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Executive Body for the Convention on Long-range Transboundary Air Pollution

Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

Working Group on Effects

Sixth joint session
Geneva, 14–17 September 2020

Report of the sixth joint session of the Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe and the Working Group on Effects

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I. Introduction

1. The Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) and the Working Group on Effects under the United Nations Economic Commission for Europe (ECE) Convention on Long-range Transboundary Air Pollution (Convention) held their sixth joint session online from 14 to 17 September 2020 in Geneva.

A. Attendance

2. The session was attended by representatives from the following Parties to the Convention: Armenia, Austria, Azerbaijan, Belgium, Canada, Croatia, Cyprus, Czechia, Denmark, Estonia, European Union, Finland, France, Georgia, Germany, Hungary, Ireland, Italy, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom of Great Britain and Northern Ireland and United States of America. Two delegates from Uzbekistan also attended the meeting.

3. Also participating were representatives of the following EMEP centres: the Chemical Coordinating Centre (CCC); the Centre for Integrated Assessment Modelling (CIAM); the Centre on Emission Inventories and Projections (CEIP); the Meteorological Synthesizing Centre-East (MSC-E); and the Meteorological Synthesizing Centre-West (MSC-W). Representatives from the following scientific centres and bodies under the Working Group on Effects participated: the International Cooperative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (ICP Modelling and Mapping) and its Coordination Centre for Effects (CCE); the Centre for Dynamic Modelling (CDM); the Joint Task Force on the Health Aspects of Air Pollution (Task Force on Health); the Programme Centre of the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes (ICP Waters); the Programme Centre of the International Cooperative Programme on Effects of Air Pollution on Materials, including Historic and Cultural Monuments (ICP Materials); the Programme Centre of the International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops (ICP Vegetation); the Programme Centre of the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring); and the Programme Coordinating Centre of the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests). Also in attendance were the Chairs of the Executive Body and the Working Group on Strategies and Review.

4. Also present were representatives of the Asia Centre for Air Pollution Research, the European Environmental Bureau and the World Health Organization (WHO).

B. Organizational matters

5. Ms. Laurence Rouîl (France), Chair of the EMEP Steering Body, and Ms. Isaura Rábago (Spain), Chair of the Working Group on Effects, co-chaired the session. At the invitation of the Co-Chairs, participants adopted the agenda for the session (ECE/EB.AIR/GE.1/2020/1/Rev.1–ECE/EB.AIR/WG.1/2020/1/Rev 1).[1]

[1] Information and documentation for the meeting, including informal documents and presentations, is available on the meeting web page (www.unece.org/index.php?id=52860).

6. At its online meeting on 29 June 2020, the Executive Body Bureau decided that the sixth joint session should be held remotely due to the coronavirus disease (COVID-19) pandemic, related travel restrictions and sanitary limitations imposed in Switzerland and in other countries. Moreover, the meeting format had to be shortened and modified significantly. The length of the meeting was reduced to four working days and the duration from 24 to approximately 12 hours. Four sessions were held in English only and there were only two 2-hour long sessions with simultaneous interpretation. The provisional draft agenda for the session (ECE/EB.AIR/GE.1/2020/1–ECE/EB.AIR/WG.1/2020/1) had to be adjusted accordingly. Discussions on several agenda items (draft updated strategy for scientific bodies under the Convention, long-term ecosystems monitoring, outreach activities, cooperation with other organizations and programmes) were postponed until the seventh joint session in September 2021. The parts of the sessions held with interpretation included the following (revised) agenda items: thematic sessions on condensables (item 7) and ozone pollution (item 6); review of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone: recommendations for the review: scientific perspective (item 4 (b)); conclusions and recommendations (item 8); election of officers (item 9); information-sharing by Parties (item 10); and closing of the meeting (item 11). For more details, see informal document Organization of work during the sixth joint session under agenda item 1.

II. Financial and budgetary matters

7. The secretariat introduced the note on financial and budgetary matters (ECE/EB.AIR/GE.1/2020/19–ECE/EB.AIR/WG.1/2020/12). The Steering Body and the Working Group:

(a) Took note of the information on financial and budgetary matters provided by the secretariat;

(b) Approved the proposed conclusions and recommendations as outlined in paragraphs 10 and 21 of the note.

