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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

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Item 2 (b) of the provisional agenda
Progress in activities in 2022 and further development of effects-oriented activities: critical loads and other issues related to modelling and mapping

Modelling and mapping*

Report by the Task Force on Modelling and Mapping, the Coordination Centre for Effects and the Centre for Dynamic Modelling

Summary

The present report is being submitted for consideration by 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 at their eighth joint session, in accordance with both the 2022–2023 workplan for the implementation of the Convention (ECE/EB.AIR/148/Add.1) and the revised mandate for the International Cooperative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trend (Executive Body decision 2019/20).[a]

The present report includes a review of the implementation of the workplan activities undertaken by the International Cooperative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (ICP Modelling and Mapping) and a summary of the discussion and conclusions reached at the third meeting of the Centre for Dynamic Modelling (Spain, 6–8 April 2022) and the thirty-eighth meeting of the ICP Modelling and Mapping Task Force and twenty-ninth meeting of the Coordination Centre for Effects (online, 3–5 May 2022). The latter meeting was organized by Ms. Alice James Casas (France) – Chair of ICP Modelling and Mapping – and the Coordination Centre for Effects, in close collaboration with the Centre for Dynamic Modelling.

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

* The present document is being issued without formal editing.

I. Introduction

1. The International Cooperative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (ICP Modelling and Mapping) is a scientific programme of the Working Group on Effects under the United Nations Economic Commission for Europe (ECE) Convention on Long-range Transboundary Air Pollution. France is the lead country of the ICP Modelling and Mapping Task Force. Germany and Sweden are the lead countries of, respectively, the Coordination Centre for Effects[1] and the Centre for Dynamic Modelling[2] – the two ICP Modelling and Mapping programme centres. The Task Force, the Coordination Centre for Effects and the Centre for Dynamic Modelling are hosted by, respectively, the French National Institute for Industrial Environment and Risks, the German Environment Agency and the Swedish Environmental Institute.

2. Representatives of 26 Parties to the Convention participate in the activities of ICP Modelling and Mapping. ICP Modelling and Mapping national focal centres help to compile and maintain the database of critical loads for acidification and eutrophication and carry out research regarding novel thresholds for impacts on plant species diversity. ICP Modelling and Mapping results are also used by the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) Task Force on Integrated Assessment Modelling, in collaboration with the Meteorological Synthesizing Centre-West, the Meteorological Synthesizing Centre-East and the Centre for Integrated Assessment Modelling. ICP Modelling and Mapping collaborates with all the international cooperative programmes (ICPs) under the Convention and with the Joint Task Force on the Health Aspects of Air Pollution.[3]

II. Progress in modelling and mapping activities

3. The thirty-eighth meeting of the ICP Modelling and Mapping Task Force along with the twenty-ninth meeting of the Coordination Centre for Effects was organized as a web conference (online, 3–5 May 2022).

4. Sixty-nine delegates from the following 23 Parties participated in the meeting: Austria, Belgium, Bulgaria, Canada, Czechia, Denmark, Finland, France, Germany, Italy, Malta, Norway, Poland, Portugal, Russian Federation, Serbia, Spain, Sweden, Switzerland, the Netherlands, United Kingdom of Great Britain and Northern Ireland and United States of America. Representatives of China also participated. Representatives of the following Convention intergovernmental bodies, expert groups and scientific centres were present: the Bureau of the Working Group on Effects and of the Task Force for International Cooperation on Air Pollution; the Coordination Centre for Effects; the Centre for Dynamic Modelling; the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests); the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring); the International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops (ICP Vegetation); the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes (ICP Waters); and the Centre for Integrated Assessment Modelling.

