Convention on Long-range Transboundary Air Pollution

Working Group on Effects

2020

Annual report of the

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

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Introduction of the ICP, 2019 news, and 2020 meeting objectives

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

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 International Cooperative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (ICP Modelling and Mapping) 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 Swedish Environmental Research Institute (IVL, Göteborg).

The mandate of the ICP M&M is to provide the Working Group on Effects and the Executive Body 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 Coordination Centre for Effects (CCE) together with the Programme Task Force (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).

Year 2019 was an important year for the Convention on Long-range Transboundary Air Pollution (CLRTAP) community, with the entry into force of the amended Gothenburg protocol on the Monday 7 October and the celebration of the 40th year anniversary of the CLRTAP in Geneva during the meeting of the Executive Body (EB) in December.

Year 2019 was also an important year within the ICP M&M community itself, as the EB made the decision to transform the "Joint Expert Group on Dynamic Modelling (JEG DM)" into the "Centre for Dynamic Modelling (CDM)" under ICP M&M, hosted by IVL Swedish Environmental Research Institute. This Centre was created on 1 January 2020. Main tasks for which CDM is mandated by the EB is the development and promotion of methods for dynamic modelling (including consideration of biodiversity, interactions with climate change and land use, CL complement 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 the national contributions on ongoing activities held since spring 2019 (date of the 2019 annual TF meeting) as well as the work achieved by CDM from January 2020 were presented during the 2020 Annual Meeting of the ICP M&M (web-conference) from Tuesday 21 to Thursday 23 April 2020. This was the 36th TF, 27th CCE and 1st CDM meeting. 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
- Critical Loads for biodiversity
- Dynamic modelling of Critical Loads

The main discussions and conclusions as regard these scientific challenges on which it was chosen to focus during the meeting are presented hereafter in Chapter 2, after the current ICP M&M workplan for 2020-2021 (Chapter 1). They are followed by food for thoughts and the upcoming revision of the long-term strategy of the effects-oriented activities (Chapter 3)

Summaries of presentations (proceedings) and the discussions (notes) directly associated to those are given in the 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 endorsed the biennial workplan for the Convention in a document including items where ICP M&M together with its designated centres constitute the main lead bodies. The document is available at the following address:

https://www.unece.org/fileadmin/DAM/env/documents/2019/AIR/EB/ECE_EB.AIR_144_Add.2__Advance_version_.pdf

The biennal ICP M&M workplan is reminded in Table 1.

Table 1: Biennal ICP M&M workplan for 2019-2021.

Workplan item	Activity description/objective	Expected outcome/deliverable	Lead body(ies)	Resource requirements and/or funding source
1.1.1.13	Call for data and contributions 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	ICP Modelling and Mapping /CCE	National Focal Centres and Germany
1.1.1.14	Empirical Critical Loads: Review and revision of the empirical Critical Loads on nitrogen published in 2011	Report on empirical Critical Loads in Europe (2021)	ICP Modelling and Mapping /CCE	National Focal Centres and recommended contributions
1.1.1.22	Review of the dynamic modelling work under the Convention; identification of areas of common interest and potential gaps	Final report 2020	ICP Modelling and Mapping /CDM(1)	Recommended contributions
1.1.1.23	Development of metrics for quantifying damage to biodiversity due to air pollution and of biodiversity damage indicators suitable as a criterion for calculating critical loads for nitrogen as a nutrient	Report on indicators of damage to biodiversity (2021)	ICP Modelling and Mapping /CDM(1)	Recommended contributions

(1) CDM's role is not stated as such in EB.AIR 144 Add.2 Advance version document but this role is valid since EB endorsed the creation of this centre during its 39th session (cf. EB.AIR Decision 2019-22 amending Decision 2002-1 on the financing of core activities.

Chapter 2 – Current status of the work on Critical Loads (CL) and CL exceedance calculations, main 2020 TF meeting discussions and conclusions for next steps

Current status of the Background Database (BDB)

The UBA is hosting the CCE since 2018 and is continuing its efforts towards information and data retrieval from the previous contributors. To this aim, CCE has contracted in 2019 Wageningen Environmental Research (WUR) and members of the former CCE to build, update and document the Background Database (BDB). Up to date, data compilation and assessment has been achieved, including compilation of data, derivation of CL parameters for eutrophication and acidification as well as consolidation of data in a geodatabase. The current focus of the project is on calculating steady state CL for eutrophication and acidification for terrestrial ecosystems, i.e data import and preparation, development of calculation framework and calculation of Simple Mass Balance (SMB) critical loads. The status of this work and the future tasks were presented during the annual 2020 TF meeting (see presentation(s) in Chapter 4 – Meeting proceedings & notes).

- **Resulting CL for eutrophication and acidification, computed and mapped with newly developed R procedures, will be evaluated. This evaluation step will consist in comparisons of (i) new CLeut and CLacid with previous CL computed by the former CCE, (ii) modelled CLeut with Empirical CL and (iii) modelled CL from volunteering countries using either a different CL model than SMB, or different criteria.**

Current status of the work on Steady-State CL

The **Call for Data (CfD) on steady-state CL** was launched by the CCE and the chair of the TF in November 2019 and clear roadmap was communicated. The deadline for the deliverables for the steady-state CL topic are spring 2020 for the status report and spring 2021 for the most recent data delivery. Following the CfD, 5 countries submitted reports.

During the annual 2020 TF meeting, 4 National Focal Centers (NFCs) presented preliminary contribution to the Call for Data on Steady State Critical Loads with different priorities and experiences.

In the light of the ongoing workplan and the upcoming Gothenburg Protocol (GP) review, NFC were encouraged to continue their work on SMB and Steady State CL and to request support from CCE to implement steady-state CL if needed.

- **Based on the national contributions and on the gap filling of CCE with the future BDB, in 2021 ICP Modelling & Mapping will propose CL data to be used in Integrated Assessment Modelling (IAM) work to support the review of the GP.**

Besides the CfD ongoing process, work on supplemental data on denitrification and weathering rates was presented during the annual 2020 TF meeting to support possible future advancements of CL calculation (see presentation(s) in Chapter 4 – Meeting proceedings & notes). During the meeting, it was pointed out that these activities are to be characterized as ongoing contribution to the review of methods and guidance. In fact, they are independent of the workplan needs and timelines to support the review of the Gothenburg protocol.

Current status of the work on Empirical CL

The Call for Data (CfD) and contribution on empirical CL was launched by the CCE and the chair of TF in November 2019, together with the one for steady-state CL. NFC were asked to contribute with two deliverables for the empirical CL topic in spring 2020 and in spring 2021.

Following the CfD, 6 countries submitted empirical CL related information in their written reports to the CCE.

During the annual 2020 TF meeting, 4 National Focal Centers (NFCs) presented preliminary contribution to the Call for Data on empirical CL with different focus points and experiences.

CCE presented a draft roadmap which has also been sent out to NFC by CCE and the Chair of the TF on 5th March 2020. In the light of the ongoing workplan and the upcoming GP review, NFCs were encouraged to continue their work on empirical CL.

- **A virtual Kick-Off meeting to design the process and discuss the open technical questions in June 2020 will be organized by CCE. Details regarding the meeting and the meeting agenda will be coordinated with and sent to the ICP M&M and the WGE-community in May.**

During the annual 2020 TF meeting, the discussions also highlighted general unsolved questions:

- if and how can gradient studies be included into the review process
- if and how to improve knowledge about marine habitats
- the definition of the protecting targets of the empirical CL might need clarification (cf. also CL for biodiversity)

Current status of the work on development of CL for biodiversity and dynamic modelling

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 Centre for Dynamic Modelling (CDM), the new centre under ICP M&M, which is operational from 1 January 2020.

Besides that, biodiversity indicators may be developed regardless of the aim of CL calculation. In this sense, the "positive indicator species per habitat" is identified as promising concept. HSI is also an operational tool even if there are remaining challenges and other parameters (light, P, acidification) might need to be added to it. In the meantime, other tools such as e.g. PROPS model are under development at several places. Links may also be done between CL for biodiversity and empirical CL for eutrophication with tools such as TITAN.

Any other items of interest for CL calculation – ongoing discussions

During the annual 2020 TF meeting, **publication of BDB** as open-source code was encouraged. CCE will be considering the possibility to give the best possible access to data results and the corresponding documentation.

Any information regarding the ICP M&M BDB, the CfD and associated data and models can be reached at the following address: *https://www.umweltbundesamt.de/en/cce-data-models*.

CCE also presented upcoming activities on **updating the common CLRTAP receptor map.** CCE looks forward to further recommendations of ICP M&M community to define activities in detail as this item will be discussed during the next Joint EMEP SB/WGE meeting in September 2020.

Chapter 3 – Future revision of the LTS of the effects-oriented activities: Food for thoughts on activities specific to M&M

The WGE is asked to review the 2010 – 2020 long-term scientific strategy of the effects-oriented activities[1] jointly with EMEP and accordingly with the 2018 version of the LTS for the Convention LRTAP[2].

Therefore, the ICP M&M chair of the programme Task Force, CCE and CDM have taken the opportunity of the 2020 Annual Meeting of the ICP M&M to ask the participants to discuss the current version of the LTS of the effect-oriented activities and highlight future challenges.

Views and thoughts were gathered in a discussion launched on the basis of questions transmitted beforehand and which are the following:

1. What are the main scientific Tasks for ICP M&M in the next 10 years and beyond?
2. What are our main realistic objectives (continuation and changes)?
3. What are our most successful methods and tools?
4. Important (new?) partners for cooperation and in WGE, in the CLRTAP and beyond?
5. How do we communicate our results, challenges and policy-relevant information?

Main scientific challenges for the future that were raised were to continuously improve the modelling and calculation of CL for eutrophication and acidification.

As ammonia is taking increasingly the role of being the dominant precursor of eutrophication and acidification it was recommended to improve assessment of ammonia effects via (i) the application of critical levels of NH3, (ii) the better linking of air quality and biodiversity monitoring.

Also, it was stated, that non-forest ecosystems, habitat to a large part of sensitive species, should receive a more prominent role in future monitoring and modelling activities. From the point of view of air pollution impact on biodiversity, the non-forested ecosystems might be more sensitive parts of the landscape than e.g. productive forests.

Last but not least it was addressed that heavy metals (HM) are still a relevant issue for ecosystem health and that future assessments might again include Critical Loads for HM.