A. Funding of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

8. The secretariat introduced the elements of section I of the above-mentioned note relevant for EMEP. The proposed schedule of mandatory contributions for 2021–2022 (ECE/EB.AIR/GE.1/2020/19–ECE/EB.AIR/WG.1/2020/12, table 4) had been calculated on the basis of the 2018 United Nations scale of assessments.[2] The secretariat also reported on the status of the contracts between ECE and the EMEP centres.

9. The Steering Body and the Working Group:

(a) Agreed on the proposal for the EMEP budget for 2021 prepared by the Steering Body Bureau and decided to forward it for approval by the Executive Body at its fortieth session. The proposed budget aimed at funding the mandatory and usual activities of the EMEP centres related to the implementation of the Convention. The total EMEP budget for 2021 ($2,358,700; ECE/EB.AIR/GE.1/2020/19–ECE/EB.AIR/WG.1/2020/12, table 3) would be the same as for 2020, but with the following split between centres: CIAM – $169,000; CCC – $824,000; MSC-W – $574,000; MSC-E – $459,000; and CEIP – $264,000;

[2] See General Assembly resolution 73/271 on the scale of assessments for the apportionment of the expenses of the United Nations (A/RES/73/271).

(b) Invited the Bureau of the Steering Body to discuss the 2022 budget for the EMEP centres at its next meeting in 2021.

B. Funding of effects-related activities

10. The secretariat introduced the elements of section II of the above-mentioned note. The secretariat recalled that, at its thirty-ninth session (Geneva, 9–13 December 2019), the Executive Body had adopted decision 2019/22 designating a new international centre at the Swedish Environmental Research Institute (Centre for Dynamic Modelling) (ECE/EB.AIR/144/Add.1). In view of that decision, it was proposed to increase the budget for funding of effects-oriented activities in 2021 and the provisional budgets for 2022 and 2023 to $2,358,700. The details of the budget (international coordination costs) were presented in ECE/EB.AIR/GE.1/2020/19–ECE/EB.AIR/WG.1/2020/12, table 10. The secretariat also presented information on the status of the contracts for 2020.

11. The Steering Body and the Working Group:

(a) Noted the proposal on the international coordination costs for core activities in 2021 not funded through the EMEP Protocol and the provisional budgets for 2022 and 2023 (see ECE/EB.AIR/GE.1/2020/19–ECE/EB.AIR/WG.1/2020/12, table 10);

(b) Noted with appreciation the amount of voluntary cash contributions made available in 2019–2020, but again invited all Parties that had not yet done so to contribute to the trust fund for financing of the effects-oriented activities, without undue delay.

III. Convention news

12. Presenting highlights of the thirty-ninth session of the Executive Body for the Convention, the Executive Body Chair noted the: adoption of the monitoring strategy for EMEP for the period 2020–2029 (ECE/EB.AIR/144/Add.1, decision 2019/1); adoption of the revised mandates for all scientific centres, international cooperative programmes and task forces (ECE/EB.AIR/144/Add.1, decisions 2019/6–2019/21); establishment of the Centre for Dynamic Modelling under ICP Modelling and Mapping (ECE/EB.AIR/144/Add.1, decision 2019/22); launch of the review of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol), as amended in 2012 (ECE/EB.AIR/144/Add.1, decision 2019/4); adoption of the 2020–2021 workplan for the implementation of the Convention (ECE/EB.AIR/144/Add. 2); establishment of the forum for international cooperation on air pollution (ECE/EB.AIR/144/Add.1, decision 2019/5); and a special session dedicated to the Convention's fortieth anniversary (11 and 12 December 2020) attended by high-level representatives of Parties and international organizations dealing with air pollution. The Executive Body requested the Steering Body to EMEP to continue its scientific work on accounting for the condensable part of particulate matter (PM). The Executive Body also requested the Working Group on Strategies and Review to discuss the policy implications of taking into account the condensable part in PM emission reporting.

13. The Co-Chairs presented a brief summary of the work of the Bureaux of the EMEP Steering Body and of the Working Group on Effects (see ECE/EB.AIR/GE.1/2020/9–ECE/EB.AIR/WG.1/2020/20), highlighting the implementation of the 2020–2021 workplan, key scientific issues (condensables, ozone effects) and the discussions on the contribution of the two scientific bodies to the review of the Gothenburg Protocol.