5. ICP Modelling and Mapping Task Force decisions were reviewed by the participants during the meeting. Presentations are available at the Coordination Centre for Effects website.[4]

6. The objectives of the meeting included:

[1] See www.umweltbundesamt.de/en/cce.
[2] See www.ivl.se/projektwebbar/centre-for-dynamic-modelling.html.
[3] The Joint Task Force on the Health Aspects of Air Pollution is a joint body of the World Health Organization European Centre for Environment and Health and the Executive Body for the Convention on Long-range Transboundary Air Pollution.
[4] See www.umweltbundesamt.de/en/meetings-workshops-0?parent=69334.

(a) Presentation of the current status of work of the Coordination Centre for Effects on updating and revising the European background database for critical loads;

(b) Presentation of the current status of work of the Coordination Centre for Effects in collaboration with the Task Force on the revision of the databases of steady-state critical loads further to the responses of national focal centres to the call for data 2019–2021 communicated in November 2019;

(c) Presentation of the current status of work of the Coordination Centre for Effects in collaboration with other bodies on the review and revision of the empirical critical loads process launched in 2019;

(d) Presentation of the current status of work of the Centre for Dynamic Modelling;

(e) Presentation of the current status of work of the Coordination Centre for Effects for the current review of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol) (ECE/EB.AIR/WG.5/2021/4);

(f) Sharing new knowledge on critical loads established through (field) experiments and modelling by the national focal centres and other expert groups;

(g) Sharing knowledge with other bodies of the Convention on crosscutting tasks;

(g) Discussion on data sharing and accessibility.

III. Relevant items of the 2022–2023 workplan

A. Update and establishment of European database for steady-state Critical Loads (workplan item 1.1.1.19)

7. Critical loads and the calculation of their exceedances are dedicated instruments for assessing possible impacts of air pollution on ecosystems. In order to target an assessment that is as scientifically sound as possible, steady-state critical loads need to be updated regularly. The current Critical Load database has been finalised in late 2021 and consists of two components. The first component is the aggregated data from national data contributions. National contributions were submitted as part of the most recent Call for Data during the period 2019-21 (for documentation it is referred to the Coordination Centre for Effects website[5]). Also data from the previous Call for Data (Hettelingh et al., 2017[6]) was used if the National Focal Centres (NFCs) confirmed the continued validity of the values to the Coordination Centre for Effects or did not object to their further use. The second component consists of data from the recently completed Critical Load background database of the Coordination Centre for Effects (Reinds et al., 2021[7]) for the countries for which no contributions were provided from the respective NFCs (36 out of 50 countries). Both data components have been merged and made available in a consolidated database. Critical Loads are available for about 4.1 million sites in Europe with an area of about 2.9 million km^2 for acidification impacts and about 2.6 million km^2 for the effects of eutrophication. The analysed ecosystems for the Critical Loads for acidification are mainly forests (54%) but also freshwater ecosystems (24%) and grasslands (16%). The Critical Loads dataset for eutrophication contains also mainly forests (65%) and different types of grasslands (20%). The updated European critical loads database has been used by the Coordination Centre for Effects for the risk assessments to support the Review of the Gothenburg Protocol. The

[5] https://www.umweltbundesamt.de/en/call-for-data?parent=69334

[6] Hettelingh, J.P., M. Posch & J. Slootweg (2017). European critical loads: database, biodiversity and ecosystems at risk: CCE Final Report 2017. RIVM Report 2017-0155. Bilthoven, Netherlands, pp. 49-60.

[7] Critical loads for eutrophication and acidification for European terrestrial ecosystems. Final report on the Coordination Centre for Effects website at https://www.umweltbundesamt.de/en/further-cce-reports?parent=68093

database and the results of the risk assessments are documented in the Coordination Centre for Effects Status Report 2022[8], which was due in 2022 according to the current work plan.