As regards **methods and tools**, some of the main issues raised were:

- the need to link biogeochemical changes to species changes which is recalled as an important issue to progress on, possibly with tools such as Target Loads;
- the need to include all habitat types into CL for biodiversity, with a better harmonisation between countries; or/and on the European scale.

Communication was raised as an important line to work on. This communication may be top-down communication and bottom-up one.

In this sense, one approach is to seek a communication **building on ICP M&M experts capacity**, via **training sessions**. Another approach is to seek a communication **leaned towards policy**, within the Convention framework, but also exchanging with EU authorities on the National Emission Ceiling Directive (NECD), the Natura2000 Directive and the European Environment Agency (EEA). These latter frameworks have to be tackled especially for most emerging issues such as biodiversity and climate change. On the policy side, linkages to the NECD have to be envisaged as a virtuous cycle, with outputs from ICP M&M further communicated to EU, but also an offer to play an active role within the NECD monitoring indicators definition. Further exchange with the Natura2000 community and the biogeographical process was recognized as mutual interest and beneficial for further developments of models and indicators.

[1] https://www.unece.org/fileadmin/DAM/env/documents/2013/air/wge/Informal_document_no_18_Revised_Long-term_Strategy_of_the_effects-oriented_activities_clean_text.pdf
[2] http://www.unece.org/fileadmin/DAM/env/documents/2018/Air/EB/correct_numbering_Decision_2018_5.pdf

Chapter 4 – Meeting proceedings & notes

Session 1 – Welcome and opening session – Chair: Alice James Casas

Within this session, 2 presentations were given:

- *"Update on WGE and Convention issues" – by Isaura Rabago Juan-Aracil (Chair of the WGE)*
- *"ICP Modelling and Mapping, New organisation of the ICP and its designated centres" – by Alice James Casas (Chair of the ICP M&M)*

The abstracts of these are available in the present document here below and the presentations themselves are made available on the CCE website, providing consent for such dissemination has been given to CCE by their authors:

https://www.umweltbundesamt.de/en/Coordination_Centre_for_Effects.

Welcome to the ICP M&M Web Conference

Alice James Casas welcomed the participants and introduced the meeting with a few words on how coronavirus crisis and the exceptional worldwide situation leaded the organisation team to cancel the in-person meeting which was expected to be hosted by the Swedish EPA in Stockholm (Sweden) and how it was finally decided to maintain it as a web conference, and consequently a condensed agenda.

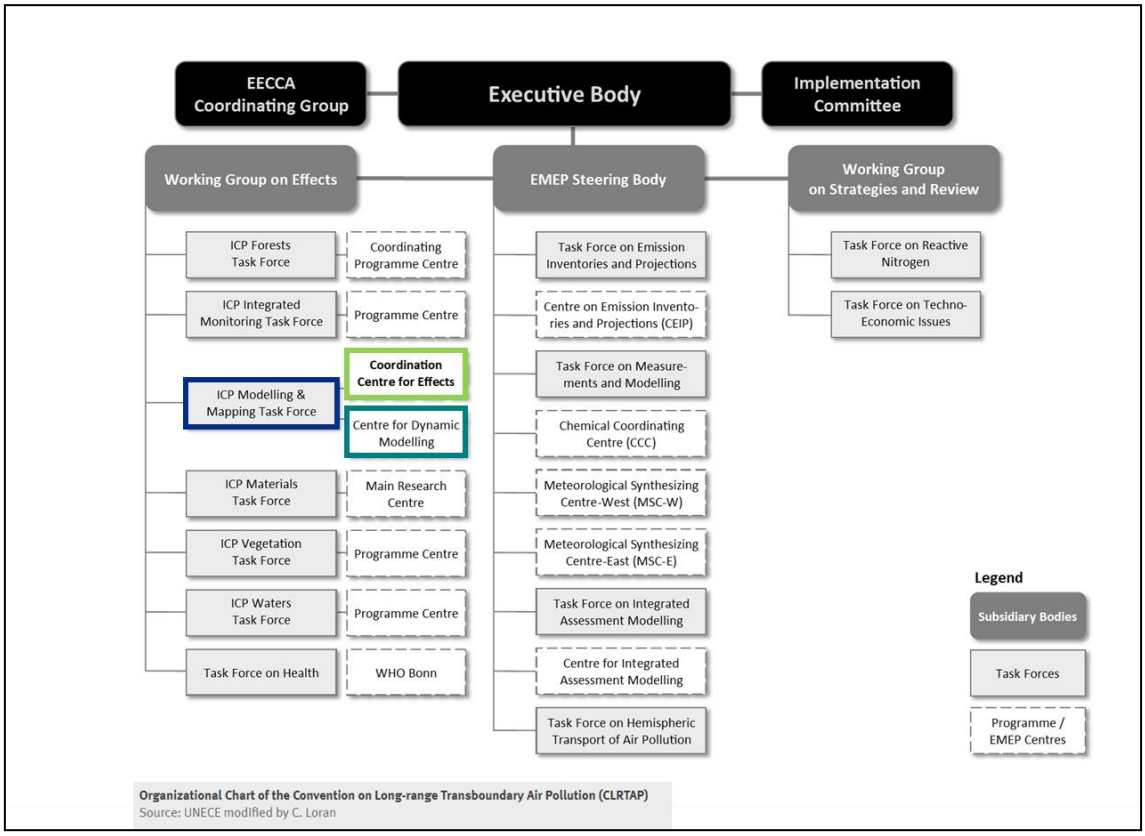
Update on WGE and Convention issues

Isaura Rabago 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, and topics addressed herein, including the GP review (EB Decision 2019/4), the need for revision of the effects-oriented activities scientific strategy, the follow-up of the WGE workplan 2020-2021 and the mandates revision. She also presented how the EB endorsed the transformation of JEG DM into an international designated centre under ICP M&M (EB Decision 2019/22 amending Decision 2002/1) and how the Extended Bureau meeting held in March 2020 welcomed the proposal of the CCE to work on the possible update of the updating the common CLRTAP receptor map. Isaura Rabago Juan-Aracil also explained the further plan and schedule for the update of the scientific strategy for EMEP and effects-related activities, coordinated by the chairs of EMEP and WGE with the participation of the Bureaux and TF/ICP. The schedule is reported in the table here below and a specific agenda item was dedicated to this issue in session 4 of the annual meeting.

Agenda (tbc) for the update of the scientific strategy for EMEP and effects-related activities Further development of Effects-oriented activities. Draft Long-Term Strategy. ECE/EB.AIR/WG.1/2009/14 Revised Strategy for EMEP for 2010–2019. ECE/EB.AIR/2009/16		
Mid May	Document structure / Key messages	Chairs Bureaux
Mid June	First draft (contribution from TF/ICPs)	Chairs Extended Bureaux
Mid July	Final draft	Chairs Extended Bureaux
End July/August	Submission to the Secretariat	

Update on the current status of ICP M&M and CCE and new CDM

Alice James Casas, chair of the Programme Task Force, introduced the recent change in ICP M&M team with the creation of the new designated centre, Centre for Dynamic Modelling, which is being operated by the Swedish Environmental Research Institute (IVL, Sweden) since 1 January 2020. This new organisation is presented in the figure here below.



Organizational Chart of the Convention on Long-range Transboundary Air Pollution (CLRTAP)
Source: UNECE modified by C. Loran

She also recalls that the mandate for ICP M&M has been revised considering this new organisation and presents the distribution of tasks described in the document adopted by the EB in December 2019 (EB Decision 2019/20).

Presentation of the new Centre: Centre for Dynamic Modelling

Filip Moldan presented the new designated Centre of the ICP M&M: the Centre for Dynamic Modelling starting with a brief look back on the development of the Joint Expert Group on Dynamic Modelling (JEG DM) and the subsequent formation of the new centre. Filip Moldan then proceeded to outline the key functions of CDM which are to develop and promote dynamic modelling generally and modelling of air pollution impact on biodiversity specifically. Furthermore, the CDM will develop a common web access point to all groups within WGE and connect with DM groups both within and outside the Convention. The presentation then outlined the immediate work plan for 2020 for setting up the new centre, and the activities and deliverables for 2020 and 2021. The deliverables consist of 2 reports; one will be a review on the dynamic modelling work under the convention (2020) and the other will be regarding indicators of damage to biodiversity (2021). Filip Moldan then described how the CDM will operate and the presentation ended with a few words and examples on the usefulness of dynamic modelling.

Session 2 – Main ICP M&M sessions

Session 2.1. General progress on CCE work – Chair: Markus Geupel (CCE)

Within this session, 2 presentations were given:

- *"General progress on CCE work" – by CCE (Christin Loran, Thomas Scheuschner and Markus Geupel)*
- *"Critical loads for eutrophication and acidification for European terrestrial ecosystems; A project to supply the CCE with a flexible and well documented background data base for critical loads" – by Gert Jan Reinds, Max Posch, Jaap Slootweg*

The abstracts of these are available in the present document here below and the presentations themselves are made available on the CCE website, providing consent for such dissemination has been given to CCE by their authors:

https://www.umweltbundesamt.de/en/Coordination_Centre_for_Effects.

Presentations and directly associated discussions

Christin Loran presented the **state of play of CCE's recent work**. She first mentioned the numerous meetings CCE took part in since 2019 annual meeting in Madrid, some of which are very important for CCE work on critical load calculation themselves and related database management (e.g. meeting promoting collaboration for critical load calculations themselves with EMEP groups and other WGE ICPs, expert meeting to prepare the review and revision of empirical CL) and participation to other meetings representing ICP M&M work in other bodies of the convention (e.g. Extended Bureaux meeting). She then presented the initiative CCE took in 2019 to publish a newsletter on their work, which the first edition published by CCE in July 2019. This was taken over since January 2020 by the chairwoman of the ICP M&M as the group was from there on associated to 2 designated centres. As this regard, all NFCs were encouraged to send any inputs of interest in the scope of Modelling and Mapping activities or for Modelling and Mapping community. Christin Loran then presented the latest technical progress including the fact that CL percentile data will be available via Web Map Service (WMS) soon.

