Convention on Long-range Transboundary Air Pollution

Working Group on Effects

2022

Annual report of the

International Cooperative Programme on Modelling & Mapping of critical levels and loads and air pollution effects, risks and trends (ICP M&M)

Chair of the Programme Task Force: Alice James Casas (INERIS, France)

Coordination Centre for Effects (CCE)
hosted by the German Environment Agency (UBA, Dessau, Germany)
headed by a team consisting of:
Markus Geupel, Thomas Scheuschner and Christin Loran

Centre for Dynamic Modelling (CDM)
hosted by the IVL Swedish Environmental Research Institute
(IVL, Göteborg, Sweden)
headed by a team consisting of:
Filip Moldan and Sara Jutterström

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Introduction of the ICP, 2021 news, and 2022 meeting objectives

The International Cooperative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (ICP Modelling & Mapping, ICP M&M) is a programme under the Convention on Long-range Transboundary Air Pollution (CLRTAP).

Interest in the critical loads (CL) and levels approach for pollution control has gathered momentum over the past decades. To provide strategies for emission reductions as inputs to the negotiations of protocols to the Convention, the ICP M&M was established in 1988.

The programme is planned and coordinated by a Task Force (TF) under the leadership of France, located at the French National Institute for Industrial Environment and Risks (Institut National de l'Environnement Industriel et des Risques, Ineris), in collaboration with the Coordination Centre for Effects (CCE) hosted at the German Environment Agency (UBA, Germany) and with the Centre for Dynamic Modelling hosted at IVL Swedish Environmental Research Institute (IVL, Göteborg).

The mandate of the ICP M&M is to provide the Working Group on Effects (WGE) and the Executive Body (EB) and other subsidiary bodies with comprehensive information on (i) critical levels and loads and their exceedances for selected pollutants, (ii) the development and application of other methods for effects-based approaches, and (iii) modelling and mapping of the present status and trends in impacts of air pollution. To this aim, the CCE together with the Programme TF determine receptor-specific critical loads for (indirect) effects of the (long-term) deposition of various air pollutants and critical levels for direct effects of gaseous air pollutants; map pollutant depositions and concentrations which exceed critical thresholds and establish appropriate methods as a basis for assessing potential damage, e.g. *via* dynamic modelling. Moreover, various European databases on soil, land, climatic and other variables are used to calculate critical loads for those countries that do not provide national data. The maps are used for integrated assessment modelling by the Task Force on Integrated Assessment Modelling (TFIAM). Since its creation in January 2020 the CDM is the second designated centre to the ICP M&M, hosted by IVL Swedish Environmental Research Institute. Its main tasks mandated by the EB are the development and promotion of methods for dynamic modelling (including consideration of effects on biodiversity, interactions with climate change and land use, to complement CLs with additional measures of the effects such as, e.g., target loads) and the development and maintenance of the common Working Group on Effects (WGE) website (https://www.unece-wge.org/).

The work achieved by CCE and CDM and the national contributions to ongoing activities held since the last annual TF meeting (April 2021) were presented during the 2022 Annual Meeting of the ICP M&M (web-conference) from Tuesday 3 to Thursday 5 May 2022. This was the 38th TF and 29th CCE meeting, which also included feedback from the distinct and 3rd CDM meeting held in Sitges (Spain) from 6 to 8 April 2022. The presentations and discussions were mainly related to the previously defined main scientific challenges, grouped under the following items:

- Steady state modelling
- Empirical Critical Loads
- Dynamic modelling

A special focus was also put on data sharing and accessibility, addressing to the meeting's participants questions put forward by the Working Group on Effects (WGE), in view of the thematic session dedicated to this issue foreseen to be planed for the 8th Joint EMEP/WGE Session in September 2022.

The ongoing ICP M&M workplan for 2022-2023 is presented in Chapter 1.

The main discussions and conclusions regarding the scientific and science-to-policy challenges cited above, on which it was chosen to focus during the meeting, are presented thereafter: Chapter 2 presents the update of Critical Loads. Chapter 3 informs on data sharing and accessibility issues.

Summaries of presentations (proceedings) and the discussions (notes) directly associated to those are given in Chapter 4.

Chapter 1 – ICP M&M 2020-2021 workplan

In line with the priorities set out in the long-term strategy for the Convention for 2020–2030 and beyond, the EB of the CLRTAP has adopted in December 2021 the biennial workplan 2022-2023 for the Convention Workplan items where ICP M&M together with its designated centres constitute the main lead bodies are summarised in Table 1. An advanced version of the full workplan is available at the following address:

https://unece.org/sites/default/files/2022-06/%28Advance%29_ECE_EB.AIR_148_Add.1.pdf

Table 1: Biennial ICP M&M workplan for 2022-2023.

Workplan item	Activity description/objective	Expected outcome/deliverable	Lead body(ies)	Resource requirements and/or funding source
1.1.1.19	Steady-state Critical Loads: (a) Update of National Critical Loads by National Focal Centres; (b) Establishment of European Background Database by CCE	Database (2020/2021) for Critical Loads for acidification and eutrophication; Report (2022)	ICP Modelling and Mapping /CCE	National Focal Centres and recommended contributions
1.1.1.20	Empirical Critical Loads: Review and revision of the CLemp N published in 2011	Report on empirical Critical Loads in Europe (2022)	ICP Modelling and Mapping /CCE	CCE, National Focal Centres and recommended contributions
1.1.1.21	Update of the harmonized Convention receptor map	Harmonized receptor map for Europe (2023)	ICP Modelling and Mapping /CCE	CCE and Germany
1.1.1.22	Critical Levels for ammonia: literature review and empirical data provision supporting a workshop	Organization of an international workshop (2022) and workshop report (2023)	ICP Modelling and Mapping /CCE	CCE and Germany
1.1.1.23	Modelling interaction between air pollution and climate change: N and C	Expert workshop (2022)	ICP Modelling and Mapping /CDM	CDM and National Focal Centres experts
1.1.1.24	Modelling biodiversity change to set critical loads for N	Report on methodology development and proposal for call for data (2023)	ICP Modelling and Mapping /CDM/CCE	CDM, CCE and National Focal Centres experts

Chapter 2 – Current status of the work on Critical Loads (CL) and CL exceedance calculations, main 2022 TF meeting discussions and conclusions for next steps

Current status of the Background Database (BGDB)

The recently updated CL Background Database was implemented in the CL exceedance framework of the CCE and is used if countries decide not to deliver national CL data. This data was tested against the previous dataset and the report can be found (Critical loads for eutrophication and acidification for European terrestrial ecosystems. Final report on the CCE website). In order to enable the NFC to compare the results of the European approach with their own the BGDB will be made available as national subsets if NFC indicate interests.

At the recent annual ICP M&M meeting, the CCE presented ways of sharing the BDB and asked NFCs to communicate on their experiences and preferences. Some NFCs expressed their interest regarding this proposal.

Current status of the work on steady-state CL

The recent call for data was answered by countries differently, while 6 countries provided updated CL data several countries confirmed their previously (2017) submitted data. In combination with the BGDB this data is the basis for current CL exceedance calculations (e.g. review of the GP). The description and the findings of the data aggregation process will be published in an CCE status report in 2022 (as demanded in WP item 1.1.1.19 of the Biennial ICP M&M workplan for 2022-2023). The main topics of this report were discussed with the NFC at the annual ICP M&M meeting 2022 and beside the data submission a national report was identified as valuable input for this report in order to publish efforts and developments by parties to the CLRTAP.

CCE encouraged input for the draft CCE status report already circulated to be sent before 17 June.

Current status of the work on empirical CL

During the 2022 TF & CCE meeting, Roland Bobbink, Sabine Braun and the CCE presented the current status of the work on the empirical CL (see Chapter 4 – Session 4)

- From June 2020 until October 2021, **45 different authors** have been working on **updating the values** proposed in different chapters of the report “Review and revision of empirical critical loads and dose-response relationships” (Bobbink et al. 2011) with **new scientific findings**.
- After two internal reviews, **a review by external experts** was achieved between August and October 2021.
- The **UNECE CCE expert workshop on empirical Critical Loads for nitrogen** held in Bern (Switzerland) and kindly hosted by Swiss Federal Office for the Environment (FOEN) from 26 to 28 October 2021 allowed reaching a consensus on the updated values.