B. Report on the review and revision of Empirical Critical Loads (workplan item 1.1.1.20)

8. The review and revision of the empirical critical loads for nitrogen was included in the 2020–2021 workplan (ECE/EB.AIR/144/Add.2, item 1.1.1.14) and the following 2022-2023 workplan (ECE/EB.AIR/148/Add.1, item 1.1.1.20) after it was considered that a substantial amount of new data and scientific papers had become available since the publication of the most recent update[9] in 2010. The final draft of the "Report on Review and revision of the empirical critical loads for Europe" is now available online[10]. The review of new available findings was coordinated and led by B-WARE Research Centre and the Coordination Centre for Effects. The scientific collaborative activity involved experts from many institutions across Europe representing the ICP Forests, ICP Integrated Monitoring, ICP Modelling & Mapping, ICP Waters and ICP Vegetation of the Working Group on Effects. The work was only possible through the active involvement and contribution of 44 authors and team of reviewers during the years 2020 and 2021. With an Expert Workshop on Empirical Critical Loads for Nitrogen hosted and funded by the Swiss Federal Office for the Environment (FOEN) in Bern 26–28 October 2021 this technical work was concluded. Following the Expert Workshop, the recommendations were incorporated in the report and the ICP Modelling and Mapping community agreed at its thirty-eighth annual meeting in May 2022 with the scientific content which led to the updated empirical critical loads for nitrogen.

9. Further to this work, the dedicated chapters of the *Manual on methodologies and criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends*[11] will be updated, once the Working Group on Effects will have taken note of the updated scientific report.

C. Organization of an international workshop on the review of Critical Level for NH_3 and workshop report (workplan item 1.1.1.22)

10. More than ten years after the recommendation of the updated CLRTAP critical levels for ammonia (Mapping Manual Chapter 3[12]), new findings on the effects of ammonia on vegetation have been discussed in a workshop prepared by the Coordination Centre for Effects and the German Environment Agency (UBA) as a lead. The workshop was held in Dessau on March 28/29 March 2022 and offered the opportunity to exchange information on national or regional programs which have been set up for the monitoring of ammonia in sensitive habitats. Scientists dealing with research on effects of ammonia on vegetation and ecosystems and those involved in the monitoring of ammonia in the environment were also asked to present their recent research.

[8] https://www.umweltbundesamt.de/en/cce-status-reports?parent=68093

[9] Roland Bobbink and Jean-Paul Hettelingh, eds., *Review and Revision of Empirical Critical Loads and Dose-response Relationships, Proceedings of an Expert Workshop, Noordwijkerhout, 23–25 June 2010* (Bilthoven, the Netherlands, National Institute for Public Health and the Environment of the Netherlands, 2011).

[10] Report on Review and revision of the empirical critical loads for Europe – Final draft : https://www.umweltbundesamt.de/en/news-0?parent=67248

[11] CLRTAP, 2017. Mapping critical loads for ecosystems, Chapter V of Manual on methodologies and criteria for modelling and mapping critical loads and levels and air pollution effects, risks and trends. UNECE Convention on Long-range Transboundary Air Pollution; accessed [02.09.2022] at www.icpmapping.org

[12] CLRTAP, 2017. Mapping Critical Levels for Vegetation, Chapter III of Manual on methodologies and criteria for modelling and mapping critical loads and levels and air pollution effects, risks and trends. UNECE Convention on Long-range Transboundary Air Pollution; accessed [02.09.2022] at www.icpmapping.org

11. The workshop was part of the current work plan for the year 2022-2023 and organized in the framework of a R&D Project financed by the German Environment Agency (UBA). Due to the COVID-19 restrictions, only 15 participants were able to attend in presence and over 100 people were following the live stream via a WebEx online meeting platform from several European countries and the US. In total, there were 145 registered participants from 28 countries including representatives from several bodies to the convention such as the UNECE Secretariat, WGE, ICP Vegetation, ICP Forest, the Centre for Dynamic Modelling, CIAM, MSC-West, TFRN and representatives from several EU Environment Agencies. 19 presentations from presenters from nine countries were dealing with a current review, models and future trends of NH_3 across Europe in the first session, different ammonia monitoring networks in the second session and with vegetation effects (recent research on different scales) in the third session. The workshop concluded, that there have only been few long-term studies on the effects of elevated NH_3 concentrations on vegetation in the last 15 years and that existing studies (reviewed so far) broadly support the ammonia critical levels updated at the 2006 UNECE Ammonia Workshop. On the monitoring of ammonia, it was summarized and recommended that in numerous countries monitoring networks are in place, different in number of stations and coverage in relation to sensitive ecosystems and that ammonia should be better respected in the future legislation (e.g. in the reviewed EU Ambient Air Quality Directives).

