;

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

[2] See http://www.icp-waters.no

[3] 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.

(b) A report on progress in activities by ICP Waters (ECE/EB.AIR/GE.1/2022/12−ECE/EB.AIR/WG.1/2022/5);

(c) The report with Scientific information for the review of the Gothenburg Protocol (ECE/EB.AIR/GE.1/2022/3−ECE/EB.AIR/WG.1/2022/3);

(d) The Strategy for scientific bodies under the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/GE.1/2022/18−ECE/EB.AIR/WG.1/2022/11);

(e) Contribution to the EMEP and WGE 2023 Joint progress report on policy-relevant scientific findings (ECE/EB.AIR/GE.1/2023/3−ECE/EB.AIR/WG.1/2023/3);

(f) The proceedings from the thirty-eighth meeting of the ICP Waters Task Force[4].

(g) The reports on the thirty-sixth chemical intercomparison[5], the twenty-sixth biological intercalibration[6] and the report on biological recovery (2022–2023 workplan item 1.1.1.11)[7]. The work on biological recovery based on data from the ICP Waters database and a new call for biological data and contributions was started in 2021. This work has continued through 2022 and 2023.

6. During the reporting period, ICP Waters participated in the following meetings under the Convention: the eighth joint session of the Steering Body to EMEP and the Working Group on Effects (Geneva, September 2022); the Extended Bureaux meeting of those two bodies (online, February 2023 and in-person in Uppsala, April 2023); the thirty-ninth 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), thirtieth Coordination Centre for Effects (CCE) workshop and fourth Centre for Dynamic Modelling (CDM) workshop (Prague, March 2022); and the thirty-eighth meeting of the Task Force of the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (online, June 2022). ICP Waters also participated in the Saltsjöbaden workshop (Gothenburg, February 2023). Moreover, ICP Waters provided input to the work on the WGE web portal.

7. A call for water chemistry data was issued in 2022, to which 21 countries submitted data. In connection with this, the data template was updated and a new online quality control system was developed.

III. Expected outcomes and deliverables for the next reporting period and in the longer term

8. In the second half of 2022, ICP Waters carried out, and will continue to carry out in 2023, the following activities, in accordance with the 2022–2023 workplan for the Convention, the ICP Waters mandate and with the decisions taken at the thirty-ninth meeting of the Task Force:

(a) Preparation of the thematic report on trends in base cations (2022-2023 workplan item 1.1.1.12). Chemical recovery of surface waters implies a decline in base cations alongside declines in strong acid anions, but recent data analyses have indicated some unexpected patterns. Very low base cation levels can add to ecological damage of aquatic organisms while the balance between base cations and acid anions are key to assessing

[4] Ingvild Skumlien Furuseth and others (editors), "Proceedings of the 38th Task Force meeting of the ICP Waters Programme in Miraflores de la Sierra, Spain, and on-line, May 10-12, 2022", ICP Waters Report No. 150/2022 (Oslo, NIVA, 2022). Available at www.icp-waters.no/publications/.

[5] Tina Bryntesen, "Intercomparison 2236: pH, Conductivity, Alkalinity, NO3-N, Cl, SO3, Ca, Mg, Na, K, TOC, Tot-P, Tot-N, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn", ICP Waters Report No. 151/2022 (Oslo, Norwegian Institute for Water Research (NIVA), 2022). Available at www.icp-waters.no/publications/.

[6] Christian Lucien Bodin and others, "Biological intercalibration: Invertebrates 2022", ICP Waters Report No. 152/2023 (Oslo, NIVA, 2023). Available at www.icp-waters.no/publications/.

[7] Gaute Velle and others, "Responses of benthic invertebrates to chemical recovery from acidification", ICP Waters Report No. 153/2023 (Oslo, NIVA, 2023). Available at www.icp-waters.no/publications/.

acidification status of surface waters. High base cation concentrations may be attributed to mineral weathering or base cation exchange at the soil exchange complex but can also be impacted by atmospheric inputs from Saharan dust. Preliminary results were presented and discussed at the thirty-ninth meeting of the ICP Waters Task Force. The report is expected to be published by the end of 2023;

(b) Update of the ICP Waters manual (ECE/EB.AIR/GE.1/2023/6-ECE/EB.AIR/WG.1/2023/6, 2024-2025 workplan item 1.1.1.11). This work was started in 2022 and is expected to be finalised by the end of 2024. A new outline has been drafted and was discussed at the thirty-ninth meeting of the Task Force, along with general discussions on scope of the manual. A revision team has been set up, which has provided and will continue to provide specific input on the different topics;

(c) Initiate the work on dose-response relationships between water chemistry and biology, to be further discussed at the fortieth meeting of the Task Force in 2024. A thematic report on this topic is planned to be finalised in 2025 (ECE/EB.AIR/GE.1/2023/6-ECE/EB.AIR/WG.1/2023/6, 2024-2025 workplan item 1.1.1.12);

(d) Arranging the thirty-seventh chemical intercomparison and the twenty-seventh biological intercalibration;

(e) Arranging the 40th meeting of the ICP Waters Task Force and 7th joint meeting with ICP Integrated Monitoring;

(f) Report on activities to the 9th joint session of the Steering Body to EMEP and the Working Group on Effects;

(g) Attending meetings inside and outside the Convention, for instance, to support the monitoring and reporting under the European Union National Emission Ceilings (NEC) Directive[8], eLTER Europe and the Minamata Convention on Mercury;

(h) Work on suggestions for open data policy, to propose further action at the fortieth meeting of the Task Force.