These updated values were presented at the 2022 TF & CCE meeting to inform NFCs and reach definitive scientific agreement on the values.

Regarding the work achieved on review and revision of empirical Critical Loads for nitrogen (CLempN), it was agreed that:

- the ICP M&M community agreed with the scientific content which led to the updated empirical critical loads for nitrogen,
- the ICP M&M TF asks the WGE to take note of the report and the updated empirical critical loads for nitrogen and to recommend their use at the 8th joint WGE/EMEP session in September 2022,
- the ICP M&M TF recommends the use of the report and the updated values as soon as the final report is published by CCE and when the awaited official notification from WGE in September is available,
- the ICP M&M TF and CCE support the update of the empirical critical loads for nitrogen planning 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 24-25 on applied risk assessment with CLempN.

NFCs were also encouraged to apply / test the updated CLempN on their territories in preparation for their response to the next call for data (CfD).

Current status of the work on development of dynamic modelling

CDM continues its efforts to explore possibilities of dynamic modelling of ecosystem effects for the work of the Convention. In 2019, it was stated that methods to compile CL for biodiversity were not robust enough to be used in IAM, and that further development was needed in this area under ICP M&M. This task falls under the mandate of the CDM. To include the option of using changes in species composition (captures 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 CfD. That however, requires CDM to provide guidance how such an effort should be organised by the individual NFCs.

Exploring biodiversity change with help of models is however not the only interest of CDM. Other interesting modelling work that could deliver politically relevant outputs within the Convention include modelling of interactions between climate change and air pollution effects, both with respect to eutrophication and to recovery from acidification, modelling of accumulation of heavy metals in the environment or modelling of the effects of ozone on plants and crops.

Manual updates

A number of updates of the manual were foreseen following work achieved on the update of empirical Critical Loads for Nitrogen and review of new scientific findings regarding ammonia.

For both topics, a new text (referring to the WS reports) would be presented in ICP M&M in 2023 for adoption and uptake into the manual. For this purpose, CCE proposed to coordinate two drafting groups corresponding to both topics and encouraged participation of the meeting attendees.

Chapter 3 – Data sharing and accessibility

A thematic session on “access to data” being foreseen at the 8th Joint EMEP/WGE session in September 2022, NFCs were encouraged to discuss how to improve access and dissemination of data of air pollution impact assessment on the environment made available upon request to researchers or other entities.

A number of questions could be addressed in this regard:

- Nature of data (which type of data) should be made available? Critical Loads or more detailed data?
- Open access to everything or restricted access (for who? for what purpose?)

The issue of data sharing and national data accessibility was discussed during the 2022 ICP M&M TF & CCE meeting. The first conclusions of these discussions are the following:

- National data are owned by the parties and accessibility / sharing is up to them
- Several NFCs expressed their interest on sharing the data by making them available
- No consensus on how this should be done, especially when reaching the point of use (and misuse) of the data
- Restricted access by requesting responsible entities, i.e. NFCs is an option which was mentioned: through e.g. data use contracts and/or user archives

Chapter 4 – Meeting proceedings & notes

Session 1 – Welcome and opening session

– Chairs: Alice James Casas & Markus Geupel

Within this session, 5 presentations were given:

- *"Recent developments under the Convention on Long-Range Transboundary Air Pollution: Gothenburg Protocol review and other activities" – by Krzysztof Olendrynszki, Carolin Sanz Noriega & Ketevan Kordzakhia (UNECE Secretariat)*
- *"Update on WGE-LRTAP issues" – by Isaura Rábago Juan-Aracil (Chair of the WGE)*
- *"Update on the Science Strategy of the Convention" – by Alice James Casas (Chair of the ICP M&M)*
- *"Ongoing activities at CCE" – by Markus Geupel (CCE Head)*
- *"Ongoing activities at CDM" – by Filip Moldan (CDM Head)*

The abstracts of these are available in the present document below and the presentations themselves are available on the CCE website (https://www.umweltbundesamt.de/en/Coordination_Centre_for_Effects), providing consent for such dissemination has been given to CCE by their authors.

Presentations and directly associated discussions

Welcome to the ICP M&M Web Conference

Alice James Casas welcomed the participants and introduced the meeting with a few words on the agenda. The first meeting day was dedicated to update on the ongoing Convention work and on the science to policy level activities led within other bodies of the Convention, including other ICPs and at national level, with NFCs contributions.

Recent developments under the Convention on Long-Range Transboundary Air Pollution: Gothenburg Protocol review and other activities

Krzysztof Olendrynzski, from the UNECE Secretariat, presented an overview of the activities ongoing under the CLRTAP, including the process of the review of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol, thereafter abbreviated "GP") launched since 2019 by EB Decision 2019/4. He summarised main achievement under a number of meetings at policy level (41st session of Executive Body held 6-8 Dec 2021 and 60th session of Working Group on Strategies and Review held 11-14 April 2022) and dedicated to scientific work (7th joint session EMEP SB/WGE held 13-16 Sep 2021 and Extended Bureaux meeting held 21-24 March 2022). Among many other information, it was announced that Task Force for International Cooperation on Air Pollution (TFICAP) under the WGSR and lead by UK and Sweden was established during 41st session of Executive Body (EB decision 2021/5) and that review of the GP was progressing at all levels of the convention work. Krzysztof Olendrynzski also updated the participants on the long list of achievements from the Secretariat on capacity building area and for further communication and outreach actions.

Gratitude was expressed by the Chair of the TF and CCE for the hard work achieved by Krzysztof Olendrynzski leaving his position at the UNECE Secretariat in June 2022.

Update on WGE and Convention issues

Isaura Rábago Juan-Aracil, chair of the Working Group on Effects (WGE), presented the latest news from the Convention and WGE: meetings held since last ICP M&M meeting (7th Joint EMEP/WGE meeting in September 2021, 41st EB meeting in December 2021, Joint EMEP/WGE Extended Bureaux meeting in March 2022), and topics addressed herein, including the GP review, the Science Strategy review, as well as the follow-up of the activities foreseen for the WGE workplan 2022-2023.

She focused on the GP review process, describing the organisational aspects of next steps, i.e. agenda of next WGE contributions to the process and documents production. She announced that given the constraints imposed by the official documents under the convention, the main "Scientific background for the review" would be included in an "Annex I" to the "Final GP Review Report" while the Annex II would contain the Technical and Policy background for the review. The Annex I content representing substantial contributions from TFs and ICPs under EMEP and WGE should be ready for June 2022. Finally, Isaura Rabago Juan-Aracil shortly explained the further plan and schedule for the update of the Science Strategy for EMEP and effects-related activities, coordinated by the chairs of EMEP and WGE with the participation of the Bureaux and TFs/ICPs the content of which was to be described by Alice James Casas in the next presentation.

After her presentation, Isaura Rabago Juan-Aracil also announced that a thematic session on "access to data" was foreseen at the 8th Joint EMEP/WGE session in September 2022. She recalled that there were some ICPs which collect data from NFCs for impact and trend assessments, but they also made it available upon request to researchers. She informed that after many years collecting and processing data, the convention bodies had become one of the best sources of data for air pollution impact assessment on the environment and that ICPs meeting held in spring was an opportunity to discuss with their community how to improve data access and dissemination. The topic was picked up for discussion in the last session of the afternoon during the NFCs' tour de table and later during the meeting (cf. Markus Geupel (CCE) and Filip Moldan (CDM) presented a brief summary of the work on modelling biodiversity change as an indicator of damage due to air pollution carried out under the ICP Modelling & Mapping. They stated that since air pollution can cause severe damage to biota, ecosystems, and ecosystem integrity it may therefore also pose a serious risk for biodiversity (characterized by the diversity of genes, species, and ecosystems). They highlighted that the ICP Modelling & Mapping has been working with biodiversity as an indicator since 2007. While the use of CLempN to describe risks for biodiversity was in focus until 2012, since then the development of indicators with vegetation models (CLbiodiv) to describe those risks has gained priority. In the meantime, in the context of the cooperation with other institutions outside convention, the Exceedance of critical loads for nitrogen deposition (CLnutN) is for example used by the European Environment Agency (EEA) as an indicator for risks of biodiversity loss in (semi)-natural ecosystems. They also mentioned the cross-cutting joint workshops with the nature conservation communities and the partly successful transfer of the Critical Load concept into different guidance documents to assess the habitat conservation status.

