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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

Fifth joint session
Geneva, 9–13 September 2019
Item 14 of the provisional agenda
Progress in activities in 2019 and further development of effects-oriented activities

Integrated monitoring on air pollution effects on ecosystems

Report by the Programme Centre of the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems

Summary

The present report is submitted to the Working Group on Effects as requested by the Executive Body for the Convention on Long-range Transboundary Air Pollution in the 2018–2019 workplan for the implementation of the Convention (ECE/EB.AIR/140/Add.1, items 1.1.1.27–1.1.1.30).

The report of the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring) presents the results of the activities undertaken since its 2018 report and, in particular, the work on dynamic modelling of the impacts of deposition and climate change scenarios to assess the benefits of currently legislated nitrogen-deposition reductions for forest biodiversity (forest understory vegetation). High-quality long-term data on deposition, climate, soil recovery and understory vegetation from 23 intensively studied sites have been used.

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I. Introduction

1. The present report of the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring) is submitted to the Working Group on Effects as requested by the Executive Body for the Convention on Long-range Transboundary Air Pollution in the 2018–2019 workplan for the implementation of the Convention (ECE/EB.AIR/140/Add.1, items 1.1.1.27–30). The report presents the results of the activities carried out between May 2018 and June 2019, and particularly the work on dynamic modelling of the impacts of deposition and climate change scenarios to assess the benefits of currently legislated nitrogen (N)-deposition reductions for forest understory vegetation.

2. The Programme, which involves some 150 scientists and 49 active sites in 16 countries, has a Task Force led by Sweden and a Centre hosted by the Finnish Environment Institute in Helsinki.[1] The United Kingdom is currently investigating possibilities for adding one site with ongoing long-term monitoring.

3. During the reporting period, ICP Integrated Monitoring held two meetings: the twenty-sixth Task Force meeting and scientific workshop (Warsaw, 7–9 May 2018) and the twenty-seventh Task Force meeting and scientific workshop (Helsinki, 4–6 June 2019). Both Task Force meetings were organized jointly with the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes (ICP Waters), with both joint and separate sessions.

4. Key topics discussed at the 2019 meeting included the status of the ICP Integrated Monitoring database, the reports to be prepared under the Convention's workplan, cooperation with other bodies and activities and the future workplan of ICP Integrated Monitoring. The scientific workshop focused on current work on the key scientific topics of the two International Cooperative Programmes (see chapter IV below). The minutes of the meetings are available from the ICP Integrated Monitoring website.[2]

II. Outcomes and deliverables during the reporting period

5. In 2018–2019, ICP Integrated Monitoring produced or contributed to the following reports:

(a) The 2018 joint progress report on policy-relevant scientific findings: Note prepared by the Chairs 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 cooperation with the secretariat (ECE/EB.AIR/GE.1/2018/3–ECE/EB.AIR/WG.1/2018/3);

(b) Integrated monitoring of air pollution effects on ecosystems: Report by the Programme Centre of the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ECE/EB.AIR/GE.1/2018/15–ECE/EB.AIR/WG.1/2018/8);

(c) The 2018 ICP Integrated Monitoring annual report;[3]

(d) A literature review on vegetation succession and resilience in forest ecosystems;[4]

[1] See www.syke.fi/nature/icpim.

[2] See footnote 1.

[3] Sirpa Kleemola and Martin Forsius, eds., *27th Annual Report 2018: Convention on Long-range Transboundary Air Pollution. International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems*, Reports of the Finnish Environment Institute, No. 20 (Helsinki, 2018). Available at http://hdl.handle.net/10138/238583.

[4] James Weldon, "Post disturbance vegetation succession and resilience in forest ecosystems – a literature review" in Kleemola and Forsius, eds., *27th Annual Report 2018: Convention on*

(e) A scientific paper on long-term changes (1990–2015) in the atmospheric deposition and runoff water chemistry at ICP Integrated Monitoring sites;[5]

(f) A scientific paper on dynamic modelling on the impacts of deposition and climate change scenarios on soil processes and soil quality;[6]

(g) A scientific paper on currently legislated decreases in nitrogen deposition and plant species recovery.[7]

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

6. In the second half of 2019 and in 2020, ICP Integrated Monitoring will contribute to or produce the following deliverables, as indicated in the Convention workplan:

(a) The 2019 joint progress report on policy-relevant scientific findings: Note prepared by the Chairs 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 cooperation with the secretariat (ECE/EB.AIR/GE.1/2019/3–ECE/EB.AIR/WG.1/2019/3);

(b) A scientific paper on the impacts of internal catchment-related nitrogen parameters on nitrogen leaching;

(c) A scientific manuscript/report on the relationship between critical load exceedances and empirical ecosystem impact indicators (item 1.1.1.31 of the workplan, to be completed in 2019);

(d) A report on trends in concentrations and fluxes of mercury and heavy metals across ICP Integrated Monitoring sites in Europe;

(e) A scientific paper on trends in recovery in the epiphytic lichen community at ICP Integrated Monitoring sites with sufficient data, after the abatement of sulphur deposition;

(f) The twenty-ninth annual ICP Integrated Monitoring report (covering activities in 2019/20), forthcoming in August 2020.

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

7. ICP Integrated Monitoring has established useful cooperation with the following bodies under the Working Group on Effects: the International Cooperative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends, on critical load calculations; the Joint Expert Group on Dynamic Modelling, on changes in biodiversity; the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes (ICP Waters); and the International Cooperative Programme on Assessment and Monitoring of Air Pollution

Long-range Transboundary Air Pollution, pp. 39–52.