12. The proceedings of the Workshop have been published on the website of the Coordination Centre for Effects[13].

D. Development of effects-oriented scientific work with a focus on dynamic modelling

13. Dynamic models of impact of air pollution can calculate and visualize possible past and future development under different scenarios. The Centre for Dynamic Modelling continues its efforts to explore possibilities of dynamic modelling of ecosystem effects for the work of the Convention. Modelling impact of air pollution on biodiversity is less explored option compared to modelling of acidification (and recovery from acidification) or modelling of eutrophication. In 2019, it was stated that the methods to compile Critical Loads for biodiversity were not robust enough to be used in Integrated Assessment Modelling, and that further development was needed in this area under ICP Modelling and Mapping. To include the option of using changes in species composition (captured by an indicator of damage such as e.g. Habitat Suitability Index or positive indicator species per habitat) as a basis for setting the critical loads is a possibility for the next call for data. That, however, requires the Centre for Dynamic Modelling to provide guidance on how such an effort should be organised by the individual national focal centres. Other interesting modelling work that could deliver politically relevant outputs within the Convention include modelling interactions between climate change and air pollution effects, both with respect to eutrophication and to recovery from acidification, modelling the accumulation of heavy metals in the environment or modelling the effects of ozone on plants and crops. Finally, modelling of soiling and corrosion of materials related to air pollution has been discussed with ICP Materials.

D. Collaboration between ICP Modelling and Mapping and other bodies of the Convention

14. The thirty-eighth meeting of the ICP Modelling and Mapping Task Force and the twenty-ninth meeting of the Coordination Centre for Effects were organized together and held in close collaboration with the Centre for Dynamic Modelling which held its third meeting separately. To build up a cooperation network within the Convention, the Coordination Centre for Effects held a bilateral meeting with the Centre for Integrated Assessment Modelling (5 October 2021) and actively took part in meetings of the Ad-hoc group on Marine Protection (AMP), with further involvement of ICP Waters and the Task

[13] https://www.umweltbundesamt.de/en/meetings-workshops-0?parent=69334

Force on Integrated Assessment Modelling. The Chair of ICP Modelling and Mapping and representatives of both the Coordination Centre for Effects and the Centre for Dynamic Modelling attended remotely the EMEP Steering Body and Working Group on Effects Extended Bureaux Meeting (online, 21–24 March 2022) and the thirty-fifth meeting of the ICP Vegetation Task Force (online, 21–24 February 2022), the joint thirtieth meeting of the ICP Integrated Monitoring Task Force and thirty-eighth meeting of the ICP Waters Task Force (Spain, 10–12 May 2022), and the thirty-eighth meeting of the ICP Forests Task Force (online, 2 and 3 June 2022).

E. Development and maintenance of the common Working Group on Effects website

15. The purpose of the common Working Group on Effects website is to provide a common entry point to which all the parts of the Working Group on Effects are linked. It does not replace or duplicate the individual ICPs' websites but provides meta information on their existence and indicates what kind of data and results are to be found where.

16. The common entry point has primarily been developed for users outside the Convention to facilitate an easy overview of the conceptual framework and of the Working Group on Effects work as a whole. The development of the new website that commenced in 2021 has continued to focus on the user perspective. The new common website is built around the key activities undertaken by the Working Group on Effects (as opposed to the previous structure centered around the ICPs' structure). The proposal is to provide access to the results generated within WGE under the three main headings: (i) Monitoring, where description and access to collected monitoring data can be found; (ii) Modelling, providing access to the model outcomes, and (iii) Policy relevant outputs, where summary of policy relevant outputs is available. Further development of the website will be discussed with all ICPs during the second half of the current year.