CCE and CDM pointed out that all established ways to calculate critical loads (CLnutN, CLacid, CLempN, CLbiodiv) are aiming at protecting biota and that CLempN is specifically aimed at protecting habitats. It was pointed out that therefore the terminology "CLbiodiv" for CL derived with vegetation models must not be misinterpreted so that it would be the only way to calculate critical loads with protection of biota in mind.

The meeting's participants discussed whether a new terminology for those CL should be found and agreed that a joint ICP M&M & CCE & CDM communication brief or brochure on "Critical Loads: tools to assess risks for biodiversity" would be beneficial as it would help to illustrate the strengths of the ICP M&M's assessment concepts in- and outside the convention.

Session 8 – Wrap-up session)

Update on the Science Strategy of the Convention

Alice James Casas updated the participants on the state of play of the Science strategy review. The contributions were currently being drafted by TFs and ICPs chairs for all sections of interest under EMEP and WGE activities. Alice James Casas informed on items focusing on strengths and successes related a WGE and M&M issues, i.e. CL and dose-response relationships, modelling and risk assessment, effects monitoring, improving knowledge on health and environmental effects. Then, remaining challenges of interest to the modelling and mapping communities were presented, such as key topics on which the convention should focus to improve scientific understanding for improving effectiveness of control strategy and modelling strategies for improvement of monitoring and modelling under EMEP and WGE. Alice James Casas explained that the texts were currently being drafted by contributors nominated by EMEP and WGE chairs until the new deadline of 10th of May.

Clarification on the drafting process were required (contributors and timing), but no further question or input were given.

Ongoing activities at CCE

Markus Geupel updated on the ongoing activities at CCE since the 2021 annual ICP Modelling & Mapping meeting. In his presentation he highlighted and summarized most important CCE activities. With his presentation he gave an outlook to more detailed presentations in the sessions 4, 5 and 7.

He recalled the published technical documentation of the recently operationalized background database to calculate SMB critical loads for eutrophication and acidification. In addition to the technical documentation and as part of the workplan for 2022 a CCE-Status-Report is under preparation, which will inform on the current Critical Load database, including NFC reports and most recent risk assessments for review of the Gothenburg Protocol (see "Use of updated CL database for GP review process").

Also he informed about the finalization of the process to review and revise the empirical Critical Loads (see "Session 4 –Empirical Critical Loads: Overview on the process of review and revision") and mentioned a project, that has been initiated at the German Environment Agency to update the receptor map for the Calculation of Critical Loads for the Entire Region of the Geneva Air Pollution Convention (see "

Updating Receptor Land Cover Map for the Calculation of Critical Loads for the Entire Region of the Geneva Air Convention").

Finally, he informed about the CCE-Expert-Workshop on Ammonia Critical Levels and Monitoring Networks, that had been taken place in late March in 2022 and initiated a review of the current Critical Levels as defined in the Mapping Manual, and the involvement of CCE in the ad-hoc Group's on Marine Protection (AMP) activities. Both CCE activities were presented and discussed in more detail under Session 7 (see "Session 7 – New and future findings developments regarding Critical Loads & critical levels and contributions to GP review process").

Ongoing activities at CDM

The current and planned activities of the CDM are in accordance with the workplan for 2022/2023. CDM is making preparatory work for an expert workshop focused on modelling interaction between air pollution and climate change. The workshop will explore links between carbon cycling used in climate reporting and nitrogen cycling investigated within CLRTAP. The workshop is planned at the end of 2022 or early 2023. The second activity of CDM is to complete a report (due in 2023) on "Modelling impact of air pollution on biodiversity". The aim of the report is to be used as guidance for calculating critical loads using modelled biodiversity change. Such guidance will be needed when including an option to include modelled change of species as one of the options for setting critical loads for sulphur and nitrogen. Third CDM activity is restructuring and further development of the common WGE web portal to provide an overview of the whole WGE and an access to all parts of WGE from a common entry point.

Session 2 – Contribution from other bodies of the Convention to effects-oriented activities

– Chairs : Markus Geupel & Alice James Casas

Within this session, 6 presentations were given:

- *"Forum on International Cooperation on Air Pollution" – Alison Davies, John Salter, Anna Engleryd and Petra Hagström, presented by Sophie Standring*
- *"ICP Waters" – presented by Kari Austnes*
- *"Recent activities of ICP Forests" – by Anne-Katrin Prescher and Kai Schwärzel*
- *"Achievements of the ICP Vegetation in 2021 and future work plan" – by Felicity Hayes, Katrina Sharps, Mike Perring and Amanda Holder*
- *"ICP Integrated Monitoring of Air Pollution Effects on Ecosystems" – by Ulf Grandin, Salar Valinia, James Kurén Weldon, presented by Thomas Dirnböck*
- *"CIAM Activities" – by Maximilian Posch*

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Presentations and directly associated discussions

Sophie Standring indicated that some collaboration was already ongoing between, for example, FICAP and ICP Vegetation with translation of factsheets in different languages (e.g. Spanish) and encouraged such type of request to be sent over to FICAP by ICP M&M if needed. During the discussion, it was mentioned that any type of promoting communication around the Mapping Manual should be beneficial, even as simple as providing the link to the dedicated webpage of the CCE in any communications, as well as promoting communication around any workshops and meeting under the umbrella of ICP M&M.

Kari Austnes, head of the Programme Centre of ICP Waters, gave an overview of **ICP Waters activities**. Publications and reports are available at icp-waters.no. The two most recent thematic reports are both on nitrogen. One is on biological effects of nitrogen deposition on surface waters.

This was a contribution to the revision of the empirical critical loads of nitrogen and included a literature review and new data analyses. The latter showed that nitrogen deposition gives increased algal production per unit P in the lower nitrogen deposition range. The other report is on nitrogen trends and spatial patterns, relating concentration levels to catchment properties, climate and nitrogen deposition. Nitrate concentrations are generally declining, but not to the same extent. The work plan for 2022 includes a report on biological trends and recovery, and for 2023 on base cation trends. For 2023-2024 there are plans to update the ICP Waters manual, and there is potential for a collaboration with ICP Forests on nitrogen trends. ICP Waters held its 38th Task Force Meeting (hybrid, in Miraflores de la Sierra, Spain) jointly with ICP Integrated Monitoring on 10 – 12 May 2022.

On behalf of the Program Co-ordinating Center, Anne-Katrin Prescher gave an update on the **recent activities of ICP Forests**. Next to the annual Technical Report, the ICP Forests Brief #5 on "Tree health is deteriorating in the European forests" was published (http://icp-forests.net/page/icp-forests-briefs) highlighting that the proportion of fully foliated trees has declined over the past 30 years. Under the 2020-2021 workplan item of Nitrogen Deposition and its effects on forest vegetation (monitoring activities according to the ICP Forests Manual)", it was shown that annual N throughfall deposition has hardly decreased in the recent years, and observed spatial patterns are relatively stable. Anne-Katrin Prescher informed that the physical 38th ICP Forests Task Force Meeting was cancelled due to the political situation in Eastern Europe and will now be held as online meeting on 2 – 3 June 2022.