Finally, she introduced briefly the CCE projects as summarised in the following list:

(i) achieved in 2019:
   a. external support for the internal framework for the calculation of CL with *R* statistic program (contractor Braincourt GmbH),
   b. empirical CL literature review (contractor Thuenen Institute),

(ii) currently ongoing in 2020 and 2021:
   a. steady-state CL background database improvement (contractor Wageningen Environmental Research)
   b. review and revision of empirical CL

(iii) to be launched by 2021:
   a. update of the harmonized CLRTAP receptor map which is ageing more than 13 years and does not consider updated land use and land cover changes since 2007

Gert Jan Reinds (Wageningen Environmental Research, contracted by CCE) presented the achievements made until now for the update of the background database (BDB) in a presentation entitled **"Critical loads for eutrophication and acidification for European terrestrial ecosystems; A project to supply the CCE with a flexible and well documented background data base for critical loads**". Gert Jan firstly presented the aims of the project which are (i) to construct a database and software in R to compute critical loads for eutrophication (by Nitrogen) and acidification (by Nitrogen and Sulphur) for terrestrial ecosystems in Europe, (ii) to precisely and extensively report the background data used (maps, tables), the computational rules implemented to derive some of the data (e.g. transfer functions between soil type and soil characteristics) and of the procedures that compute the critical loads and (iii) to validate this database and its results as far as

possible. The 4 corresponding work packages (WP) were also presented and the current state of play of the work was indicated. At this stage, compilation of data (geographical data and all input parameters needed for the sake of CL calculations) and their assessment is achieved (WP1) and calculation of steady-state CL for eutrophication and acidification (WP2) is on the way. Validation (WP3) and reporting (WP4) were presented as the next steps for the future months. The project's end is foreseen for February 2021.

While the contributor announced the project to **compare results with modelled critical loads** from two countries (e.g. CH and NL) that use either a different critical load model or different criteria, the wish was indicated by other parties (e.g. SE) to collaborate on this part.

During the discussion, **publication of the BDB** as documentation and as open-source code was encouraged.

Markus Geupel concluded that the collaboration with the contractor was much appreciated, especially the fact that this enabled communication with active members of the former CCE, which is of valuable importance, and that CCE was looking forward to the next steps and results.

Session 2.2. Status of Steady-State Modelling – Chair: Markus Geupel (CCE)

Within this session, 9 presentations have been given:

- *"Status of Steady-State Modelling: CCE introduction & Status of the Call for Data" – by CCE (Christin Loran, Thomas Scheuschner and Markus Geupel)*
- *"Information on the status of steady-state CL in Norway" – by Kari Austnes*
- *"Simple Mass Balance (SMB) Critical Loads – UK status and application" – by Kasia Sawicka & Ed Rowe*
- *"Status report CL SMB (Flanders)" – by Johan Neirynck*
- *"Adapting national scale critical loads for lichens, trees, and herbaceous plants to local management of federal lands" by Michael Bell, Christopher Clark, Linda Pardo, Linda Geiser, Jason Lynch, Emmi Felker-Quinn, Jennifer Phelan, and Jeffrey Herrick*
- *"Status of Steady-State Modelling: Discuss single parameters of the equations" – by CCE (Thomas Scheuschner)*
- *"Denitrification as a part of the calculation of critical loads" – by Cornelius Oertel*
- *"Weathering rates of German soils with PROFILE" – by Juliane Hoehle*
- *"What's new in the Forsafe 2.0 model?" – by Harald Ulrik Sverdrup, Salim Belyazid, Cecilia Akselsson, Martin Erlandsson Lampa, Giuliana Zanchi, Lin Yu, and Dani Kurz*

The abstracts of these are available in the present document here below and the presentations themselves are made 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

Christin Loran presented the **state of play of ICP M&M work as regards steady-state modelling and the corresponding Call for Data**. She recalled the timeline and objectives of the Call for Data launched in November 2019 and for which a first steady-state status report was expected from NFCs in April 2020. This first report objective is to prepare the modelling task, inter alia by identifying the aspects of the model which require improvement. To this aim, it should contain a critical assessment of the tentative methods and challenges of the national modelling of the steady-state CLs. Up to date, a total of 9 answers on the CfD were received by CCE including 6 reports. Belgium (Flanders), Canada, Ireland, Norway, Switzerland and the United Kingdom (UK) did provide a steady-state report. Christin Loran then recalled the objective for the second deliverable is to provide with most recent national steady-state CL which have a medium-term validity (ca. 5 years) and with that are deemed policy relevant in the light of the GP review.

Three presentations were then performed by NFCs representing Norway (Kari Austnes), the United Kingdom (Kasia Sawicka & Ed Rowe) and Belgium (Flanders, Johan Neirynck) to inform on the status of steady-state CL in their country.

Kari Austnes recalled why **Norway** always mainly focused and is still focusing on **CL for acidification of surface waters**, because surface waters are shown to be the most sensitive ecosystems in this country and that SMB CL ever failed to be exceeded for forests soils. She briefly explained models used for calculating these CL and associated chosen grid scales. She mentioned the carrying out in 2019 of a survey of 1000 statistically selected lakes across the country which would be the starting point for the revision of national CL. Finally, Kari presented the questions currently addressed within Norwegian 2020 project to update these CL, such as the models used, the possible changes to be considered in this area and consequences of the choices made thereof. Other technical questions were raised such as the need to update some data (e.g., N uptake) and extrapolation from lakes to the entire country, but also some more upstream and strategical questions such as the cost and benefit of some this CL update.

Kasia Sawicka presented an **update on the status of SMB approaches for calculating CL in the UK**. In the UK, the SMB equation is parameterised using different chemical criteria for managed and unmanaged woodlands on mineral or organo-mineral soils, and woodlands on peat soils and to derive CL for non-woodland habitats on peat soils and freshwaters. For woodland habitats, in its simplest form the SMB CL for acidity can be expressed as acid neutralising capacity (ANC) generated by base cation weathering minus critical leaching of ANC, while for peat soils, the equation used since 2003 to calculate CL for acidification uses the runoff (in meters) and the critical hydrogen ion concentration equivalent to pH 4.4, this equation being applicable to upland and lowland acid peat soils. CL for the lowland arable fen areas are 4.0 keq ha-1 year-1, which represents the top of CL empirical range for soils. For surface waters, UK uses an equation modified from the catchment-based First-Order Acidity Balance model (Henriksen & Posch, 2001). Changes consist in assuming that the terrestrial nitrogen sink including forest uptake is averaged over the whole terrestrial catchment.

In the SMB approach for the nutrient-N the long-term inputs and outputs of nitrogen from the system are calculated, i.e. nitrogen uptake (removal by harvesting of trees), nitrogen immobilisation, denitrification as well as acceptable level of nitrogen leaching. Finally, Kasia Sawicka alerted on the considerable uncertainties associated with the SMB methods application in the UK. The first parameter which should be further configured is N leaching, which is currently consisting in fixed values for acceptable N concentration assumed for managed conifers and managed broadleaved woodland while leaching should be calculated from an equation taking account of precipitation surplus *and* acceptable N concentrations. Denitrification is another issue for refinement with spatiotemporal variability to take account of as well as the difficulty of measuring the denitrification flux to dinitrogen. Besides that, N fixation is not generally considered as part of the SMB for woodlands, while N fixation by alder (*Alnus spp.*) may be significant in some types of wet woodland. Finally, weathering rates for base cations are deemed very uncertain because of lack of development of measurement methods on different soil types and uncertainty regarding soil maps.

Johan Neirynck firstly introduced the vegetation map (EUNIS classes B, E, F, G), soil and meteorological data specific to **Belgium (Flanders)** before presenting the different equations used for calculation of CL for nutrient N and acidity in his country and some results for different habitats (coastal dunes, coniferous forests, deciduous forest, grassland and heathland). He finally presented the percentages of areas with CL exceedances in 2017 in Flanders by habitat types for forest, grassland and heathland (via the use of the Flemish version of an existing RIVM model for deposition mapping). It was noticeable that 97%, 69% and 100% of respectively forest, grassland and heathland areas are submitted to CL exceedance as regards eutrophication. Regarding acidification, CL exceedances are less remarkable for Forest (59%) and Grassland (43%) while they are still high for heathland (83%.)

Across the Atlantic, **US federal agencies** are also using critical loads to manage ecosystems. This is what was indicated by Michael Bell in a presentation entitled "**Adapting national scale critical loads for lichens, trees, and herbaceous plants to local management of federal lands**". He informed that many initial CL were specific to certain localities or ecoregions. Recent CL research has emphasized national- and regional-scale datasets to prepare models of biotic responses to nitrogen and sulfur deposition. National-scale CL now include species- and community-level responses for epiphytic macrolichens and trees, while herbaceous plants have been analyzed regionally. The datasets differ in the response parameters selected but all are widely applicable to forested ecosystems. By synthesizing predictions, managers and regulatory authorities

can use current deposition to identify resources at risk and support decision-making to meet legal responsibilities for natural resource protection. This analysis explores a variety of ways of applying species and community specific responses to federal lands.

These new CL have a higher level of certainty across a broader geographic area allowing for a refined analysis at a local level. Individual tree, herb, and lichen species have unique response curves for growth, survival, or probability of detection that can be related to species lists for a given site or modeled species distribution ranges. When compared to current deposition the range of responses for individual species can be used to direct management and policy action. Lichen and herb community level CL account for climate and other limiting environmental influences, so the responses be mapped on the forest cover in the National Land Cover Database to only apply the critical load to proper ecosystem types. Combining overlapping CL gives decision-makers a range of response levels from which they can make informed decisions based on perceived risk. Through this analysis US federal agencies have identified where additional data collection is needed in order to improve the applicability of CL and where alternate analyses using a reduced range of sites are needed to account for variability in environmental/geographic factors.

During the discussion, Michael Bell had the opportunity to specify that even if most of the results presented herein are originated from national science offices, their role was to connect those who actually work in the federal lands to the information, so they can disseminate it to their local communities. Besides that, it was indicated that the results of this work have an impact on management and policy in the country when both the National Park Service and US Forest Service are using these relationships to assess risk of new pollution sources that are near federal lands. Some reduction in emissions have even been negotiated at a certain stage.

As introduction for the next block Thomas Scheuschner then discussed some aspects of the "**single parameters of the equations**" referring to the steady state mass-balance modelling of CL for terrestrial ecosystems. He started this item by recalling the general objective of this topic and highlighted the fact that the CL should be based on the "present knowledge". He then identified some potential development target for steady-state approach (1. Extension to other ecosystems 2. Inclusion of climatic effects (if possible) 3. Include insights from other ecoregions) and then clarified the current status of the CCE regarding this subject. After a quick recollection of the most relevant parameters of the SMB equation he divided them into two groups, parameters describing ecosystem characteristics and parameters highly related to a chosen Critical Limit. In the end of his talk he linked general research topics to these two groups and proposed potential questions for the group discussion.