IV. Gothenburg Protocol review

A. Questions to subsidiary bodies of the Convention

14. Ms. Kimber Scavo, the Chair of the Gothenburg Protocol review group, presented information on the scope and content of the review. The Gothenburg Protocol review group had been tasked by the Chair of the Working Group on Strategies and Review with developing a preparatory document on the review entitled "Preparations for the review of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone, as amended in 2012." (ECE/EB.AIR/2020/3-ECE/EB.AIR/WG.5/2020/3) to facilitate the discussion. Annex I to the preparatory document provided a list of questions to the subsidiary bodies under the Convention (see informal document under agenda item 4 (a)). The list of questions could be helpful to subsidiary bodies in preparing for the review. The EMEP Steering Body and the Working Group on Effects subsidiary bodies might need to adjust their 2020–2021 workplan activities, as appropriate, to be able to undertake some of the work required for the review. She also presented a draft outline of the review report and the time frame for the review.

B. Recommendations for the review: scientific perspective (views from scientific centres, task forces and international cooperative programmes)

15. The Chair of the EMEP Steering Body provided an introduction to the discussion on the contribution of the Convention scientific bodies to the Gothenburg Protocol review. She focused on the questions formulated by the review group related to the following issues:

(a) Review of obligations in relation to emission reductions (questions 1.1–1.5 in the informal document under agenda item 4 (a));

(b) Trends in air pollutants concentrations and their impact on human health (questions 2.1, 2.3 and 2.4);

(c) Trends in deposition and impacts on ecosystems and materials (2.2, 2.3 and 2.5);

(d) Monitoring, modelling, science-based approaches (2.6–2.8 and 3.1);

(e) Projections and potential drivers (3.1–3.6);

(f) Specific topics including black carbon (BC) (4.1 and 4.2), condensables (4.3 and 4.4) and ammonia (5.1–5.4).

16. She also commented on the timeline for the review (September 2020–December 2022) and the draft outline of the review report. She then encouraged the centres and task forces to discuss and comment on the issues listed above (see below for the key elements of the discussion).

17. The Head of CIAM reported on a recent study – with MSC-West contribution - on the outlook for global air quality in 2040 that could make an important contribution to the Gothenburg Protocol review. The study had been carried out with the Greenhouse Gas - Air Pollution Interactions and Synergies (GAINS) model. One hundred and eighty emission source regions had been considered, while source receptor relationships had been derived from the global EMEP model. The Clean Air Scenario 2040 generated by the GAINS model would bring $PM_{2.5}$ exposure from anthropogenic sources below the current WHO guideline for ~90 per cent of the global population. On the other hand, the role of $PM_{2.5}$ from natural

sources (soil dust, sea salt, biogenic) was currently under review for the WHO air quality guideline revision. The study showed that moving towards the WHO guideline required a mix of policies. No single policy field alone could exhaust the full potential for air quality improvements. About two thirds of the potential improvements could be delivered by further air quality policies. The remaining third were connected to other policy fields, including energy and climate policies, food policies and agricultural policies. Achieving clean air required integrated multisectoral policy approaches.

18. A representative of Germany presented the rationale for including marine ecosystem protection in the Gothenburg Protocol review. Marine ecosystems – in particular, coastal areas – were sensitive to eutrophication by nitrogen. Approximately 20–30 per cent of current nitrogen loads to the Baltic Sea resulted from atmospheric deposition, therefore improvements were needed soon. In integrated assessment modelling under the Convention various elements were considered: (a) critical loads for terrestrial and freshwater ecosystems; (b) flux-based critical levels for generic crop species; and (c) health-related effects. However, there were not currently any thresholds to protect marine ecosystems. Interlinkage of air quality and marine protection policies would enhance the effectiveness of both policy areas. She recalled the ongoing cooperation between the Convention and the Convention for the Protection of the Marine Environment of the North-East Atlantic and the Baltic Marine Environment Protection Commission (HELCOM). For example, MSC-West modelled atmospheric air pollution deposition to the North Sea and the Baltic Sea on a regular basis.

