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Working Group on Effects

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Progress in activities in 2021 and further development 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 seventh 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).

The report is a progress report on activities, including a summary of the discussion and results presented at the thirty-seventh 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, 28 and 29 April 2021).

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 seventh 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).[1] The report is a progress report on activities, including a summary of the discussion and results presented at the thirty-seventh meeting of the ICP Waters Task Force (online, 28 and 29 April 2021).

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.

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 30 years' worth of data. Data calls are issued regularly, and the data are used in trend assessments.

4. The thirty-seventh meeting of the ICP Waters Task Force was attended by 46 experts from 18 Parties to the Convention. The thirty-seventh 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-seventh meeting was held remotely and, for practical reasons, held separately from that of the ICP Integrated Monitoring Task Force. 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 trends, nitrogen, acidification, browning and biological status and trends. The presentations are available from the ICP Waters home page[2] and are summarized in the minutes.[3] More detailed results from selected presentations will also be available in the proceedings of the 2021 Task Force meeting, which will be produced before September 2021.[4] 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:

[1] Available at www.unece.org/env/lrtap/executivebody/eb_decision.html.
[2] See www.icp-waters.no/meetings/.
[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.
[4] Øyvind Garmo and Kari Austnes, eds., "Proceedings of the thirty-seventh Task Force meeting of the ICP Waters Programme" (ICP Waters report in preparation).

(a) The 2020 joint progress report on policy-relevant scientific findings of the EMEP Steering Body and the Working Group on Effects (ECE/EB.AIR/GE.1/2020/3−ECE/EB.AIR/WG.1/2020/3). The report contains information on data, activities and results generated by ICP Waters;

(b) A report on progress in activities by ICP Waters (ECE/EB.AIR/GE.1/2020/12–ECE/EB.AIR/WG.1/2020/5);

(c) The update of the Strategy for scientific bodies under the Convention on Long-range Transboundary Air Pollution (postponed until 2022);

(d) The reports on the thirty-fourth chemical intercomparison[5] and the twenty-fourth biological intercalibration.[6]

6. During the reporting period, ICP Waters participated in the following meeting under the Convention: the sixth joint session of the Steering Body to EMEP and the Working Group on Effects (online, 14–17 September 2020); the Extended Bureaux meeting of those two bodies (online, 1–4 March 2021); the thirty-seventh 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, 20–22 April 2021); the twenty-ninth meeting of the Task Force meeting of ICP Integrated Monitoring (online, 13 and 14 April, 2021); and the thirty-seventh meeting of the Task Force of the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (Birmensdorf, Switzerland (hybrid), 10 and 11 June 2021). ICP Waters also contributed to the Ad-hoc group on Marine Protection, which presented inputs to the Convention, to consider marine eutrophication in the review and possible revision of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol).

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

7. In the second half of 2020, ICP Waters carried out, and will continue to carry out in 2021, the following activities, in accordance with the 2020–2021 workplan for the Convention and with the decisions taken at the thirty-seventh meeting of the Task Force:

(a) Finalization of the thematic report on reactive nitrogen in 2021 (2020–2021 workplan item 1.1.1.7). The work on trends in nitrogen species based on data from the ICP Waters database was started in 2020. At the thirty-sixth Task Force meeting of ICP Waters (online, 11 and 12 May 2020), 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 and include a literature review and a data analysis on the effects of reactive nitrogen on freshwater biology.[7] This work has continued through 2020 and 2021. It has now been decided to produce two reports on reactive nitrogen in 2021: one focusing on biological effects, and the other focusing on trends;

(b) Preparation of the thematic report on biological recovery and responses to changing water chemistry (2020–2021 workplan item 1.1.1.8). 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 publication to 2022, due to the expansion of the workplan item 1.1.1.7 report. The content was discussed at the thirty-seventh Task Force meeting of

[5] Cathrine Brecke Gundersen, “Intercomparison 2034: pH, Conductivity, Alkalinity, NO_3-N, Cl, SO_4, Ca, Mg, Na, K, TOC, Tot-P, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn”, ICP Waters Report No. 143/2021 (Oslo, Norwegian Institute for Water Research (NIVA), 2020). Available at www.icp-waters.no/publications/.