In a presentation entitled "**Denitrification as a part of the calculation of critical loads**", Cornelius Oertel introduced how research on quantifying denitrification from forest soils is still needed to improve the calculation of critical loads for N, especially for the parameter denitrification. He compared the calculations methods of CL for nutrient N in Europe and Germany and presented how the German approach includes the clay content as the factor for anhydromorphic soils. The German approach uses the clay content usually available in national soil survey databases and the given values from a mapping manual for hydromorphic soils. To test the German approach, a literature review of around 300 N_2O and 80 N_2 studies was run as well as a laboratory study with mineral soils from German forest sites. The question of this research work was whether the values from the literature and the experiments showed N_2O emissions in correlation with clay content, as stated in the German approach. The laboratory study showed that N_2O emissions from mineral soils under forest are clearly below 1 kg N ha^{-1} a^{-1}. No conclusions were found for clay contents above 35 %, as forest sites with a clay content above 35 % are rare in Germany. However, the literature study could not show any significant differences for the clay content as well. In field studies other parameters like draughts overlay the influence of clay onto N_2O emissions. Hence, the data basis has to be improved for better calculations. The question remains whether different denitrification factors are required for forest mineral soils depending on clay or whether the drainage status is sufficient.

Juliane Hoehle then presented another work focusing on "**Weathering rates of German soils with PROFILE**". She firstly introduced mineral weathering as the ultimate net source of base cations in terrestrial ecosystems, together with deposition, and how accurate estimates of base cation weathering (BCw) are crucial to assess the long-term sustainability and acid sensitivity of an ecosystem. As within the framework of its CLRTAP reporting obligations, Germany used the soil texture approximation (STA) based on data from a large-scale, land use dependent German soil map for the estimation of base cation weathering, it is now needed to lead

an independent calculation using PROFILE - a steady state soil chemistry model – to validate this estimation. The objectives of the project presented were to review weathering rates from literature and to compare the results of PROFILE with the soil texture approximation. As a result, the weathering literature dataset built during the study consists of 683 records with values from three continents published between 1991 and 2019. The database contains the base cation weathering rates as total, as well as data for each base cation, if available. To compare weathering rates from literature directly with the soil texture approximation, the main problem has been the lack of background information (particle size distribution, parent material, mineral composition) in published studies. If possible, the literature values were assigned to substrate classes according CLRTAP, Table V.15 (2017) or if SiO2 content of the soil is available, according to the classification from McNulty et al. (2007). Most of the reviewed weathering rates are associated with weathering class 1 (coarse texture and acid substrate), whilst for weathering classes 3 and 5 weathering rates from literature with sufficient metadata have not yet been found.

To conclude on the steady-state modelling session, Harald Ulrik Sverdrup presented recent updates in the FORSAFE model in a presentation entitled "**What's new in the Forsafe 2.0 model?**". He basically summarised these updates first as (i) a revision of weathering module with expanded kinetics to include more minerals, better performance in deeper soils and groundwater and (ii) inclusion of phosphorus into the ForSAFE-VEG system which involves soil microorganism community and biomass. The work done demonstrated the importance of this inclusion for tree growth as well as ground vegetation composition and how it allows an accurate simulation of soil and runoff nitrogen dynamics. Another update addressed (iii) the mode geometry, when ForSAFE was reconfigured to handle soil profiles and forest stands on flat land, soil profiles on slopes, soil chemistry dynamics on slopes along flow paths, forest growth, catchments and hydrology, water chemistry entering streams from sloping watersheds. (iv) Biodiversity was also addressed in this revision of the model, with vegetation module recreating the plant species distribution over space and time in sites across Sweden, Switzerland, United States of America and France with good accuracy. According to this work, it appeared that effects are likely to be observed on terrestrial environments long before anything is visible in the waters because while models are ready for terrestrial ecosystems, substantial developments are still needed for the aquatic ecosystems. Besides a more accurate biodiversity consideration, (v) climate change was also addressed, including the effects of climate change on carbon cycling, soil chemistry, forest growth and biodiversity, as well as (vi) tree growth and forest production (inclusion in the vegetation module). This latter inclusion allowed accurate simulation of tree growth, forest production and nutrient dynamics (Water balance, cations, nitrogen and phosphorus). Validation was finalised and showed that the model works well for mapping CL for nitrogen and acidity based on biodiversity protection, using regional databases. Biodiversity-based CL have been completed, validated and published for Sweden, Switzerland, United States of America and France, but have not yet been included in the Swedish National CL Reporting to the CCE. Vegetation change simulations field were tested and validated for United States (Rocky Mountains, New England), Sweden, Switzerland and France (Regionally, Research sites). Finally, Harald Sverdrup recalled how policy failures hamper an efficient development of such models via lack of funding for building CL for nitrogen and acidity based on biodiversity due to lack of priority and interest.

General discussions about further work on steady-state CL

In the light of the ongoing workplan, the current call for data and the upcoming GP review NFC were encouraged to continue their work on steady-state CL and to request support from CCE to implement steady-state CL if needed.

Activities and research on updating and/or improving the steady-state CL were characterized as important parallel and continuous processes to keep methods and models up-to-date. Likewise, it was underpinned that updates of CL data for the needs of the Gothenburg Protocol review and the current CfD should focus on existing parameters and equations already documented in the Mapping Manual.

In 2021, based on the results of the CfD, ICP M&M will propose CL data to be used in IAM to support the review of the GP and for how long the validity of the reported CL is going to be defined.

Session 2.3. Review of empirical critical loads for Nitrogen – Chair: Thomas Scheuschner

Within this session, 5 presentations have been given:

- *"Review and Revision of Empirical Critical Loads for Nitrogen: CCE introduction & Status of the Call for Data" – by CCE (Christin Loran, Thomas Scheuschner and Markus Geupel)*
- *"Swiss Contribution to the review of the empirical critical loads for nitrogen" – by Reto Meier*
- *"Review of empirical critical loads for nutrient-N: UK contributions" – by Ed Rowe*
- *"Irish contribution to the review of empirical critical loads for nitrogen" – by Julian Aherne, Kayla Wilkins and Hazel Cathcart*
- *"Canadian contribution to the review of empirical critical loads for nitrogen — setting biodiversity-based empirical critical loads of nutrient nitrogen in boreal Canada using gradient forest analysis" – by Nicole Vandinther and Julian Aherne*

The abstracts of these are available in the present document here below and the presentations themselves are made 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

Christin Loran presented the state of play of ICP M&M work as regards Review and Revision of Empirical Critical Loads for Nitrogen and the corresponding Call for Data. She presented the schedule proposed which was communicated to participants before the meeting (by email on 5th March 2020) to comment and react on. Christin Loran also recalled that the objective of the update of the current 10 years old empirical Critical Loads for Nitrogen is to add new relevant information from studies on the impacts of N on semi-natural ecosystems published since 2009. Although scientific focus of this review and revision remains to be defined, main gaps identified in the current document gathering the empirical CL (Bobbink and Hettelingh, 2011[3]) allow drawing orientations on some items such as the need for more research on some of the habitats (e.g., steppe, Mediterranean vegetation types, swamp forests, mires, fens, coastal habitats), the need for additional effort in allocation of N effects to appropriate EUNIS forest habitat subtypes, the need for some more rigorous guidelines for evaluation of new studies (estimation of deposition, confounding factors, statistics) and the need for studying the assumption of differential effects of oxidized and reduced nitrogen. Christin Loran then presented the most recent achievements, with the results of the preliminary literature review led for CCE by the Thünen Institute. She finally recalled the Call for Data launched in November 2019 and for which first empirical CL short report was expected from NFCs in April 2020. This first report objective is to prepare the review of the process of empirical CLs with identification of experts and resources to contribute. Up to date, 7 reports were received by CCE: Austria, Belgium (Flanders), Canada, Ireland, Norway, Switzerland and the United Kingdom (UK). The second status report expected March 2021, shall contain national findings – originated from experiments or research work – on dose-response relationships which are likely to be included within the review of on empirical CLs and a literature review which should summarize the national, scientific state of the art, available data and a recommendation for revision depending on the results of the assessment. Finally, Christin Loran presented the next steps based on the proposed schedule.

Reto Meier informed about the "**Swiss contribution to the review of the empirical critical loads for nitrogen**". He highlighted three nitrogen addition experiments in (sub)alpine grasslands also exploring interactions with elevated tropospheric ozone and climate change. He addressed gradient studies based on Swiss ecosystem monitoring and recalled related findings about critical load ranges for mountain hay meadows and alpine scrub habitats as well as findings in regard to soil acidification. Further in-depth analyses based on

[3] Bobbink, R., & Hettelingh, J.-P. (2011). Review and revision of empirical critical loads and dose-response relationships: Proceedings of an expert workshop, Noordwijkerhout, 23-25 June 2010. (Report 680359002/2011). Bilthoven, the Netherlands: Coordination Centre for Effects, National Institute for Public Health and the Environment. https://www.rivm.nl/bibliotheek/rapporten/680359002.pdf.

Swiss monitoring data are planned in context of the review. Finally, he informed about the Swiss experts contributing to the review and announced the offer to organize a workshop for the review in Switzerland.

Ed Rowe presented an overview of UK contribution to the review of empirical CL in a presentation entitled "**Review of empirical critical loads for nutrient-N: UK contributions**". He explained that new empirical evidence for relating impacts to N deposition has emerged since 2010, in particular from surveys and analyses of large floristic datasets. According to the work achieved, the review needs to consider whether survey evidence should be included, and aspects such as the weather damage should be defined as the point where the difference from less polluted examples becomes significant, or the point of most rapid change. The UK NFC has assembled a group of 20 scientists willing to participate in the review.

To which extent marine habitats are considered within CL assessments was discussed. Kari Austnes indicated that there are a lot of literature studies on marine systems responses to N, but these may not be specifically linked to N from deposition.

Roland Bobbink raised an issue of what studies will be taken into the consideration in the upcoming review of empirical critical loads. Historically only the N-addition experiments were taken into account. However, results from several important large-scale gradient studies became available and could make a significant contribution to our process understanding along with the experiments.