19. A representative of CCE reported on the planned contribution of CCE to the review of the Gothenburg Protocol. The main task of CCE would be to calculate the exceedance of critical loads for eutrophication and acidification for the available deposition data (for example, 1990–2018/2019) based on a new critical load data set (available in spring 2021) containing updated National Focal Centre data and a new background database. A comparison of the 2012 and 2021 critical load data sets was possible, but the relevancy of that comparison and the corresponding results might be limited by the information available on the first data set. If the planned results were to be ready in time (mid/autumn 2021) for the ongoing review process, new findings on empirical critical load and an updated receptor map could not be included.

20. The Working Group on Effects and the EMEP Steering Body pointed out the relevance of the questions asked by the Gothenburg Protocol review group, but also the challenging timeline proposed for gathering answers and recommendations. Even if the 2020–2021 workplan were revised to prioritize answers to the questions, it would be very difficult to elaborate them before summer 2021. However, the Steering Body and the Working Group on Effects acknowledged the fact that, thanks to activities implemented by the international cooperative programmes, the task forces and the centres over the past years, a lot of valuable material was currently available to prepare the review process.

21. The Steering Body and the Working Group on Effects:

(a) Took note of the questions posed by the Gothenburg Protocol review group to scientific bodies and carefully considered how best to contribute to the review process;

(b) Requested the scientific centres, task forces and international cooperative programmes to provide their requested contributions to the review. The contributions would be further discussed during the 2021 meeting of the Bureaux of the EMEP Steering Body and of the Working Group on Effects.

The EMEP Steering Body and Working Group on Effects would coordinate the work.

V. Progress in effects-oriented activities in 2020 and further work

A. Air pollution effects on health

22. A representative of the Task Force on Health/WHO provided highlights of the twenty-third meeting of the Task Force (virtual, 12 and 13 May 2020), which had focused on: updates on relevant national and international policies; tools and country experiences in capacity-building on air quality and health; progress in research on health impacts of air pollution; activities on air pollution and health in the time of the COVID-19 pandemic; communication and public health messages for air pollution; and an update on the implementation of the 2020–2021 workplan. Achievements had included: an update of the WHO global air quality guidelines, including the publication of systematic reviews of evidence in a peer-reviewed journal; a capacity-building workshop on air quality and health for experts from Armenia, Azerbaijan and Georgia, implemented in cooperation with the Convention secretariat; and further work on tools used by the Parties. The meeting had also discussed progress in research on health impacts of air pollution, including a new study on the effects of low-level air pollution in Europe, a new project on the estimation of morbidity from air pollution and its economic costs, and a study on developing an outlook for global air quality to 2040. Moreover, presentations had been given on the main conclusions from the United States Environmental Protection Agency Integrated Science Assessment for Ozone and Related Photochemical Oxidants[3] and progress in work on a report entitled "Human Health Effects of Polycyclic Aromatic Hydrocarbons (PAHs) as Air Pollutants". Presentations related to the pandemic had included: an overview of the emerging evidence of linkages between air pollution and COVID-19; a summary of WHO activities in the context of air pollution and COVID-19; and a presentation on the effects of COVID-19 lockdown measures on air pollutants concentrations.

23. The Steering Body and the Working Group:

(a) Noted the process, progress and timeline of the ongoing WHO global air quality guidelines updating project;

(b) Took note of and welcomed the joint capacity-building workshops organized by WHO with support from the Convention secretariat.

B. Critical loads and other issues related to modelling and mapping

24. The Chair of the ICP Modelling and Mapping Task Force, CCE and CDM reported jointly on progress in activities in 2020, including the outcomes of the thirty-sixth Task Force meeting (online, 21–23 April 2020). The meeting had focused on addressing the main scientific challenges regarding critical loads and levels and air pollution effects, risks and trends, and had concluded that there was a need to:

(a) Pursue the work at CCE on: (i) developing the European Background Database for Critical Loads; (ii) updating critical loads according to National Focal Centres' inputs following the Call for Data 2020–2021; and (iii) review and revision of the empirical critical loads database based on the contribution of an ad hoc expert panel;

[3] See: www.epa.gov/isa/integrated-science-assessment-isa-ozone-and-related-photochemical-oxidants.