[6] Gaute Velle and others, “Biological intercalibration: Invertebrates 2020”, ICP Waters Report No. 144/2020 (Oslo, NIVA, 2020). Available at https://hdl.handle.net/11250/2725297.

[7] Minutes of the thirty-sixth meeting of the Task Force of ICP Waters, para. 36. Available at www.icp-waters.no/icp-waters-task-force-meetings/.

ICP Waters in 2021 and the planning of the report is in progress. A call for data and contributions has been issued;

(c) Contribution to the update of the critical loads of nitrogen for surface waters issued by the Coordination Centre for Effects, in particular through the work with the reports on reactive nitrogen;

(d) Contribution to the 2021 Joint progress report on contribution to the review of the Gothenburg Protocol (ECE/EB.AIR/GE.1/2021/3–ECE/EB.AIR/WG.1/2021/3); Contribution to the finalization of the Strategy for scientific bodies under the Convention on Long-range Transboundary Air Pollution (postponed until 2022); Report on activities to the eighth joint session of the Steering Body to EMEP and the Working Group on Effects; Contribution to the 2022-2023 workplan;

(e) Contribution to the review of the Gothenburg Protocol;

(f) Attending meetings inside and outside the Convention, for instance, to support development of monitoring guidance under the European Union National Emission Ceilings (NEC) Directive[8] and the Minamata Convention on Mercury.

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

8. ICP Waters has focused on synergies with other bodies and group under the Working Group on Effects. 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 COVID-19 pandemic, and this was repeated in 2021. There was regular collaboration on thematic reports with ICP Integrated Monitoring and with other bodies under the Convention. Nitrogen was also seen as a natural topic for collaboration with other bodies under the Convention.

9. With regard 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-seventh meeting of the Task Force of ICP Waters and presented its work. Armenia submitted data to the ICP Waters database in 2020. Georgia also expressed an interest in delivering data, but concluded that, at the current time, no relevant data were being collected.

V. Scientific and technical cooperation with relevant international bodies

10. 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 and was represented at the online meeting held on 4 June 2020, as were the Working Group on Effects and the other ICPs. ICP Waters have provided thorough feedback on the reporting template. ICP Waters will continue to be active in contributing expertise and activities in the work to implement the Directive.

11. 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 followed and contributed to the development of the document “Guidance on monitoring of mercury and mercury compounds to support the effectiveness evaluation of the Minamata Convention” of the Minamata Convention.

[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.

12. ICP Waters has been following the ongoing development of the European Long-Term Ecosystem Research (eLTER) network and the associated eLTER H2020 project. ICP Waters supports the effort and encourages the national focal centres to explore how their countries interact with eLTER, and where possible, to support the strengthening of links between ICP Waters monitoring sites and networks and eLTER.

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

13. *Trends in water chemistry*. Major indices of acidification such as acid neutralizing capacity (ANC), pH and toxic aluminium indicate that waters demonstrate a process of recovery, based on the ICP Waters data set that includes records since 1990 from circa 500 lakes and rivers in Europe and North America. The observed trends are a response to reduced deposition of acidifying substances, but changes in climate, as well as land use, are becoming more important as drivers of change. Major perturbances such as wildfires and insect outbreaks are often climate-related and can result in reacidification of surface waters.

14. *Effects of COVID-19 pandemic detected in ICP Waters sites*. Long-term data sets of environmental monitoring of alpine and subalpine sites in Italy and Switzerland revealed a distinct reduction in deposition of sulfur and oxidized nitrogen in 2020 that deviated from the long-term trend. These deviations result most likely from lower emission of nitrogen oxides to the atmosphere because of reduced vehicle traffic during the COVID-19 pandemic. Some improvements in water chemistry were also noted, especially for nitrate, which suggests that alpine, acid-sensitive sites are extremely well-suited for monitoring freshwater responses to rapid changes in atmospheric chemistry.