[5] Jussi Vuorenmaa and others, “Long-term changes (1990–2015) in the atmospheric deposition and runoff water chemistry of sulphate, inorganic nitrogen and acidity for forested catchments in Europe in relation to changes in emissions and hydrometeorological conditions”, in *Science of the Total Environment*, vol. 625 (June 2018), pp. 1129–1145.

[6] Maria Holmberg and others. “Modelling study of soil C, N and pH response to air pollution and climate change using European LTER site observations”, in *Science of the Total Environment*, vols. 640 and 641 (November 2018), pp. 387–399.

[7] Thomas Dirnböck and others “Currently legislated decreases in nitrogen deposition will yield only limited plant species recovery in European forests”, in *Environmental Research Letters*, vol. 13, No. 12 (December 2018). Available at https://doi.org/10.1088/1748-9326/aaf26b.

Effects on Forests (ICP Forests), on long-term trends calculations and effects indicators. ICP Integrated Monitoring also uses emission scenario data from the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe.

V. Strengthening the involvement of countries of Eastern and South-Eastern Europe, the Caucasus and Central Asia in work under the Convention

8. Participants from Armenia, Georgia and the Russian Federation participated in the joint ICP Integrated Monitoring and ICP Waters Task Force meeting in Helsinki, from 4 to 6 June 2019. Serbian sites were included in the scientific papers on dynamic modelling on soil impacts[8] and plant recovery. The Russian Federation is planning to include a new site in the ICP Integrated Monitoring network.

VI. Scientific and technical cooperation activities with relevant international bodies

9. ICP Integrated Monitoring cooperates closely with the Long-term Ecosystem Research in Europe network[9] and many sites are common to both bodies. An Integrated European Long-term Ecosystem, Critical Zone and Socioecological Research Infrastructure project with funding from the European Union Horizon 2020 programme was launched in June 2015 and will end in December 2019. One outcome is that the Integrated European Long-term Ecosystem, Critical Zone and Socioecological Research Infrastructure is now on the 2018 European Strategy Forum on Research Infrastructure roadmap. The European Strategy Forum is a strategic instrument for developing the scientific integration of Europe and strengthening its international outreach through the coordinated development of major research infrastructures.

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

10. The following findings of ICP Integrated Monitoring are of particular scientific relevance:

(a) European databases and maps of critical loads have been instrumental in the negotiation of effect-based Protocols to the Convention. However, because the critical load concept is based on a steady-state approach, dynamic models are needed in order to assess the timescale of impacts and recovery from changes in air pollutant emissions. Interaction with changes in climate variables is also of key importance. Current climate warming is expected to continue in the coming decades and the current high levels of nitrogen deposition may stabilize, in contrast to the clear decrease in sulphur deposition. These pressures have distinctive regional patterns and their impact on ecosystem conditions is modified by local site characteristics. Atmospheric nitrogen pollution is considered responsible for a substantial decline in plant species richness and for altered community structures in terrestrial habitats worldwide. Nitrogen affects habitats through direct toxicity, soil acidification, and in particular, by favouring fast-growing species. Pressure from nitrogen pollution is decreasing in some areas. In Europe (European Union 28), overall emissions of nitrogen oxides declined by more than 50 per cent while ammonia emissions declined by less than 30 per cent from 1990 to 2015, and further decreases may be achieved. The timescale over which these improvements will affect ecosystems is uncertain;

(b) Twenty-three European forest sites belonging to the ICP Integrated Monitoring, ICP Forests and European Long-term Ecosystem Research networks with high-

[8] Holmberg and others, “Modelling study of soil C, N and pH response to air pollution and climate warming using European LTER site observations”.

[9] See www.lter-europe.net.

quality long-term data on deposition, climate, soil chemistry, and understory vegetation were used to assess the benefits of currently legislated nitrogen deposition reductions on forest understory vegetation. A dynamic soil model coupled to a statistical plant species niche model was applied with site-based climate and deposition.[10] Indicators of nitrogen deposition and climate warming effects, such as the change in the occurrence of oligophilic (favouring nutrient-poor conditions), acidophilic (favouring acidic conditions) and cold-tolerant plant species, were used to compare the present with projections for 2030 and 2050. The decrease in nitrogen deposition under current legislative emission reduction targets until 2030 was not expected to result in a release from eutrophication. Albeit, the model predictions showed considerable uncertainty when compared with observations; they indicated that oligophilic forest understory plant species will further decrease. This result is partially due to confounding processes related to climate effects and to major decreases in sulphur deposition and consequent recovery from soil acidification, but shows that decreases in nitrogen deposition under current legislative emission reduction targets will most likely be insufficient to allow recovery from eutrophication.

11. It can thus be concluded that long-term research and monitoring sites are reference systems for developing and validating ecological models. Environmental policies may increasingly take advantage of infrastructures such as ICP Integrated Monitoring and Integrated European Long-term Ecosystem, Critical Zone and Socioecological Research Infrastructure and of the integrated ecosystem models they are enabling. The results also showed that oxidized and reduced nitrogen emission reductions need to be considerably greater to allow recovery from chronically high nitrogen deposition. Legislative efforts should also focus on limiting nitrogen saturation in parts of the world that have so far avoided the extreme amounts of cumulative nitrogen deposition that have occurred across large areas of Europe.

VIII. Publications

12. A list of ICP Integrated Monitoring publications and references for the present report are posted on the ICP Integrated Monitoring website.

[10] Dirnböck and others “Currently legislated decreases in nitrogen deposition will yield only limited plant species recovery in European forests”.