Julian Aherne presented the "**Irish contribution to the review of empirical critical loads for nitrogen**". In Ireland empirical critical loads have been determined for 16 habitats (Annex 1 classification is used to describe habitats), e.g., an empirical critical load is determined for upland blanket bog and applied uniformly to all locations. Empirical critical loads are habitat-specific rather than site-specific. The determination of the exact empirical critical load from within (or outside) of the published recommended range (Bobbink and Hettelingh, 2011) is based on supporting (statistical) analysis of national plant species (relevé) data. Modifying factors are not applied. Change point analysis and the maximum nitrogen critical load (CLN_{max}) determined from PROPS-CLF are used to refine the recommended range. The spatial distribution of habitats has been mapped using a combination of habitat survey data and landcover data. The Annex 1 Habitat classification is primarily used for empirical critical loads as national plant species abundance (relevé) data are collected to define the spatial coverage of nationally important habitats, i.e., Annex 1 habitats. Empirical critical loads were recently revised and use to support reporting under Article 17 of the Habitats Directive. Where possible Annex 1 habitats are mapped to equivalent EUNIS habitats, e.g., 91A0 = G1.8.

Julian Aherne then presented the "**Canadian contribution to the review of empirical critical loads for nitrogen** by setting biodiversity-based empirical critical loads of nutrient nitrogen in boreal Canada using gradient forest analysis". As it is well established that chronic nitrogen (N) deposition can negatively impact plant-species biodiversity; as such, there is concern that anthropogenic N emissions from the Athabasca Oil Sands Region (AOSR) are impacting surrounding habitats. The objectives of this study were to determine the relative importance of N as a driver of plant species community composition and to identify biodiversity-based empirical thresholds for atmospheric N deposition. Gradient forest analysis was applied to species abundance data (206 species) for 46 Jack pine dominant sites in the Athabasca Oil Sands Region across 35 environmental gradient variables (soil chemistry, climate and deposition). Soil chemical variables accounted for > 26% of the total explainable variation in the dataset, followed by climate (19%) and deposition variables (5%); the joint-effect between variables also explained a significant portion of the total variation ($p < 0.001$; redundancy analysis). Total deposited nitrogen (TDN) and sulphur were identified as important variables in gradient forest analysis. A single, definitive threshold across TDN was identified at approximately 5.6 kg N ha–1yr–1 (while a TDS threshold was found at 14.4 kg S ha–1yr–1). The TDN threshold was associated primarily with change points for several vascular species (*Pyrola asarifolia*, *Pyrola chlorantha*, *Cornus canadensis*, *Arctostaphylos uva-ursi*), in addition to some bryophyte and lichen species (*Pleurozium schreberi*, *Vulpicida pinastri* and *Dicranum polysetum*). The results suggest that the empirical critical load of nutrient N for Jack pine boreal forests surrounding the Athabasca Oil Sands Region is 5.6 kg N/ha/yr.

Discussion about further work on empirical CL

During 2019 ICP M&M annual meeting, a clear wish to launch a review of the empirical CL was expressed by several participants and a review and revision of these were enrolled in the ICP M&M Workplan for years 2020-2021.

Following the presentations, CCE requested the NFCs,

- if there are more NFCs / Experts who would like to contribute to the process, with expertise to contribute to or lead on other work packages
- if there are more NFCs / Experts who would like to contribute to the process, with funding, specifying that the estimated minimum cost of the operation still to be covered is 130.000 €,
- how far the proposed time schedule is feasible
- how should the results be published (Special Issue in a scientific journal)

CCE informed, that 45.000 € have been made available by the CCE in 2019 and that trust funds available for CCE in 2020 and 2021 will be used to support the review process.

While the process for review has now started and that some countries have already contributed to the call for empirical CL data, the discussions during the meeting highlighted the challenge around several general unsolved questions like if and how gradient studies should be included into the review process, if and how "damage" should be the point of significant change, if and how to improve knowledge and inclusion about coastal and marine habitats (only salt marshes included up to now), and finally how the definition of the protecting targets of the empirical CL might need clarification.

In summary of the discussions, to address the unsolved questions mentioned above and specify the roadmap of the process it was indicated that a virtual kick-off meeting was being prepared by CCE in June 2020.

Session 2.4. Critical Loads for Biodiversity and Dynamic Modelling – Chair: Filip Moldan

Within this session, 6 presentations have been given:

- *"Overview of JEG DM achievements until Dec. 2019 & WorkPlan for CDM – by Filip Moldan and Sara Jutterström*
- *"Critical Loads for Biodiversity CCE work ≤ 2017 & view on future (sort of)– by Maximilian Posch*
- *"Progress with metrics and biodiversity-based critical loads" – by Ed Rowe, Simon Smart, Adriana Ford-Thompson and Ulli Dragosits*
- *"Biodiversity Modeling and Critical Loads Assessment in the USA" – by Todd McDonnell, Gert Jan Reinds, Wieger Wamelink, Paul Goedhart, Max Posch, Tim Sullivan and Chris Clark*
- *"Biological effects of Currently legislated decreases in nitrogen deposition in Europe" – by Thomas Dirnböck, with contributions from CLRTAP ICPs and eLTER*
- *"Response of more than 1000 herbaceous species across 20 vegetation alliances to atmospheric deposition of nitrogen in the United States – by Kayla Wilkins and Julian Aherne*

The abstracts of these are available in the present document here below and the presentations themselves are made 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

Filip Moldan presented an "**Overview of JEG DM achievements until Dec. 2019 & Work Plan for CDM**" starting with a look back on the formation of JEG DM in 1999 as an *ad hoc* group directed towards the future development of dynamic modelling and its inclusion under the WGE in 2001. The presentation then focused on the work with developing target loads in the early days of JEG DM and the question why they were never used to form the policy and what lessons could be learned for future work. Speculatively, this could be attributed to factors such as resistance to new concepts or too complicated calculations, but more likely there was not enough of follow up to explain and demonstrate the benefits of the concept outside the scientific community. Filip Moldan then discussed different useful aspects of dynamic modelling: to calculate and visualize possible future development under different scenarios, integrate, interpret and package theoretical knowledge with results from experiments and monitoring. JEG DM was an important forum for scientists to interact and to co-ordinate efforts and many issues were discussed and reported to the WGE. However, it had no mandate and no resources, in contrast the newly formed CDM have both. The key elements of the mandate are to develop and promote dynamic modelling, develop common web access point to all groups within WGE and to connect with DM groups both within and outside the Convention. The presentation ended with some thoughts on how to utilize dynamic modelling in the work of LRTAP.

Maximilian Posch gave an overview of the work done until the end of 2017 by the ICP M&M on biodiversity modelling, especially on CL, in a presentation entitled "**Critical Loads for Biodiversity CCE work ≤ 2017 & view on future**". This work had ended with a European biodiversity CL (CLbio) database. However, the NFCs who submitted CLbio (7 Parties) did not feel enough confidence in the calculations to be used for policy purposes. Therefore, WGE had decided that those CLs were not (yet) to be used in IAM. Finally, points for potential further work on biodiversity indicators were summarised, including a continuation linking biodiversity indicators to CLs, but also, e.g. dose-response modelling.

Ed Rowe presented some "**Progress with metrics and biodiversity-based critical loads**". Simple metrics and targets are often preferred, e.g. the target in the 2019 Clean Air Strategy for England is expressed in terms of N deposition, not critical load exceedance. However, dynamic modelling of species responses can account for damage and recovery delays, and produce metrics more closely related to biodiversity targets. Models and metrics developed in recent years have great potential for summarising and communicating the science of pollution impacts.

Todd McDonnell gave an overview of the "**Biodiversity Modeling and Critical Loads Assessment in the USA**". Vegetation response functions (expressed as version 2 of the Probability of Occurrence of Plant Species model for the United States [US-PROPS v2]) were developed based on observations of forest understory and grassland plant species presence/absence and associated abiotic characteristics derived from spatial datasets. Improvements to the US-PROPS model, relative to version 1, were mostly focused on inclusion of additional input data, development of custom species-level input datasets, and implementation of methods to address uncertainty. The application of US-PROPS v2 were investigated to evaluate the potential impacts of atmospheric nitrogen (N) and sulfur (S) deposition, and climate change on forest ecosystems at three forested sites located in New Hampshire, Virginia, and Tennessee in the eastern United States. Species-level N and S critical loads (CLs) were determined under ambient deposition at all three modeled sites. CL exceedance was found at all three model sites. The New Hampshire site included the largest percentage of species in exceedance. Simulated warming air temperature typically resulted in lower maximum occurrence probability, which contributed to lower CLs of N and S deposition. According to the authors of this work, the US-PROPS v2 model, together with the PROPS-CLF model to derive CL functions, can be used to develop site-specific CLs for plants within broad regions of the United States.

Thomas Dirnböck presented "**Biological effects of Currently legislated decreases in nitrogen deposition in Europe**" Presented results are based on the work of ICP IM, ICP Forests and the H2020 project eLTER. Based on CLE and B10 emissions scenario modelled with the EMEP model and climate scenarios RCP4.5 and RCP8.5, the used model chain (including VSD+ and PROPS) predicted further decrease in oligotrophic species attributable to still high N deposition between now and year 2030. The presentation acknowledged the leading role of PROPS database. The importance of factors other than air pollution (such as changes in light conditions for the forest understory vegetation due to management practices) was highlighted. Further work on development of biodiversity change indicators was recommended. Using positive indicators such as low-N species was identified as a very promising approach.

Kayla Wilkins informed on a tremendous piece of work on “Response of more than 1000 herbaceous species across 20 vegetation alliances to atmospheric deposition of nitrogen in the United States”. She introduced the topic stating that as atmospheric N deposition is recognized as a key driver of biodiversity loss leading to shifts in species composition, often to undesirable species, through eutrophication, acidification, and reduced pest resistance, adding that while N deposition has decreased in the United States (U.S.) since the enactment of air quality policies in the 1990s, reduced forms of N have increased in many regions, and atmospheric N deposition still remains elevated at levels that may negatively impact sensitive plant species. The authors applied Threshold Indicator Taxon Analysis (TITAN) to plant species abundance data for more than 1000 species occurring within 20 vegetation alliances across the U.S. to identify N deposition thresholds at which those species significantly changed in abundance. Further, TITAN was used to assess synchrony in the individual species change points to determine a community level N deposition change point for each vegetation alliance. The community level change points ranged from 1.8 kg N ha−1 yr−1 (*Artemisia tridentata* shrubland alliance) to 14.3 kg N ha−1 yr−1 (*Fagus grandifolia - Quercus rubra - Quercus alba* forest alliance), based on species that demonstrated a decrease in abundance across the N deposition gradient. At the species level, a wide range of change points for species was found decreasing in abundance, from 1.3 kg N ha−1 yr−1 (*Sisymbrium altissimum*) to 16.8 kg N ha−1 yr−1 (*Euonymus americanus*). In general, for species that occurred in multiple vegetation alliances there was little variation in their change points across the alliances (mean = 1.92 kg N ha−1 yr−1, median = 1.3 kg N ha−1 yr−1). Kayla Wilkins concluded stating that this approach offers a powerful way to examine a large number of species across different habitats, thus expanding our understanding of the impacts of N deposition in the U.S., and could contribute to air quality policies in the U.S.