Katrina Sharps provided a summary of ICP Vegetation activities for 2021 and outlined the workplan for 2022-23. New information has been added to the annex for Chapter 3 of the Mapping Manual (Scientific Background Document B); review of the critical levels for NOx is scheduled for 2022/23 (with the organisation of workshop in May 2022, see "

Review of Critical Levels for NOx") updated ozone injury guides (specific to biogeographic region) are available on the ICP Veg website; outreach work has included mapping of ozone impacts on African crops, an online course, YouTube video, webinar and leaflets/brochures; the 2020-22 moss survey has data from 29 countries so far and includes a pilot study on mosses as biomonitors of microplastics. The 35th ICP Vegetation Task Force Meeting was held online on 21 – 24 February 2022.

Thomas Dirnböck presented "**Current activities at ICP Integrated Monitoring**". After many successful years at SYKE in Finland the ICP IM Programme Centre has now moved to SLU in Sweden. The new team was introduced. There is a planned joint task force meeting with ICP Waters in Spain 10-12 May, which will be primarily an in-person event with the possibility to participate remotely. An introduction to the planned Extended IM monitoring was given, where less intensively monitored sites in habitats other than forests will be added. This has the added benefit of facilitating reporting under the NEC directive. The 2022-23 work plan involves operationalising and advertising the Extended IM network, and launching a project modelling biodiversity impacts in cooperation with CDM. Activities during 2021-2022 included the migration of the Programme Centre, work on the revision of the Gothenburg Protocol. Scientific papers currently either at the stage of manuscripts or submitted include a paper on the impacts of internal catchment-related nitrogen parameters to TIN leaching, a paper on HM trends in concentrations and fluxes across ICP IM sites in Europe and a paper on the effects of N enrichment on forest bryophyte vegetation." ICP Integrated Monitoring held its 30th Task Force Meeting (hybrid, in Miraflores de la Sierra, Spain) jointly with ICP Waters on 10 – 12 May 2022.

During discussion, the scope and status of progress of "Extended ICP IM" was further clarified, especially on the fact that (i) a clear link was aimed at with NECD reporting in terms of the sites monitored and that (ii) extension of monitoring sites was currently under progress with promotion from the ICP IM to the NFCs.

Maximilian Posch (IIASA/CIAM) gave an **overview of the carried out and ongoing work at CIAM**. This includes the implementation of the 2021 critical loads (CLs) for acidity and eutrophication, provided by the CCE, into the GAINS-Europe integrated assessment modelling system, currently being used in the review of the Gothenburg Protocol. By employing N and S depositions resulting from scenarios developed by CIAM he illustrated with maps the range of reductions in CL exceedances that would be feasible by 2050.

During the discussions, it was mentioned *inter alia* how dramatic was the decrease in CL exceedances for nutrient N when projecting CL with a scenario in 2050 based on a "low-diet" corresponding to eating less meat.

Session 3 – NFCs' contributions to effects-oriented activities

– Chairs : Alice James Casas & Markus Geupel

Within this session, 4 presentations were given:

- *"Updating SMB Critical Loads in China" – by Lei Duan*
- *"Revising the UK receptor maps and atmospheric models used to calculate critical load and critical level exceedances" – by Ed Rowe, Naila Hina, Ed Carnell, Massimo Vieno, Beth Raine, Cristina Martin Hernandez, Pete Levy, Kasia Sawicka & Sam Tomlinson*
- *"Application and Dissemination of Critical Loads in the United States" – by Emmi Felker-Quinn, Kayla Wilkins, Mike Bell, Linda Pardo*

Presentations and directly associated discussions

Lei Duan presented an update on SMB Critical Loads in China. He indicated that considerable efforts to reduce SO2 and NOx emission have allowed to achieve significant improvement of air quality in China. However, the acidification and eutrophication risks for soil and surface water still exist, according to the critical load exceedances updated recently. The CL exceedance could not be eliminated even if the multi-targets of air quality and CO2 mitigation was achieved in 2035. This calls for stricter NH3 emission control, mainly from agriculture and animal grazing.

Ed Rowe presented the achievement of considerable update works. The UK NFC has revised the receptor maps and atmospheric models used to calculate critical load and critical level exceedances. Habitat maps are now derived principally from UK Land Cover Map 2019 (LCM 2019). For some habitats the maps were refined using data on soil moisture class, or the occurrence of species or assemblages. Ammonia concentration maps are now calculated using EMEP4UK. Deposition fluxes are still calculated using Concentration-Based Estimated Deposition (CBED), but on the basis of the EMEP4UK ammonia map. Resulting changes in exceedance statistics have been modest, apart from for some specific habitats. Nevertheless, when calculation methods are changed, it is important to explain clearly the reasons for the changes, and to illustrate the consequences for reported statistics.

After his presentation, he was asked if only empirical critical loads were used in the UK. Ed further indicated that SMB CL were used for acidity and that CLempN were used for eutrophication while biodiversity-based CL were not used for official reporting in the UK. He stressed that hopes were there to see CDM activities increasing the interest and the focus on that kind of indicators. Ed also mentioned that there was a need to study further how many years of reducing acidity pollution were needed to achieve deposition below CL.

Regarding the update of the atmospheric chemistry and transport model from FRAME to EMP4UK model, it was asked how great the impact of this change on the exceedance of CL or their distribution or the performance of the indicators was, used at UK level. Ed answered that changing atmospheric model raised an increase of CL exceedance by 5 or 10%, which might be substantial at policy level even though not in absolute terms, so this is the reason why UK wanted to change the receptor map at the same time to do all the changes together. These changes had caused differences in conclusions and it was recognised that there was never a good time to make them, but what needed to be done was to clearly communicate on the changes made, especially when the results are being used at policy level.

Emmi Felker-Quinn presented "Application and Dissemination of Critical Loads in the United States" *via* the Critical Loads of Atmospheric Deposition (CLAD), a science committee under the National Atmospheric Deposition Program (NADP). She announced the next new version of the National Critical Load Database to be made available online in May 2022 and presented research works going on in the field (e.g. new critical loads for epiphytic lichens and interaction of lichen communities with climate change, ecological thresholds under atmospheric nitrogen deposition for herbaceous species. Emmi Felker-Quinn also presented some outreach issues to land managers regarding Critical Loads.

NFCs tour de table

In total 15 NFC present at that time during the meeting took the chance to inform briefly about their ongoing national activities. In summary they reported on projects deriving Critical Loads and assessing the current Critical Limits, their planned work to apply the new empirical Critical Loads and specific single projects such as a lichen inventory or assessments in Mountain hay meadows.

In some of the countries, national Critical Load activities were successfully related to policy driven action in the fields of climate change, the NEC Directive of the EU and to effect oriented activities in N2000 areas.

Finally, the NFCs expressed their need for an official call for data to plan and finance the national contributions. Possible topics for a potential Call for data were identified during the tour de table, such as Critical Load database updates, application of the new empirical Critical Loads on the NFC national maps and the further support of the dynamic modelling activities.

After the tour de table, the issue of data sharing and national data accessibility was opened for discussion. Several NFCs expressed their interest on sharing the data by making them available. However, slightly different views were given on the degree of freedom for this, and no consensus was found on how this should be done. Several NFCs expressed their fear that the data uploaded with a complete freedom might lead to a misuse and/or a misinterpretation of the data. Because of this, a possible restricted access by requesting responsible entities, i.e. NFCs was mentioned. This could be done through contracts on data use, and/or by restricting user archives.

Session 4 –Empirical Critical Loads: Overview on the process of review and revision

– Chair: Markus Geupel (CCE)

Within this session, 2 presentations were given:

- *Empirical critical loads of N: overview of the process of review and revision (2020-2022)" – by Roland Bobbink, Sabine Braun, Christin Loran & Hilde Tomassen*
- *"Next steps before applicability of new CLempN" – by Markus Geupel & Alice James Casas*

The abstracts of these are available in the present document below and the presentations themselves are available on the CCE website (https://www.umweltbundesamt.de/en/Coordination_Centre_for_Effects), providing consent for such dissemination has been given to CCE by their authors.