IV. Cooperation with other groups, task forces and subsidiary bodies, including with regard to synergies and possible joint activities

9. ICP Waters has focused on synergies with other bodies and groups under the Working Group on Effects. The Task Force meeting has been held jointly with ICP Integrated Monitoring from 2016 onwards, to mutual satisfaction. There is regular collaboration on thematic reports with ICP Integrated Monitoring and with other bodies under the Convention. Nitrogen is especially considered as a natural topic for collaboration with other bodies under the Convention, and dynamic modelling of recovery of surface waters could also be such a topic.

10. The involvement of countries in Eastern and South-Eastern Europe, the Caucasus and Central Asia in ICP Waters work includes participation of Armenia, Belarus, Georgia, the Republic of Moldova and the Russian Federation. Armenia was present at the thirty-ninth meeting of the Task Force of ICP Waters and presented its work. Moldova and Armenia submitted data under the 2022 call for water chemistry data.

V. Scientific and technical cooperation with relevant international bodies

11. ICP Waters has been following the ongoing development of the European Long-Term Ecosystem Research (eLTER), which has been on the European Strategy Forum on Research

[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.

Infrastructures (ESFRI) roadmap since 2018. Since 2020, the preparation for and development of the eLTER RI as European Research Infrastructure Consortium (ERIC) has been supported by two EU-funded 5-year projects involving 27 countries. Several ICP Waters sites around Europe are associated with the eLTER network, and ICP Waters supports and encourages the national focal centres to explore how their countries can interact with the upcoming eLTER RI. ICP Waters contributed to the letter on collaboration between WGE and eLTER RI.

VI. Highlights of the scientific findings: policy-relevant issues

12. *Chemical recovery (and confounding factors).* Water chemical records from acid-sensitive waters in Europe and North America demonstrate responses to declining deposition of sulfur, in particular declines in sulfate concentrations. This is associated with declines in base cations, following the principle of electroneutrality. The decline in acid deposition leads to chemical recovery, as shown by increases in acid-neutralizing capacity and pH. An additional aspect of chemical recovery is the increase in dissolved organic carbon (DOC) concentrations, which potentially impact aquatic biology because DOC serves as nutrient source, affects the water temperature and lake thermal structure and acts as sunblock for sensitive species. In many regions, deposition of sulfur now approaches background levels and factors other than deposition, such as climate, become increasingly important for variations in surface water acidification.

13. *Biological recovery and biodiversity.* Long-term records of aquatic macro-invertebrates from 55 acid-sensitive rivers and lakes in Europe (Germany, Italy, Norway, Sweden, UK and Switzerland) were investigated for responses to reduced acid deposition. Aquatic macro-invertebrates spend most part of their life cycle in water and feed on plants, bacteria and decaying organic material, and are food sources to other organisms. Forty-seven percent of all rivers (21 sites, covering the period 1994-2018) and thirty-five percent of all lakes (34 sites, covering the period 2000 to 2018) showed significant increases in species richness of EPT (Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies)) taxa. Species of EPT are useful for assessing biological responses to acidification because many of them are sensitive to acidification, and because they have been consistently determined at the species level throughout the monitoring period. The smaller change in EPT taxa in lakes compared with rivers could be related to the shorter time period studied in lakes, but biological communities in lakes can also be less responsive than in rivers because of lower rates of habitat recolonization in lakes.

14. *Review of the Gothenburg Protocol.* The contribution from ICP Waters to the Review of the Gothenburg Protocol included estimations of expected chemical recovery given EMEP deposition scenarios for 2030 and 2050 for a few selected ICP Waters sites, and a comparison of modelled and measured ANC. It was concluded that further reduction of S and N deposition will lead to more chemical recovery, but not to pre-acidification water chemistry. Climate change and interannual variability in weather will have greater effects on ANC as acid deposition declines, with unknown consequences for biological recovery.

15. *Open data policy.* Open data policy following FAIR principles (describing how data can be organized so they can be easily accessed, understood, exchanged and reused) is supported by all participants in ICP Waters, and in many countries monitoring data are made publicly available already. Implementation of these principles can be done through creative common licenses, where the degree of openness of the data can be further specified. Also, data papers may be a useful tool for making data more accessible and understandable. The Programme Centre will propose further action at the next Task Force meeting.

16. *Chemical intercomparison.* Results from the thirty-sixth chemical intercomparison are available. Twenty-six laboratories from 15 countries participated. Two sets of samples were prepared and distributed to the participants: one for the determination of ions and one for metals. In general, the results were of the same quality as previous years, with an overall acceptance rate of 75%. Total nitrogen was included for the first time this year. General trends in the choice of techniques are especially promising for the determination of metals at low levels. ICP Waters uses water samples with a substantial interannual variation in

concentration levels, reflecting the variation found within the ICP Waters network. The chemical intercomparison is a valuable tool for quality assurance of laboratory analyses.

17. *Biological intercalibration.* Results from the twenty-sixth biological intercalibration of invertebrates are available. The goal was to evaluate the quality of, and harmonize, the taxonomic work. Two laboratories participated in 2022. The mean Quality assurance index (Qi) was 80.7 and 97.5, where 80 is the limit for good taxonomic work. Results in the biological intercalibrations over time suggest that the taxonomists in the laboratories affiliated to ICP Waters have good taxonomic skills.

VII. Publications

18. For a list of scientific papers from the ICP Waters network as well as ICP Waters reports, see the ICP Waters website.[9]

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