Session 3. Cooperation with other groups – Chair: Alice James Casas

Within this session, 5 presentations have been given:

- *“CIAM Activities” – by Maximilian Posch*
- *“ICP Waters status” – by Kari Austnes*
- *“Achievements of the ICP Vegetation in 2019 and future work plan” – by Felicity Hayes, Harry Harmens, Katrina Sharps and Amanda Holder*
- *“Update on ICP Forests activities” – by Anne-Katrin Prescher*
- *“Current activities at ICP Integrated Monitoring” – by Ulf Grandin, Salar Valinia, Martin Forsius, presented by Maria Holmberg*

The abstracts of these are available in the present document here below and the presentations themselves are made 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

Maximilian Posch detailed **Centre for Integrated Assessment Modelling’s (CIAM) most recent activities** amongst which a main one is the preparation of the review of GP (pending formal approval of EB end 2020), which consists inter alia in collating the best available background material on cost-effective emission control strategies (e.g., managing databases of updated CLs, emissions). Other recent activities of CIAM have consisted in finishing the global study on long-term outlook of emissions. This was submitted to WHO and may further help setting (new) targets for potential GP update too. In the sense of moving forward with further developments of new indicators, CIAM addressed his interest to get WGE approved biodiversity indicator (e.g., biodiversity CLs). Finally, Maximilian Posch informed the audience about an imminent meeting between CCE and CIAM (planned around end of June).

Isaura Rabago Juan-Aracil took the opportunity of this presentation focusing on the potential review of the GP to announce that there would be a **special session for groups to the review of the GP during the next Joint EMEP SB/WGE meeting in September 2020**.

Kari Austnes presented the "**ICP Waters status**". Besides information on regular meetings and website, she presented technical work foreseen and achieved with the new reports published. Some of them are "regular annual reports" (Task Force Meeting proceedings, Report on chemical intercomparison, Report on biological intercalibration). Another noticeable report published early 2020 is the "Trends and patterns in surface water chemistry in Europe and North America between 1990 and 2016, with particular focus on changes in land use as a confounding factor for recovery". Kari Austnes presented the main findings and conclusions of this report. The study, led on 500 sites in Europe and North America with water chemical records from 1990 to 2016 shows decline in sulphate at most sites (by 40-60%), nitrate mainly declining, but by less, and with fewer significant trends, chloride also declining many places, base cations declining, but still increasing ANC, increasing total organic carbon (TOC), partially replacing mineral acidity, so limiting the pH increase. As regards the comparison between Europe and North America, contrasts can be observed, with improvements levelling off in Europe and accelerating in North America for sulphate, chloride and acidity, when comparing the 2000s with the 1990s. According to authors, these observations can be linked to different timing of abatement policies and economic recession. On top of this, acidic episodes have become less severe in line with the recovery of average chemistry. Finally, it is shown that land use and land cover change can affect recovery. Besides this important piece of work, Kari Austnes announced the upcoming of another work scheduled for 2020 that is the ICP Waters report on nitrogen. Basic questions to be addressed under this workplan item are (i) the reasons for which nitrate is declining to a lesser extent (and in particular, if there are regional differences or differences related to catchment properties), (ii) consequence of organic carbon increase on organic nitrogen and (iii) consequence of studying the water chemistry trends on understanding the process of nitrogen saturation.

Next cooperation opportunity with ICP Waters is 36th ICP Waters Task Force Meeting (online) on 11 – 12 May 2020.

Harry Harmens presented "**Achievements of the ICP Vegetation in 2019 and future work plan**", firstly announcing that ICP Waters has had a change in leadership, with Harry Harmens retirement, Felicity Hayes as the new chair of the Task Force, Katrina Sharps as the new head of the Programme Centre and Amanda Holder as a research associate among 2 positions foreseen to be allocated. Presentation of main achievements comprises interactive impacts between ozone and nitrogen (main findings on crops, semi-natural vegetation and Mediterranean vegetation), risk of ozone impacts on wheat (prediction 2030), update of the modelling and mapping manual chapter 3 (with e.g., reviewing and re-introducing parameterisations related to leaf area index for upscaling to canopy level and large scale modelling, parameterisation for (semi-) natural vegetation in the EMEP model for calculating POD_1IAM and development of new chapters for Scientific Background Document B). Harry Harmens also presented the main results of the moss survey led on 2015-2016, main ones being the North-West to South-East gradient in Europe and the high concentrations in (south-)east due to anthropogenic sources and high wind-resuspension (mineral soils). He then announced the next survey to be held 2020-2022 for heavy metals, nitrogen and persistent organic pollutants (POPs). Finally, current workplan 2020-2021 was recalled with activities including contribution to revision of empirical critical loads for nitrogen in collaboration with the CCE and the ICP M&M.

ICP Vegetation held its 33rd Task Force Meeting (Riga, Latvia) on 27 – 30 January 2020.

Next cooperation opportunities with ICP Vegetation are (i) Air pollution & plants conference (Paphos, Cyprus on 7 – 11 September 2020 and (ii) 34th ICP Vegetation Task Force Meeting (Kaunus district, Lithuania) on (provisional dates) 22 – 25 February 2021.

Anne-Katrin Prescher from PCC of ICP Forests presented an "**Update on ICP Forests activities**" with firstly an overview of meetings of importance held since spring 2019 with e.g., 8th Scientific Conference of ICP Forests, XXV IUFRO World Congress 2019, EANET-ICP Forests Workshop on regional impact assessment of atmospheric deposition and air pollution on forest ecosystems and the expert meeting on the review and revision of empirical Critical Loads. Main publications and outputs were also introduced with *inter alia* the upcoming "Technical Report 2020" and the revision of the "Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests" (Revision of 14 out of 18 Manual Parts). Anne-Katrin Prescher finally presented highlights from the Technical Report 2019 including results regarding nitrate, ammonium, sulphate, calcium, potassium and magnesium depositions (updated as of 2017) and damages on tree crown condition (as of 2018). On this latter item, mean defoliation was observed and damage cause assessments led to the conclusions that insect and drought were the two main causes of damage. Finally, Anne-Katrin Prescher recalled that ICP Forests supports ICP Modelling & Mapping to review

and revise the empirical critical loads by supporting allocation of N effects to appropriate EUNIS forest habitat subtypes. PCC will further encourage ICP Forests members to join the review, especially, asking the Expert Panel on Biodiversity and Ground Vegetation for participation.

Next cooperation opportunities with ICP Forests are (i) 36th ICP Forests Task Force Meeting (online) on 11 – 12 June 2020 and (ii) the 9th Scientific Conference "Forest Monitoring to assess Forest Functioning under Air Pollution and Climate Change" (Zurich), 7 – 9 June 2021.

Maria Holmberg presented "**Current activities at ICP Integrated Monitoring**". The current ICP IM network involves 15 active countries, with 49 active sites. New interest from Canada has been noted. Four scientific papers have been published in priority topics, the most recent one being a paper on disturbances and resilience at a long-term boreal forest monitoring site by Weldon and Grandin (https://doi.org/10.1002/ece3.5061). Currently, there is on-going work to prepare manuscripts on i) the impacts of internal catchment-related nitrogen parameters to TIN leaching; ii) heavy metals trends in concentrations and fluxes across ICP IM sites in Europe; iii) the effects of N enrichment on forest vegetation. Work plan items for 2020-2022 include papers and reports on i) the recovery in the epiphytic lichen community after the decrease in S deposition; ii) on state and effects of mercury and heavy metals at the IM sites iii) the relationship between critical load exceedances and empirical ecosystem impact indicators. The workplan also mentions initial plans for cooperation with CDM on biodiversity and critical loads and plans to expand the IM network to more countries.

Next cooperation opportunity with ICP Integrated Monitoring is 28th ICP IM Task Force Meeting (online) on 13 – 14 May 2020.

Session 4. Wrap-up session and Scientific Strategy – Chair: Alice James Casas, Markus Geupel (CCE) and Filip Moldan (CDM)

Within this session, 5 presentations have been given:

- *"Wrap-up of Session 2" – by Markus Geupel, Thomas Scheuschner and Filip Moldan*
- *"Introduction to the WGE Scientific Strategy update with respect to the Long-Term Strategy (LTS) for the Convention – ICP M&M topics" – by Alice James Casas, Markus Geupel and Filip Moldan*
- *"Some challenges for the coming decade with respect to N deposition" – by Roland Bobbink*
- *"Future of effects-oriented work" – by Reto Meier*
- *"ICP M&M – Workplan 2020-2021" – by Alice James Casas, Markus Geupel and Filip Moldan*

Wrap-up of main session

Markus Geupel, Thomas Scheuschner and Filip Moldan presented a brief wrap-up of the main ICP M&M scientific session (session 2) which main items can be summarised as follows:

Database management and Steady-state modelling

- CCE presented upcoming activities on updating the common CLRTAP receptor map and looks forward to further recommendations of ICP M&M community to define activities further in detail, and to launch a call for tender in 2021.
- CCE continues the work on background database with Wageningen Research and members of the former CCE. As regards this work, publication of documentation and as open-source code was encouraged
- National status reports: 4 National Focal Centers presented preliminary contribution to the Call for Data on SMB and steady-state CL with different focus points and experiences (6 countries submitted reports)
- In the light of the ongoing workplan and the upcoming GP review NFC were encouraged
    - to continue their work on SMB and Steady State Critical Loads
    - to request support from CCE to implement simple Steady-state balance Critical Loads if needed