Presentations and directly associated discussions

The overview on the current status of the revision of empirical Critical Loads of Nitrogen (CLempN) for Europe was a joint presentation by Roland Bobbink, Sabine Braun, Christin Loran and Hilde Tomassen. It is, however, worth indicating that this was made possible by the tremendous work of 45 experts from different ICPs who have been contributing to the review and revision work during the past two years.

In this presentation the coordination team shortly summarized the history and the strength of the approach to derive empirical Critical Loads by reviewing and assessing studies describing and quantifying impacts of nitrogen deposition on ecosystems. The aim of the current review process was, to collect and evaluate all new scientific data of the period 2010 – 2021, to adapt the receptor coding to the new EUNIS ecosystem classification system and to integrate nitrogen gradient studies in the empirical approach. Also, the coordination team explained the procedure and organization of work during the past 2 years and highlighted the high scientific aspiration to gain robustness and transparency. Special attention was paid to the presentation to the revision of the CLempN for forests (EUNIS class T).

The empirical Critical Loads ranges are now, in total, available for 51 different EUNIS habitat types. The project team was able to add 8 new EUNIS habitat types during the process. The most outstanding result was that for around 50% of the EUNIS habitat types the CLempN became lower based upon new evidence.

Discussion about further work on empirical CL

These updated values were presented at the 2022 TF & CCE meeting to inform NFCs and reach definitive scientific agreement on the values.

It was agreed that:

- the ICP M&M community agreed with the scientific content which led to the updated empirical critical loads for nitrogen,
- the ICP M&M TF asks the WGE to take note of the report and the updated empirical critical loads for nitrogen and to recommend their use at the 8th joint WGE/EMEP session in September 2022,
- the ICP M&M TF recommends the use of the report and the updated values as soon as the final report is published by CCE and when the awaited official notification from WGE in September is available,
- the ICP M&M TF and CCE support the update of the empirical critical loads for nitrogen planning 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 24-25 on applied risk assessment with CLempN.

NFCs were also encouraged to apply / test the updated CLempN on their territories in preparation for their response to the next CfD.

Session 5 – Steady-state Critical Loads for acidification and eutrophication

– Chair: Thomas Scheuschner (CCE)

Within this session, 4 presentations were given:

- *"Preparation of CCE Status report 2022" – by CCE (Thomas Scheuschner, Christin Loran and Markus Geupel)*
- *"Database accessibility to NFCs" – by CCE (Thomas Scheuschner, Christin Loran and Markus Geupel)*
- *"Evaluating Simple Mass Balance regarding climate dependences and impacts" – by Jana Nieburh*
- *"Updating critical limits for used in the simple mass balance model (SMB) for critical loads calculation" – by Thomas Dirnböck, Karl Knaebel, Ika Djukic & Sarah Venier*

The abstracts of these are available in the present document below and the presentations themselves are available on the CCE website (https://www.umweltbundesamt.de/en/Coordination_Centre_for_Effects), providing consent for such dissemination has been given to CCE by their authors.

Presentations and directly associated discussions

Thomas Scheuschner presented the status on the work of the CCE status report 2022. The main outline and most important topics were discussed. The NFC are now asked to send their feedback to the distributed draft and also their national reports by 17th of June 2022.

The CL background database is now integrated in to the CCE CL exceedance framework. National subsets of this data can be obtained by the respected NFC via the CCE cloud. This new opportunity was presented by Thomas Scheuschner and some NFC expressed their interest in this "on-demand" service. The option of publishing an GIS-WebMap-Service (WMS) was also discussed but no currently running applications were identified.

The German NFC is currently working on the evaluation of Simple Mass Balance for eutrophication and acidification critical loads regarding possible climate dependences and impacts. This work was presented by Jana Niebuhr, from the German Federal Agency (UBA). The main objectives of this project are: (1) estimating the variation of climate-related input variables with climate change, (2) evaluation of the Critical Load SMB Modelling regarding possible additional climate dependences, (3) estimating the effect of climate change on Critical Loads. Jana Niebuhr announced that the sensitivity of critical load variables and results of the critical load calculation would be assessed by variating climate related variables in the German NFC dataset and Level II sites (ICP Forests) according to climate projections for Germany. A literature search for the evaluation of the current status of research regarding possible climate dependences of eutrophication and acidification processes is being carried out as well. Cooperation with other NFCs was very welcome, about which the following questions were included in the survey prepared for the project on critical limits (cf. presentation "Updating critical limits for used in the simple mass balance model (SMB) for critical loads calculation" by Thomas Dirnböck & Karl Knaebel): (1) Do you know about similar activities/relevant findings that should be considered in this project?, (2) Does your NFC apply climate-dependent variables in the critical load calculation other than those described in the mapping manual? If so, which ones?

Thomas Dirnböck and Karl Knaebel presented results from another recent project funded by the UBA. The project aims to review and possibly update critical limits currently applied in the simple mass balance model (SMB) for critical load calculations. The project can be subdivided in four main tasks: literature review, sensitivity analysis, NFC survey, spatially explicit modelling of critical limits for eutrophication, an expert workshop. In our presentation, the presenters gave insights on the current work status of each of the mentioned tasks and presented preliminary results. They also emphasized the NFC survey on critical limits, which will be send out to all NFCs as soon as possible. Furthermore, the presenters announced an expert workshop on critical limits, which is planned to be hold in autumn of 2022.

Session 6 – Dynamic Modelling

– Chair: Filip Moldan (CDM)

Within this session, 2 presentations were given:

- *"Dose-effect Relations for Habitat types and Nitrogen deposition" – by Wieger Wamelink, P.W. Goedhart, H.D. Roelofsen, R. Bobbink, M. Posch, H.F. van Dobben & Data providers*
- *"Summary of the 3rd meeting of the Centre for Dynamic Modelling held in Sitges, Spain, April 6-8" – by Filip Moldan & Sara Jutterström*

The abstracts of these are available in the present document below and the presentations themselves are available on the CCE website (https://www.umweltbundesamt.de/en/Coordination_Centre_for_Effects), providing consent for such dissemination has been given to CCE by their authors.

Presentations and directly associated discussions

Wieger Wamelink presented "Dose-effect Relations for Habitat types and Nitrogen deposition". In the Netherlands, and more and more across the world, nitrogen deposition has a negative impact on Natura2000 sites and habitat types. Critical loads for nitrogen deposition have been established to assess the quality loss of the habitat types. When the nitrogen deposition raises above habitat types specific critical load, the quality of the habitat is expected to be significantly negatively influenced. To investigate how the quality of the habitat type is affected beyond the critical load, we estimated response curves for plant species. The curves are based on the occurrence of plant species in North-Western Europe (EVA-database) and the estimated nitrogen deposition at the site (EMEP-data). As covariables we included soil type, average annual temperature, and yearly precipitation. Based on indicative species for the habitat types responses were estimated for habitat types occurring in the Netherlands. For 60 out of the 61 terrestrial habitat types, it was possible to estimate response curves for habitat types for nitrogen deposition.

For 37 curves the response was judged to be reliable. Some of the curves showed a steep decline and some a more gradual decline with increasing nitrogen deposition. Response curves were compared with both the empirical and modelled critical loads. For a significant part of the curves the decrease of species occurrence already occurs at lower deposition levels than the critical load. For a part of the species and also habitat types we found unexpected response curves, indicating that more research is needed. 41 of the curves could be validated on gradient deposition field studies, for which 25 curves showed a significant relation between modelled response curve and field data (Lin's correlation coefficient).

Filip Moldan presented a brief summary of the third CDM meeting which was held in April 6-8 2022. The meeting was organised as a physical meeting in Sitges, Spain combined with a remote participation option in two out of four sessions. Participants discussed current activities and future plans of CDM. Discussions were centred around 19 presentations delivered at the meeting. The main common themes were recovery from acidification, biodiversity, and interaction with climate change.