15. *Biological responses to less acidic waters.* Monitoring data from the United Kingdom of Great Britain and Northern Ireland demonstrate biological changes consistent with a response to chemical recovery in several, but not all, recovering acidified waters, while data from high alpine lakes in Italy do not show clear trends. In the United Kingdom of Great Britain and Northern Ireland, the extent of biological change does not show a clear relationship with threshold levels of ANC commonly used to define “critical limits”. Factors that drive the rate of biological recovery are not well understood and it is not always clear which organisms are most acid sensitive. The environments of ICP Waters sites are not only recovering from acidification but are more enriched with reactive nitrogen and are becoming warmer because of climate change. The post-acidification biological community assemblies may be very different from the pre-acidification state.

16. *Nitrogen.* The deposition of nitrogen has declined less than that of sulfur and major questions remain concerning the chemical and biological effects thereof. Climate and catchment properties are important determinants of nitrogen leaching, linking air pollution and effects of reactive nitrogen in surface waters. Although nitrogen is an essential nutrient, phosphorus is often the dominant control of freshwater productivity. However, there is increasing evidence that nitrogen derived from nitrogen deposition can influence freshwater productivity in nutrient-poor lakes. Leaching of nitrogen deposited from air to surface waters, and downstream to marine ecosystems, can also contribute to marine eutrophication because nitrogen is the limiting nutrient in marine waters. Source attribution of nitrogen in water bodies (i.e. to deposition, agriculture or other sources) is important for effect-evaluation of policies to reduce emissions of nitrogen to the environment. Preliminary results in the nitrogen report indicate that useful input is being generated to support the empirical critical load guidance currently being developed under the Working Group on Effects.

17. *Monitoring networks of surface waters under various policy instruments (Convention, NEC Directive, European Union Water Framework Directive)*[9] *benefit each other mutually*. In many European countries, surface water monitoring networks deliver data to support several policy instruments, such as the Convention, the NEC Directive and the Water Framework Directive. In some countries, the NEC Directive monitoring network is more

[9] 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.

extensive than the national monitoring network delivering data to ICP Waters, while in other countries, the networks are largely identical. Under the Water Framework Directive, the suggested minimum lake size is 0.5 km^2, which is larger than that of many headwater lakes reported to ICP Waters. Small headwater lakes and streams that are not confounded by local pressures, such as agriculture or point source pollution, are pivotal for the assessment of regional scale pressures (air pollution, climate change) such as under the Convention and the NEC Directive. Differences between national classification systems for surface water acidification may limit robust national comparisons of ecological status under the Water Framework Directive. The physico-chemical definition of the important threshold between good and moderate (i.e. acceptable/non-acceptable) state of water body acidification differs between Norway, Sweden and Finland. A Nordic data set on chemistry and biology has been used to propose an ANC-based system that can be used to harmonize classification systems.

18. *Chemical intercomparison.* Results from the thirty-fourth chemical intercomparison were reported (see para. 5 (d) above). Twenty-one laboratories from 13 countries participated. The results from 2020 were good overall (overall acceptance rate of 80 per cent), but poor for total phosphorous. The chemical intercomparison was a valuable tool for quality assurance of laboratory analyses.

19. *Biological intercalibration.* Results from the twenty-fourth biological intercalibration of invertebrates were reported (see para. 5 (d) above). The goal was to evaluate the quality of, and harmonize, the taxonomic work. Three laboratories participated in 2020. With a mean Quality assurance index (Qi) of 91, 96 and 97, 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.

VII. Publications

20. For a list of ICP Waters publications and references for the present report, see the ICP Waters website.[10]

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