- Ongoing work on supplement data on denitrification and weathering rates was presented to support possible future advancements of CL calculation; it was pointed out that these activities are
    - to be characterized as ongoing contribution to the review of methods and guidance
    - independent of workplan needs, timelines to support the review of the GP
- Based on the national contributions to the CfD and on the gap filling of CCE with the future Background database, in 2021 ICP Modelling & Mapping will
    - discuss duration of validity of CL data
    - propose CL data to be used in IAM to support the review of the GP

Review and revision of empirical critical loads for nitrogen

- CCE presented the recent activities regarding the update of empirical CL and the response to the CfD
- CCE presented a potential road map for this process including a broad, preliminary time frame and single work packages
- 4 National Focal Centres presented the progress regarding empirical CL in their countries (7 NFC submitted information in their written reports to the CCE)
- The discussion highlighted several general unsolved questions:
    - if and how can gradient studies be included into the review process
    - if and how to improve knowledge about marine habitats
    - the definition of the protecting targets of the emp CL might need clarification
- Following the discussions, a virtual Kick-Off meeting to design the process and discuss the open technical questions in June 2020 will be organized by CCE (online)

Critical Loads for Biodiversity and Dynamic Modelling

- CDM is operational from January 2020, with a broader mandate compared to JEG DM (science, webpage & outreach). Science needs to keep in mind the policy perspective.
- Modelling biodiversity: past achievements & current status and future challenges
- Biodiversity indicators need to be linked to work of TFIAM. CL is not the only potential way of making this connection, indicators could be used in more ways
- “Positive indicator species per habitat” identified as promising concept
- Further work with PROPS[4] was presented, development is ongoing at several places.
- HSI[5] is operational even if there are remaining challenges and other parameters (light, P, acidification) might need to be added. DM can and must handle
- TITAN[6] analysis presented, connects to both CLempN and DM Bio.

Update of the scientific strategy of the effects-oriented activities

Alice James Casas introduced the WGE Scientific Strategy update with respect to the Long-Term Strategy (LTS) for the Convention and ICP M&M linked topics.

[4] PROPS : Probability of Occurrence of Plant Species

[5] HSI: Habitat Suitability Index

[6] TITAN: Threshold Indicator Taxa Analysis

While the WGE was asked to review the 2010 – 2020 long-term scientific strategy of the effects-oriented activities[7] jointly with EMEP and accordingly with the 2018 version of the LTS for the Convention LRTAP[8], ICP M&M chair of the programme Task Force, CCE and CDM have asked the participants to prepare for a discussion on the current version of the LTS of the effect-oriented activities (see link (1) below) which is about to be updated. To this aim, some questions had been transmitted beforehand:

1. What are the main scientific Tasks for ICP M&M in the next 10 years and beyond?
2. What are our main realistic objectives (continuation and changes)?
3. What are our most successful methods and tools?
4. Important (new?) partners for cooperation and in WGE, in the CLRTAP and beyond?
5. How do we communicate our results, challenges and policy-relevant information?

Besides these preceding questions, participants had also been encouraged to prepare presenting their inputs in the form of slides if deemed relevant.

Roland Bobbink presented what he conceived as the **main challenges for the coming decade with respect to N deposition**. According to him, ammonia is an issue. Indeed, as one main challenge for the future will be to reach a significant reduction in the emissions of N compounds to the atmosphere and in deposition from the atmosphere to nature, the control of ammonia emissions and the deposition of reduced N are especially problematic, because NOx will be automatically reduced by the shift to a non-fossil community, but ammonia will not. Therefore, an increase in ammonia/ammonium deposition in the coming decade is very likely. According to Roland Bobbink, the two important scientific challenges for the coming decade are (i) to optimize the different dynamic model chains in Europe/UN/ECE, including biodiversity aspect and use them/test them jointly to get the best estimation of long-term trends in N deposition effects (in combination with other stressors) and (ii) to compare the outcome with the empirical approach and to combine them to an integrated assessment of N deposition effects in future (including biodiversity). To be able to lead this work, funds are needed.

Reto Meier highlighted in a brief presentation the content within the current effects-oriented LTS which are relevant to ICP M&M according to him, with “the analysis of environmental and health effects (…), in particular with respect to effects of reactive nitrogen, particulate matter, ozone, and risks from heavy metals and POPs” (3); actions on which improvements are needed such as “the interaction of air pollution control with climate change, land use change and the protection of biodiversity”, the “participation of and cooperation with EECCA and SEE countries” and the “development of common policies on a hemispheric of global scale” (5); and main tasks such as the collection, assessment and further developments of knowledge and information on i.a., exposure-response relationships, critical loads, levels and limits and linkages between air pollution, biodiversity, climate change and land use (7). Reto Meier indicated that building on strengths of the convention (e.g., links between science and policy, multi-pollutant and multi-effect approaches, robust system of emission inventories and monitoring activities), the future effects-oriented LTS should (i) allow national experts to continue active exchanges and collaboration, (ii) identify knowledge gaps and make use of new scientific knowledge and (iii) provide a consistent and comprehensible communication towards policy.

During the discussion main tasks for ICP M&M, as well as methods and tools were rather deeply addressed.

As regards the **tasks** to be addressed, **critical levels of ammonia** were actively discussed after Roland Bobbink’s presentation. Ammonia is recognised as a main precursor of ecosystem effects and discussed as a possible cause of e.g., heathland to grassland change. Questions were raised as whether and how concentrations of ammonia and deposition should be combined or not. It was pointed out that a closer linking of biodiversity and air quality monitoring, as done in the Netherlands where an extensive NH3-measurement

[7] https://www.unece.org/fileadmin/DAM/env/documents/2013/air/wge/Informal_document_no_18_Revised_Long-term_Strategy_of_the_effects-oriented_activities_clean_text.pdf

[8] http://www.unece.org/fileadmin/DAM/env/documents/2018/Air/EB/correct_numbering_Decision_2018_5.pdf

network exists in Natura2000 areas, would lead to further valuable information on air pollution effects on plants, ecosystems and biodiversity.

Also, it was stated that large parts of the current monitoring focus on forest ecosystems. Air pollution and vegetation monitoring in non-forest ecosystems, where a large part of very sensitive species is located, could deliver further information to be used in the modelling of CL and for determination of empirical CL.

Reto Meier's presentation also raised the question if there are intentions to update CL for **heavy metals**. Consensual comments were made that mercury should be tackled at least and/or firstly with linkages to the Minamata Convention. A number of national projects on heavy metals issues were cited (e.g., update of heavy metal modelling in the UK to account for pH and Dissolved Organic Carbon change with recovery from acidification, trends in waters in Norway).

As regards **methods and tools**, some of the main issues raised were:

- the need to link biogeochemical change to species changes was recalled as an important issue to progress on, possibly with tools such as Target Loads;
- the need to include all habitat types into CL for biodiversity, with a better harmonisation between countries; or/and on the European scale.

Communication was raised as an important line to work on. This communication may be top-down communication and bottom-up one.

In this sense, one approach is to seek a communication **building on ICP M&M experts capacity**, *via* training sessions. Another approach is to seek a communication **leaned towards policy**, within the Convention framework, but also exchanging with EU National Emission Ceiling Directive (NECD) and European Environment Agency (EEA). These latter frameworks have to be tackled especially for most emerging issues such as biodiversity and climate change. On the policy side, linkages to the NECD have to be envisaged as a virtuous cycle, with outputs from ICP M&M further communicated to EU, but also an offer to play an active role within the NECD monitoring indicators definition. Further exchange with the Natura2000 community and the biogeographical process was recognized as mutual interest and beneficial for further developments of models and indicators.

The ICP M&M Chair, the CCE and the CDM recalled the narrow timeline indicated by Isaura Rabago Juan-Aracil at the beginning of the meeting and indicated that the main issues raised during the discussion would be communicated to the secretariat within the document to be drafted before end of July.

Workplan 2020-2021

Before closing the meeting, the chair of the Programme Task Force, CCE and CDM recalled the current Workplan 2020-2021 for which ICP M&M activities are in progress or to be launched.

This biennal ICP M&M workplan is reminded in Table 1 of the present report (Chapter 1 – ICP M&M 2020-2021 workplan, page 6).

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)

36th Task Force Meeting, 27th CCE Workshop, and 1st CDM Meeting

Held remotely on Microsoft TEAMS

April 2020 – on Tuesday 21st, Wednesday 22nd and Thursday 23rd afternoons

FINAL AGENDA

Tuesday 21st April afternoon				
Session 1 – Welcome and Opening session Chair: Alice James Casas				
13:30	–	14:00	Connection to the meeting / welcome	Alice James C.
14:00	–	14:15	"Tour de table", introduction to the meeting & the remote meeting good practices	Alice James C.
14:15	–	14:30	Update on WGE and Convention issues	Isaura Rabago
14:30	–	14:40	Brief update on the current status of ICP M&M and CCE and new Centre for Dynamic Modelling (CDM)	Alice James C.
14:40	–	14:50	Presentation of the new CDM	Filip Moldan

Session 2 – Main ICP M&M sessions				
Session 2.1 – General progress on CCE work Chair: Coordination Centre for Effects (CCE)				
14:50	–	15:00	General progress on CCE work	CCE
15:00	–	15:15	Development of an updated background database for the CCE	Gert Jan Reinds

Session 2.2 – Status of Steady-State Modelling Chair: Coordination Centre for Effects (CCE)				
15:15	–	15:30	CCE introduction & status of the CfD	CCE
15:30	–	15:40	Information on the status of SMB CL in Norway	Kari Austnes
15:40	–	15:50	Information on the status of SMB CL in UK	Kasia Sawicka
15:50	–	16:00	Information on the status of SMB CL in Belgium (Flanders)	Johan Neirynck
16:00	–	16:10	Adapting national scale critical loads of lichen, trees, and herbaceous species to local management of US federal lands	Michael Bell
16:10	–	16:25	Brief Break	
16:25	–	16:40	Discuss single parameters of the equation	CCE
16:40	–	16:50	Denitrification as a part of the calculation of critical loads	Cornelius Oertel
16:50	–	17:00	Weathering rates with PROFILE	Juliane Hoehle
17:00	–	17:10	Forsafe 2.0 presentation of the new model	Harald Sverdrup
17:10	–	18:00	Discussions about further work on steady-state CL	All