These were discussed in light of the latest modelling work but also from a perspective of results from the latest data collection and analysis. Dynamic modelling benefits from increasing process understanding and wealth of data used in the modelling work. However, there is also a tendency to include ever increasing amount of complexity in the models to make them capable to cope with increasing demands on model performance and increasing complexity of questions that models are aiming at answering. This poses a difficult balance between developing models that are robust, reliable and useful but also that do not require data not commonly available and processes difficult to conceptualize. As an example, the undisputable importance of earth worms on a number of soil processes and was discussed.

Potential model complexity expansion and increase in demands on monitoring programs to include additional – and often complex parameters to be included - needs careful justification assessment. There are, however, also examples where new techniques might provide useful and qualitatively new information without massive investments in additional monitoring. One such technique discussed at the meeting is a possibility to measure ecosystem DNA in waters and soils. An increasing volume on collected eDNA data might also have a potential as a basis for further model development, calibration and testing.

Discussion about further work on DM

Further work of CDM will continue exploring potential of using biodiversity models for policy purposes as it is one of the issues specifically defined in the CDM mandate. The width of modelling efforts undertaken by the individual ICPs and also by teams outside the convention is, however, much bigger and CDM will continue its task to follow also 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 presence and in the future.

Session 7 – New and future findings developments regarding Critical Loads & critical levels and contributions to GP review process

– Chair: Markus Geupel & Thomas Scheuschner

Within this session, 6 presentations were given:

- *"Expert Workshop on Ammonia" – by Markus Geupel*
- *"Review of Critical Levels for NOx" – by Mike Perring*
- *"Use of updated CL database for GP review process" – by CCE (Markus Geupel, Christin Loran & Thomas Scheuschner)*
- *"Estimation of Exceedance of Critical Atmospheric Nitrogen Inputs (CAI) to the Baltic Sea" – by Gudrun Schütze, Markus Geupel, Wera Leujak, Thomas Scheuschner*
- *"Updating Receptor Land Cover Map for the Calculation of Critical Loads for the Entire Region of the Geneva Air Pollution Convention" – by Steffen Gebhardt*
- *"Air pollution & Biodiversity" – by Markus Geupel & Filip Moldan*

Presentations and directly associated discussions

Expert Workshop on Ammonia

CCE informed, that more than ten years after the last update of CLRTAP critical levels for ammonia (Mapping Manual), new findings on the effects of ammonia on vegetation have been discussed at a workshop prepared by the CCE and Germany as a lead. The expert workshop was held on 28/29 March 2022 as a hybrid meeting. The option for physical attendance was in Dessau, Germany. The workshop was part of the current CCE work plan for the year 2022-2023 of CLRTAP (1.1.1.22). Scientists dealing with research on effects of ammonia on vegetation and ecosystems were invited to present their research. Also, the workshop offered the opportunity to exchange information on national or regional programs which have been set up for the monitoring of ammonia in sensitive habitats. There were 134 registered participants from 28 countries including representatives from several EU Environment Agencies, the UNECE Secretariat, from the WGE, the ICP Vegetation, the ICP Forests, the Center for Dynamic Modelling (CDM), the Center for Integrated Assessment Modelling (CIAM), MSC-West in Oslo and the Task Force on Reactive Nitrogen (TFRN) (https://www.umweltbundesamt.de/en/news-0?parent=67248).

The workshop concluded, that there have only been few long-term studies on the effects of elevated NH3 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. Also it was noted that further long-term experimental studies at field scale for different habitat types and climates must be a priority, because under a changing pollution climate the risk for the most sensitive species groups (e.g. certain lichens, mycorrhiza or insects) may even rise.

On the monitoring of ammonia, it was summarized that in numerous countries monitoring networks are in place, different in number of stations and coverage in relation to sensitive ecosystems. It was recalled that a low-cost European standard for passive monitoring of ammonia is in place. Finally, the workshop recommended that ammonia should be better respected in the future legislation (Air Quality and Nature Protection) and the workshop-participants urged the European Commission dealing with the Ambient Air Quality Directives (AAQD) revision to consider ammonia for inclusion into the revised AAQD.

CCE took good note of the meeting participants recommendation, to assess Critical Level Exceedance if possible across the EME region and compare areas at risk to comparable outputs in Critical Load assessments.

Review of Critical Levels for NOx

ICP Vegetation informed the meeting about the upcoming review of NOx critical levels and associated first online workshop (24th May 2022). The workshop will include topics: historical perspective on the current critical levels; review of literature to ascertain whether there are new data to justify / revise the existing critical levels including in respect to vegetation/ecosystem types and modifying factors; applicability of concentration-based NOx critical levels; scope of application of the critical levels; and, whether concentration-based maps are appropriate for understanding vegetation damage associated with critical level exceedances. Further details available from Mike Perring (mikper@ceh.ac.uk).

Use of updated CL database for GP review process

Thomas Scheuschner (CCE) presented the assessments to support the review process of the Gothenburg Protocol. For that, the CCE compared the current Critical Load database (2021), consisting of national data and CL calculated with the background database with a time series of deposition of eutrophying and acidifying air pollutants provided by MSC-West. The detailed results have been reported to the GP review group for the reporting to the EB and will be published in the CCE Status Report 2022 which is going to be published in the second half of the year 2022.

The results of the exceedance calculations for acidification show a decreasing trend. Exceedances of CLacid occur on 14.0% (2000) and 4.4% (2019) of the ecosystem area and the European average accumulated exceedance (AAE) is about 124 eq ha^{-1} yr^{-1} (2000) and 23 eq ha^{-1} yr^{-1} (2019). Hot spots of exceedances can be found in the Netherlands and its border areas to Germany and Belgium, and some smaller maxima in southern Germany and Czechia, whereas in most of the European ecosystems CLacid are not exceeded.

Critical Loads for eutrophication are still exceeded in large parts of the model domain. Moreover, the share of ecosystems, where the Critical Loads for eutrophication are exceeded, decreases relatively slowly, starting at 75 % in 2000 and going down to 64% in 2019, with an AAE of about 438 eq ha^{-1} yr^{-1} and 264 eq ha^{-1} yr^{-1} in 2000 and in 2019, respectively. The highest exceedances of CLs are found in the Po Valley in Italy, the Dutch-German-Danish border areas and in north-eastern Spain.

The data analysis for the GP review process also includes a distinct analysis of the receptors regarding the connection of natural protections status (e.g. Natura 2000) and CL exceedance. This analysis did not show any remarkable differences between areas with or without any protection status. Which might give the impression that more efforts need to be done in order to protect the most vulnerable areas in Europe.

The data was furthermore analysed regarding the impact of different Nitrogen species (oxidized or reduced forms of Nitrogen). The data indicated a clear trend of an elevated share of reduced Nitrogen in regions with the highest CL exceedances.

Estimation of Exceedance of Critical Atmospheric Nitrogen Inputs (CAI) to the Baltic Sea

Gudrun Schütze, representing the Ad-hoc expert group on Marine Protection (AMP) and referring to the policy question 2.8, informed about first results of the work on including the risk of eutrophication of the Baltic Sea in the Gothenburg Protocol review. A simple and pragmatic approach to derive Critical Atmospheric Input rates of nitrogen (CAIs) could be developed in close cooperation with experts from the Reduction Scheme Core Drafting Group (RedCore DG) of HELCOM (for more detail, see Informal Paper to the 7th Joint Meeting of EMEP SB and WGE). The CAIs are exceeded by recent deposition rates (2019) in all sub basins, albeit the Average Accumulated Exceedances (AAEs) are low. Limitations of the approach are the strong dependency of CAIs on the actual nitrogen deposition rates and that the most nitrogen sensitive areas i.e., the coastal zones, could not be considered. While the results can be regarded as a first impression on the extend of risk, the spatial distribution of sensitivity and exceedances need to be interpreted with caution. Further work by HELCOM and CLRTAP experts is needed. In its Meeting of March 2022, the Extended Bureaux of the EMEP SB and WGE concluded that the work of AMP should be continued. The-effectiveness of control options for each input category should be considered for reduction strategies and coastal areas should be addressed in future work.