IV. Recommendations and other outcomes of the thirty-eighth meeting of the Task Force

17. Following the publication of the final draft of the "Report on Review and revision of the empirical critical loads for Europe", the ICP Modelling and Mapping Task Force and the Coordination Centre for Effects:

(a) Asks the WGE to take note of the report and the updated empirical critical loads for nitrogen and to recommend their use;

(b) Recommends the use of the report and the updated values as soon as the final report is published by the Coordination Centre for Effects and when the awaited official notification from WGE in September is available;

(c) Welcomes the update of the empirical critical loads for nitrogen and recommends to plan a new Call for Data on national application of CLempN to be issued in 2023. The collected information provide input needed to prepare a future item in the workplan 2024-2025 on applied risk assessment with CLempN;

(d) Encourages the national focal centers to apply / test the updated CLempN on their territories in preparation for their response to the next call for data;

(e) Recommends to coordinate a drafting group to update the Mapping Manual in 2023 with latest findings;

18. Following the discussions at the Expert Workshop on ammonia in March 2022 and the publication of the proceedings of the workshop, the ICP Modelling and Mapping Task Force and the Coordination Centre for Effects note the following:

(a) The Coordination Centre for Effects took good note of the meeting participants recommendation to assess Critical Level Exceedance if possible across the EMEP region and compare areas at risk to comparable outputs in Critical Load assessments;

(b) The Coordination Centre for Effects will coordinate a drafting group to propose an update of the Mapping Manual in 2023 with latest findings.

19. Further work of the Centre for Dynamic Modelling will continue exploring the potential of using biodiversity models for policy purposes as it is one of the issues specifically defined in the Centre for Dynamic Modelling mandate. The width of modelling efforts undertaken by the individual ICPs and also by teams outside the convention is, however, much bigger and the Centre for Dynamic Modelling will continue to follow other modelling efforts (e.g. on recovery from acidification, interactions of eutrophication with climate change, modelling heavy metals, ozone) that could provide politically relevant results assessing damage to ecosystem by air pollution dynamically, i.e. in the past, at present and in the future.

20. The ICP Modelling and Mapping Task Force and centres have contributed actively to the current review of the Gothenburg Protocol by:

(a) Calculating critical loads exceedance for European countries, based on the data submitted by the national focal centres within the recent or the previous call for data (2019–2021/2015–2017), as well as on the updated background database for countries that have not provided new critical loads data since 2017;

(b) Contributing to evaluation of impacts of new scientific findings on environmental and health effects assessments, for example, impact of critical loads, dynamic modelling of ecosystem recovery, interactions between air pollution, climate change, nitrogen fluxes and other stress factors for biodiversity.

21. The revision of the current long-term strategy of the effects-oriented activities has been supported by ICP Modelling and Mapping by the following recommendations:

(a) Improve assessment of ammonia effects via both the implementation of critical levels of ammonia and the better linking of air quality and biodiversity monitoring;

(b) Give non-forest ecosystems – as a habitat for a large number of sensitive plant species – a more prominent role in future monitoring and modelling activities;

(c) Continue progress on considering critical loads for heavy metals;

(d) Link biogeochemical change to species changes, recalled as being an important issue to progress on, possibly with tools such as target loads;

(e) Include all habitat types for biodiversity, with improved harmonization between countries or/and on the European scale;

(f) Additional efforts are needed to further develop the critical load methodology by incorporating insights derived from modelling shifts in plant species composition. In addition, impacts on ecosystem services could be progressively incorporated into risk assessments communication;

(g) Continue the development of methods to assess the risk of eutrophication through atmospheric nitrogen deposition in marine ecosystems, including coastal areas and in cooperation with experts from the Baltic Marine Environment Protection Commission.

22. The further development and consolidation of acidification and eutrophication critical loads should be continued, as should the development of critical loads using dynamic modelling concepts.