Wednesday 22nd April afternoon - Session 2 continued				
Session 2.3 – Review of Empirical Critical Loads for Nitrogen Chair: Coordination Centre for Effects (CCE)				
13:30	–	14:00	Connection to the meeting / welcome	Alice James C.
14:00	–	14:15	"Tour de table", introduction to the meeting & the remote meeting good practices	Alice James C.
14:15	–	14:30	CCE introduction (roadmap and recent events) & status of the CfD	CCE
14:30	–	14:40	Information on Swiss Contribution to review of CLempN	Reto Meier
14:40	–	14:50	Information on UK Contribution to review of CLempN	Ed Rowe
14:50	–	14:55	Information on Irish Contribution to review of CLempN	Julian Aherne
14:55	–	15:00	Information on Canadian Contribution to review of CLempN	Julian Aherne
15:00	–	15:30	Discussion about further work on empirical CL	CCE
15:30	–	15:40	Brief Break	

Session 2.4 – Critical Loads for Biodiversity and Dynamic Modelling Chair: Centre for Dynamic Modelling (CDM)				
15:40	–	16:10	Overview of JEG DM achievements until Dec. 2019 & WorkPlan for CDM	Filip Moldan
16:10	–	16:25	CL biodiv - CCE work until end of 2017 and views on further work	Maximilian Posch
16:25	–	16:35	Exploring N emission and site buffering scenarios	Ed Rowe
16:35	–	16:50	Biodiversity Modeling and Critical Loads Assessment in the USA	Todd McDonnell
16:50	–	17:00	CL biodiv - habitat suitability modeling	Thomas Dirnböck
17:00	–	17:10	Response of more than 1000 herbaceous species across 20 vegetation alliances to atmospheric deposition of nitrogen in the United States	Kayla Wilkins

Session 3 – Cooperation with other groups Chair: Alice James Casas				
17:10	–	17:20	Update on CIAM work	Maximilian Posch
17:20	–	17:30	Update on ICP Waters	Kari Austnes
17:30	–	17:40	Update on ICP Vegetation	tba
17:40	–	17:50	Update on ICP Forests	Anne-Katrin Prescher
17:50	–	18:00	Update on ICP Integrated Monitoring	Maria Holmberg

Thursday 23rd April afternoon

Session 4 – Scientific Strategy and Wrap-up session

Chair: Alice James Casas & CCE & CDM

14:30	–	15:00	Connection to the meeting / welcome	Alice James C.
15:00	–	16:00	Discussing WGE Scientific Strategy update with respect to the Long-Term Strategy (LTS) for the Convention	All

The WGE is asked to review the long-term scientific strategy of the effects-oriented activities, which covers the time frame 2010 – 2020 and beyond.

Please prepare here for an active discussion (see questions below) on the current version of the LTS of the effect-oriented activities (see link (1) below) which is about to be updated accordingly with the 2018 version of the LTS for the Convention LRTAP (see link (2) below)

1. What are the main scientific Tasks for ICP M&M in the next 10 years and beyond?
2. What are our main realistic objectives (Continuation and changes)?
3. What are our most successful methods and tools
4. Important (new?) partners for cooperation and in WGE, in the CLRTAP and beyond?
5. How do we communicate our results, challenges and policy-relevant information?

(1) https://www.unece.org/fileadmin/DAM/env/documents/2013/air/wge/Informal_document_no_18_Revised_Long-term_Strategy_of_the_effects-oriented_activities_clean_text.pdf

(2) http://www.unece.org/fileadmin/DAM/env/documents/2018/Air/EB/correct_numbering_Decision_2018_5.pdf

Do not hesitate to envisage a contribution in the form of 1-2 slides if you wish to do so.

16:00	–	17:00	Discussing ICP M&M Work Plan	All

Please return any comment to:

Alice James Casas – alice.james@ineris.fr

CCE – cce@uba.de

CDM – filip.moldan@ivl.se

Annex II – List of participants

Name	First Name	Country	Affiliation	ICP M&M Role (e.g. NFC)	Oral presentation
Aherne	Julian	Canada	Trent University	NFC	Information on Irish Contribution to review of CLempN; Information on Canadian Contribution to review of CLempN
Alonso	Rocío	Spain	Ecotoxicology of Air Pollution - CIEMAT		
Augustin	Sabine	Switzerland	Federal Office for the Environment		
Austnes	Kari	Norway	Norwegian Institute for Water Research (NIVA)	NFC	Steady state critical loans - status and plans for Norway; Update on ICP waters
Bak	Jesper	Denmark	Aarhus University		
Bealey	William	United Kingdom	UK Centre for Ecology & Hydrology		
Bell	Michael	United States	United States National Park Service	NFC	Adapting national scale critical loads of lichen, trees, and herbaceous species to local management of US federal lands
Bermejo-Bermejo	Victoria	Spain	CIEMAT- Environmental Dept.		
Bobbink	Roland	The Netherlands	B-WARE Research Centre Radboud University		

Name	First Name	Country	Affiliation	ICP M&M Role (e.g. NFC)	Oral presentation
Braun	Sabine	Switzerland	Institute for Applied Plant Biology		
Bugalho	Lourdes	Portugal	Instituto Português do Mar e da Atmosfera, I.P., (IPMA)		
Chuman	Tomas	Czech Republic	Czech Geological Survey	NFC	
Cunha	Alexandra	United Kingdom	JNCC		
De Marco	Alessandra	Italy	ENEA CR Casaccia		
Dirnböck	Thomas	Austria	Environment Agency Austria	NFC	Biological effects of currently legislated decreases in Nitrogen deposition in Europe
Dombos	Miklos	Hungary	Institute for Soil Sciences and Agricultural Chemistry, Centre for Agricultural Research		
Duan	Lei	China	Tsinghua University		
Fornasier	Francesca	Italy	istitution ISPRA	NFC	
Futter	Martyn	Sweden			
García-Gómez	Héctor	Spain	CIEMAT		
Geiser	Linda	United States	US Forest Service		

Name	First Name	Country	Affiliation	ICP M&M Role (e.g. NFC)	Oral presentation
Georgiev	Georgi	Bulgaria	Executive Environment Agency	NFC	
Geupel	Markus	Germany	German Environment Agency (UBA)	CCE Team	
Gonzalez-Fernandez	Ignacio	Spain	CIEMAT		
Harmens	Harry	United Kingdom	ICP Vegetation / UK Centre for Ecology & Hydrology		Achievements of the ICP Vegetation in 2019 and future work plan
Henriques	Diamantino	Portugal	Instituto Português do Mar e da Atmosfera		
Hinsberg van	Arjen	Netherlands	Netherlands Environmental Assessment Agency (PBL)		
Hoehle	Juliane	Deutschland	Public enterprise SACHSENFORST		Weathering rates of German soils with PROFILE
Holmberg	Maria	Finland	Finnish Environment Institute (SYKE)	NFC	Activities of ICP Integrated Monitoring and Finnish ICP M&M NFC
James	Alice	France	INERIS	TF Chair	New organisation of the ICP MM and its designated centres; ICP M&M work plan 2020-2021; WGE scientific strategy
Jenkinson	Holly	United Kingdom	Natural England		

Name	First Name	Country	Affiliation	ICP M&M Role (e.g. NFC)	Oral presentation
Jutterström	Sara	Sweden	IVL	CDM Team	
Kruchina	Elena	Russia	YU. A. Izrael institute of Global Climate and Ecology (IGCE)		
Loran	Christin	Germany	German Environment Agency	CCE Team	General progress on CCE work; CLempN review; Status of Steady State Modelling CL
McDonnell	Todd	United States	E&S Environmental Chemistry		Biodiversity Modeling and Critical Loads Assessment in the USA
Meier	Reto	Switzerland	Swiss Federal Office for the Environment	NFC	Information on Swiss Contribution to review of CLempN
Mercieca	Nadine	Malta	Environment and Resources Authority		
Mitchell	Zak	United Kingdom	UK Centre for Ecology and Hydrology		
Moldan	Filip	Sweden	IVL	CDM Team	Centre for Dynamic Modelling; Overview JEG DM achievements until Dec. 2019 & Work Plan for CDM
Neirynck	Johan	Belgium	Research Institute for Nature and Forest (INBO)	NFC	Status report CL SMB (Flanders)
Oertel	Cornelius	Germany	Thunen Institute		Denitrification as a part of the calculation of critical loads

Name	First Name	Country	Affiliation	ICP M&M Role (e.g. NFC)	Oral presentation
Olendrzynski	Krzysztof	Switzerland			
Pardo	Linda	United States	USDA Forest Service		
Phelan	Jennifer	United States	RTI International		
Posch	Maximilian	Austria	IIASA/CIAM		CIAM activities; CL for Biodiversity CCE work until 2017 & outlook
Pozdnyakova	Ekaterina	Russia	YU. A. Izrael institute of Global Climate and Ecology (IGCE)		
Prescher	Anne-Katrin	Germany	Thünen Institute of Forest Ecosystems		Update on ICP Forests activities
Rabago Juan-Aracil	Isaura	Spain	CIEMAT	WGE Chair	Update on WGE and Convention issues
Reinds	Gert Jan	The Netherlands	Wageningen Environmental Research		CL for eutrophication and acidification for Europe
Richter	Simone	Germany	German Environment Agency		
Rönnback	Pernilla	Sweden	Swedish University of Agricultural Sciences, SLU		
Rowe	Ed	United Kingdom	Center for Ecology & Hydrology	NFC	UK contribution to CLempN review; Progress with metrics and biodiversity-based CL

Name	First Name	Country	Affiliation	ICP M&M Role (e.g. NFC)	Oral presentation
Sawicka	Kasia	United Kingdom	UK Centre for Ecology & Hydrology	NFC	SMB CL – UK status and application
Schembri	Ariana	Malta	Environment and Resources Authority		
Scheuschner	Thomas	Germany	German Environment Agency	CCE Team	Status of Steady-State Modelling - Discuss single parameters
Sicard	Pierre		ARGANS		
Sverdrup	Harald Ulrik	Norway	Inland University		What is new in the ForSAFE-2 model
Vowles	David	United Kingdom	Defra		
Wellbrock	Nicole	Germany	Thünen Institue of Forests Ecosystem		
Wilkins	Kayla	Canada	Trent University, School of Environment		Response of more than 1000 herbaceous species across 20 vegetation alliances to atmospheric deposition of nitrogen in the United States
Woodward	Huw	United Kingdom	Imperial College London		
Zappala	Susan	United Kingdom	JNCC	NFC	