Updating Receptor Land Cover Map for the Calculation of Critical Loads for the Entire Region of the Geneva Air Convention

For the calculation of the Critical Loads (CL) for terrestrial ecosystems throughout Europe, but also for the modelling of air quality, the creation of an up-to-date harmonized land cover map is necessary. This update is currently elaborated in a project coordinated by the CCE. The main contractor is Earth Observation Solutions and Services (EOSS) GmbH and the first achievements of the project were presented by Steffen Gebhardt from EOSS. Besides the update, another objective of the project is a spatial extension of the existing map to Caucasian and Central Asian parties. Also a further extension to North American parties is examined.

Based on an evaluation of the availability and suitability of different spatial data it was decided to 1) use CORINE Land Cover 2018 and Ecosystem Type Map v3.1 and apply transition rules towards EUNIS Level 1 and Level 2 for European countries covered by CORINE Land Cover Maps, 2) use Copernicus Global Land Cover Map and apply transition rules towards EUNIS Level 1 and Level 2 for European countries not-covered by CORINE Land Cover Maps, 3) use Global Potential Natural Vegetation maps to further disaggregate Level 2 forest and vegetation classes towards Level 3. The project will last until the end of 2023.

Air pollution & Biodiversity

Markus Geupel (CCE) and Filip Moldan (CDM) presented a brief summary of the work on modelling biodiversity change as an indicator of damage due to air pollution carried out under the ICP Modelling & Mapping. They stated that since air pollution can cause severe damage to biota, ecosystems, and ecosystem integrity it may therefore also pose a serious risk for biodiversity (characterized by the diversity of genes, species, and ecosystems). They highlighted that the ICP Modelling & Mapping has been working with biodiversity as an indicator since 2007. While the use of CLempN to describe risks for biodiversity was in focus until 2012, since then the development of indicators with vegetation models (CLbiodiv) to describe those risks has gained priority. In the meantime, in the context of the cooperation with other institutions outside convention, the Exceedance of critical loads for nitrogen deposition (CLnutN) is for example used by the European Environment Agency (EEA) as an indicator for risks of biodiversity loss in (semi)-natural ecosystems. They also mentioned the cross-cutting joint workshops with the nature conservation communities and the partly successful transfer of the Critical Load concept into different guidance documents to assess the habitat conservation status.

CCE and CDM pointed out that all established ways to calculate critical loads (CLnutN, CLacid, CLempN, CLbiodiv) are aiming at protecting biota and that CLempN is specifically aimed at protecting habitats. It was pointed out that therefore the terminology “CLbiodiv” for CL derived with vegetation models must not be misinterpreted so that it would be the only way to calculate critical loads with protection of biota in mind.

The meeting’s participants discussed whether a new terminology for those CL should be found and agreed that a joint ICP M&M & CCE & CDM communication brief or brochure on “Critical Loads: tools to assess risks for biodiversity” would be beneficial as it would help to illustrate the strengths of the ICP M&M’s assessment concepts in- and outside the convention.

Session 8 – Wrap-up session

– Chair: Alice James Casas & Markus Geupel

Within this session, one presentation was given co-authored by the chairwoman, CCE and CDM, to synthetise the main outputs of the meeting. It is available on the CCE website (https://www.umweltbundesamt.de/en/Coordination_Centre_for_Effects).

Main conclusions of the meeting and its discussions were indicated in this presentation. These are reported hereunder and some of them are summarised also in Chapter 2 and Chapter 3 of the present report.

Data sharing and data accessibility

After the tour de table, the issue of data sharing and national data accessibility was opened for discussion. Several NFCs expressed their interest on sharing the data by making them available. However, slightly different views were given on the degree of freedom for this, and no consensus was found on how this should be done. Several NFCs expressed their fear that the data uploaded with a complete freedom might lead to a misuse and/or a misinterpretation of the data. Because of this, a possible restricted access by requesting responsible entities, i.e. NFCs was mentioned. This could be done through contracts on data use, and/or by restricting user archives.

Update of Empirical Critical Loads for Nitrogen

The 2022 TF & CCE meeting had allowed to inform NFCs and reach definitive scientific agreement on the values.

Thus, it was agreed that:

- the ICP M&M community agreed with the scientific content which led to the updated empirical critical loads for nitrogen,
- the ICP M&M TF will asks the WGE to take note of the report and the updated empirical critical loads for nitrogen and to recommend their use at the 8th joint WGE/EMEP session in September 2022,
- the ICP M&M TF recommends the use of the report and the updated values as soon as the final report is published by CCE and when the awaited official notification from WGE in September is available,

the ICP M&M TF and CCE support the update of the empirical critical loads for nitrogen planning 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 24-25 on applied risk assessment with CLempN. NFCs were also encouraged to apply / test the updated CLempN on their territories in preparation for their response to the next CfD.

CCE informed it aimed at mapping new CLempN and evaluate how far the update of CLempN impact the CL exceedances. This work should be combined with:

- the receptor map updating
- possible scientific publication of the revised CLempN

Steady-state Critical Loads for acidification and eutrophication

Regarding steady-state Critical Loads CCE encouraged input for the draft CCE status report already circulated to be sent before 17 June, especially regarding:

- NFCs reports
- Comments on the text

CCE presented ways of sharing the BDB and asked NFCs to communicate on their experiences and preferences. Some NFCs expressed their interest regarding this proposal.

During the 2022 TF & CCE meeting, two presentations relating to further developments of SMB CL modelling

- Climate impact on modelling results (Jana Niebuhr)
- Review of critical limits (Thomas Dirnböck & Karl Knaebel)

CCE encouraged NFCs contributions to these ongoing processes.

Dynamic Modelling perspectives

It was stated that biodiversity modelling (e.g. modelling of plant species, butterflies, aquatic organisms occurrence probability) could serve as a basis for setting critical loads for nitrogen and sulphur, but that it also provided a dynamic picture of how biodiversity would evolve in the future under various scenarios. **Modelling biodiversity change could be an additional tool for policy purposes, and CDM proposed opening for further modelling work in the next CfD**.

Cooperation with researchers who conduct ecosystem experiments had been of high importance for model development and the combination of models, monitoring and experiments were still the most powerful tool in generating new insights in ecosystem functioning. **CDM stressed this benefited from co-operation outside LRTAP**.

Extension of data collection should be planned not only in time but also in scope because it added value to the existing data series and was a successful (and cost-efficient) way to generate new understanding and knowledge needed for model development. **Opening LRTAP sites to other research was to be promoted**.

Upcoming Call for Data (CfD)

Given the update of CLempN (achieved) and of the receptor map (in progress), ICP M&M and the CCE informed they aimed at launching a new CfD in 2023 to be prepared for the WP 24/25. In this regard, the following options were to be considered:

- NFCs and CCE interactions on Background data SMB CL
- NFCs application of the updated CLempN to national receptor maps
- Further work with dynamic models of air pollution effects
- Instructions to be provided for “vegetation model based-CL“?

Manual updates

A number of updates of the manual were foreseen following work achieved on the update of empirical Critical Loads for Nitrogen and review of new scientific findings regarding ammonia.

For both topics, a new text (referring to the WS reports) would be presented in ICP M&M in 2023 for adoption and uptake into the manual. For this purpose, CCE proposed to coordinate two drafting groups corresponding to both topics and encouraged participation of the meeting attendees.

Annexes

Annex I – Final Agenda

Convention on Long-Range Transboundary Air Pollution
Working Group on Effects

International Cooperative Programme on
Modelling and Mapping of Critical Levels & Loads
and Air Pollution Effects, Risks and Trends
(ICP M&M)

38th ICP M&M Task Force and 29th CCE meeting

Tuesday 3rd, Wednesday 4th and Thursday 5th May 2022

Online meeting

FINAL AGENDA (May 2022) with the final schedule
All times CEST

Please note the meeting will be recorded for reporting purpose.
Should you have any objection regarding the recording of your contribution, please contact us.

TUESDAY 3 MAY (11 AM – 5.30 PM including breaks)

Opening session (11 AM – 12.30 PM)
– Chair: Alice James Casas & Markus Geupel
"Chapeau" session including policy relevant questions and WGE framework/activities

- Latest news from the Convention (Krzysztof Olendrzynski)
- Latest news from the WGE (Isaura Rábago)
- Update on the Science Strategy (Alice James Casas)
- Ongoing activities at CCE (Markus Geupel)
- Ongoing activities at CDM (Filip Moldan)

Lunch Break (12.30 – 1.30 PM)

Contributions from other bodies of the Convention to effect-oriented activities (1.30 PM – 3 PM)
– Chair: Alice James Casas & Markus Geupel

- Forum for International Cooperation on Air Pollution (Sophie Standring)
- Update on ICP Waters activities (Kari Austnes)
- Update on ICP Forests activities (Anne-Katrin Prescher)
- Update on ICP Vegetation activities (Katrina Scharps)
- Update on ICP Integrated Monitoring activities (Thomas Dirnboeck)
- Update on CIAM activities (Maximilian Posch)

Coffee Break (3 – 3.30 PM)

NFCs' contributions to effect-oriented activities (3.30 – 5.30 PM)
– Chair: Alice James Casas & Markus Geupel

- Updating SMB critical loads in China (Duan Lei)
- Revising the UK receptor maps and atmospheric models used to calculate critical load and critical level exceedances (Ed Rowe)
- Application and Dissemination of Critical Loads in the United States (Emmi Felker-Quinn)
- NFCs "tour de table"

WEDNESDAY 4 MAY (11 AM – 5 PM including breaks)

Empirical Critical Loads: Overview on the process of review and revision (11 AM – 12.15 PM)
– Chair: Markus Geupel

- Presentation of the results (Roland Bobbink & Sabine Braun)
- Next steps before applicability of updated values (Markus Geupel & Alice James Casas)

Lunch Break (12.15 – 1.15 PM)

Steady-state Critical Loads for acidification and eutrophication (1.15 – 2.30 PM)
– Chair: Thomas Scheuschner

- **Background database**
- Preparation of Critical Loads status report 2022 including CL reports from NFCs (Thomas Scheuschner)
- Database accessibility to NFCs: technical exchanges on, and possible download of CL database (Thomas Scheuschner)
- **Improving and discussion CL and critical limits**
- Identification/implementation of climate-dependent variables in Critical Load Modelling using the SMB-Method (Jana Niebuhr)
- Revision of critical limits for SMB (Thomas Dirnböck & Karl Knaebel)

Coffee Break (2.30 – 3 PM)

Dynamic Modelling issues (3 – 5 PM)
– Chair: Filip Moldan

- Response curves and CL of habitat types for nitrogen deposition based on European data (Wieger Wamelink)
- Summary of the third meeting of the Centre for Dynamic Modelling (Filip Moldan)
  - C and N dynamics in soils, models and observations
  - Dynamic Modeling undertaken at ICPs
- Discussing inclusion of DM in the next Call for Data (in view of the WP 2024-2025)

THURSDAY 5 MAY (1.30 – 5 PM including breaks)

New & future scientific developments regarding Critical Loads & Critical Levels and contributions to GP review process (1.30 – 3.30 PM)
– Chair: Markus Geupel & Thomas Scheuschner

- Critical Levels for ammonia and oxidised Nitrogen
  - Feedback from the WS on NH3 (Markus Geupel)
  - Update on NOx Critical Level review – ICP Vegetation (Mike Perring)
- Use of updated background database for GP review process (Thomas Scheuschner)
- Protection of marine ecosystems: First results achieved under *ad hoc* group on protection of marine ecosystems (AMP) (Gudrun Schuetze)
- Update on current work on the receptor map (Steffen Gebhardt)
- Air pollution and biodiversity: Critical loads and other indicators and ways forward (Markus Geupel & Filip Moldan)

Coffee break (3.30 – 4 PM)

Wrap up session (4 – 5 PM)
– Chair: Alice James Casas & Markus Geupel

For further details, you may contact: Alice James Casas – alice.james@ineris.fr
CCE – cce@uba.de

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Annex II – List of participants

Family name	First Name	NFC	CLRTAP Body	Oral Presentation Title
Aherne	Julian	Canada		
Alonso	Rocío			
Augustin	Sabine			
Austnes	Kari	Norway	ICP W	Status ICP Waters
Bak	Jesper	Denmark		
Bal	Dick			
Bobbink	Roland			Overview on the process of review and revision of the empirical critical loads of N
Branquinho	Cristina			
Braun	Sabine			Overview on the process of review and revision of the empirical critical loads of N
Britton	Andrea			
Cathcart	Hazel			
Chuman	Tomáš	Czech Republic		
Clark	Chris			
Cosby	Jack			
De Marco	Alessandra			
Dirnböck	Thomas	Austria	on behalf of ICP IM	Update on ICP IM activities

Family name	First Name	NFC	CLRTAP Body	Oral Presentation Title
Aherne	Julian	Canada		
Alonso	Rocío			
Dragosits	Ulli			
Duan	Lei			Updating SSMB critical loads in China
English	Yvonne			
Felker-Quinn	Emmi			Application and Dissemination of Critical Loads in the United States
Fornasier	Maria Francesca	Italy		
Ge	Xiaodong			
Gebhardt	Steffen			Updating Receptor Land Cover Map for the Calculation of Critical Loads for the entire region of the Geneva Air Pollution Convention
Georgiev	Georgi	Bulgaria		
Geupel	Markus		CCE	CCE presentations
Gromov	Sergey	RF		
Hayes	Felicity		ICP Veg	
Héctor García Gómez	Hector			
Hina	Naila			

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Aherne	Julian	Canada		
Alonso	Rocío			
James Casas	Alice		ICP M&M TF Chair	Update on the Science Strategy
Juda-Rezler	Katarzyna			
Jutterström	Sara		CDM	
Kelleghan	David			
Knaebel	Karl			
Kohli	Lukas			
Krishnan	Anjana			
Manninen	Sirkku			
Meier	Reto	Switzerland		
Moldan	Filip	Sweden	CDM	Summary of the third meeting of the Centre for Dynamic Modelling
Neirynck	Johan			
Niebuhr	Jana			Identification/implementation of climate-dependent variables in Critical Load Modelling using the SMB-Method
Olendrzynski	Krzysztof		CLRTAP Secretariat	Latest news from the Convention
Oliveira	Maria Alexandra			

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Aherne	Julian	Canada		
Alonso	Rocío			
Perring	Michael			Update on NOx critical levels review – ICP Vegetation
Phelan	Jennifer	USA		
Posch	Maximilian		CIAM	Update on CIAM activities
Prescher	Anne-Katrin		ICP F	Update on ICP Forests activities
Rábago	Isaura	Spain	WGE Chair	Latest news from the Convention
Reinds	Gert Jan			
Richter	Simone			
Rowe	Ed	UK		Revising the UK receptor maps and atmospheric models used to calculate critical load and critical level exceedances
Schembri	Ariana			
Scheuschner	Thomas	Germany	CCE	CCE presentations
Schuetze	Gudrun			Protection of marine ecosystems: First results achieved under ad hoc group on protection of marine ecosystems (AMP)
Sharps	Katrina		ICP Veg	Update from ICP Vegetation
Standring	Sophie		TFICAP	The Forum for International Cooperation on Air Pollution (FICAP)

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Aherne	Julian	Canada		
Alonso	Rocío			
Tennant	Ginger			
Tomassen	Hilde			Overview on the process of review and revision of the empirical critical loads of N
Van Hinsberg	Arjen	The Netherlands		
Vanderheyden	Vincent	Belgium - Walloon		
Vowles	David			
Wamelink	Wieger			Response curves and CL of habitat types for nitrogen deposition based on European data
Wilkins	Kayla			
Zhigacheva	Ekaterina			