(b) Launch the update of the harmonized Convention receptor map used for diverse modelling purposes by different bodies within the Convention framework;

(c) Enhance development of critical loads for biodiversity by reviewing the former dynamic modelling work under the Convention and, based on that, identify areas of common interest and potential gaps;

(d) Enhance development of the common Working Group on Effects portal.[4]

25. The Programme Task Force and CCE proposed to the Working Group on Effects not to extend the deadline for the update of the steady-state critical loads from the Call for Data 2020–2021. The delay of the deadline had been proposed previously to allow for a consecutive revision of the empirical and steady-state critical loads. Based on the timeline for the Gothenburg Protocol review, further specified during the meeting, it was agreed that an extension might hamper the consideration of the latest critical loads update and, therefore, would not be expedient. The Chair of CDM presented progress in establishing the new Programme Centre hosted by IVL Swedish Environmental Research Institute (Gothenburg, Sweden). The CDM had been officially established on 1 January 2020 following decision 2019/22 (see ECE/EB.AIR/144/Add.1). The CDM Chair reported on progress on review of the dynamic modelling work under the Convention (workplan item 1.1.1.22).

26. The Steering Body and the Working Group recommended that:

(a) The establishment of the new European Background Database for Critical Loads be pursued and finalized by CCE in early 2021;

(b) The review and revision of the empirical critical loads be pursued by CCE during 2021 and 2022 and be ready for discussion by the Working Group on Effects by September 2022, and for the Executive Body for adoption by December 2022;

(c) Taking due consideration of the Gothenburg Protocol review process timeline, Parties be urged to update their critical loads following the Call for Data 2020–2021;

(d) The harmonized Convention receptor map be updated by CCE starting in 2021, and be based on contributions provided by other bodies of the Convention;

(e) Heavy metals critical loads update be considered as a scientific issue to build on in the next biennial workplan;

(f) There be further development by National Focal Centres and CDM of the metrics for quantifying damage to biodiversity due to air pollution.

C. Air pollution effects on materials, the environment and crops

27. The Head of ICP Materials reported on developments and the outcomes of the thirty-sixth meeting of the ICP Materials Task Force (online, 6–8 April 2020). The main items discussed at the meeting had been:

(a) Trends in pollution, corrosion and soiling;

(b) Update of the Mapping Manual to include soiling;

(c) The call for data on the United Nations Educational, Scientific and Cultural Organization (UNESCO) cultural World Heritage Sites.

28. Results from the recent trend analysis (1987–2019) showed that acidification (sulfur dioxide) still played a role for corrosion, albeit a minor one, and ozone was of minor

[4] https://www.unece-wge.org/.

importance for the corrosion of copper. It had not been possible to show any effect of particulate matter (PM) on corrosion, but the effect on soiling (modern glass, coil-coated materials) was high and significant. There was no decreasing trend in soiling of modern glass, which was one of the new materials to be included in the future update of the Mapping Manual, which would include soiling for the first time. A new exposure for trend analysis would start in 2020, with one- and four-year samples withdrawal in 2021.

29. At UNESCO cultural World Heritage Sites, the recession, estimated from present dose-response functions, and the consequent estimated maintenance/repair cost of calcareous stone materials seemed to be dominated by the presence in the atmosphere of nitric acid (HNO_3), and coarse particles with a diameter of 10 micrometers (μm) or less (PM_{10}). Copper corrosion was dominated by sulfur dioxide and ozone combined effect (dry deposition). PM_{10} and nitrogen dioxide contributed to glass soiling for about 90 per cent. PM_{10} was the only pollutant considered for limestone soiling. A decrease in concentrations of nitrogen dioxide in the atmosphere could bring benefits in reducing the damage and therefore the cost of the damage of the corrosion of limestone and of the soiling of glass. A decrease in PM_{10} concentrations could bring benefits in reducing the damage and the cost in corrosion and soiling of limestone and soiling of glass.

30. The Head of the ICP Forests Programme Coordinating Centre summarized the highlights of the thirty-sixth Task Force Meeting of ICP Forests (online, 11 and 12 June 2020). He presented both the main activities of ICP Forests over the past 12 months and the upcoming ICP Forests Brief No. 4 entitled “Increased evidence of nutrient imbalances in forest trees across Europe”. He listed the ICP Forests activities/objectives under the 2020–2021 workplan, including ongoing research on the concentration and effects of ozone, nitrogen and heavy metals in forest ecosystems. The representative of ICP Forests also reported on the input of ICP Forests to the new long-term strategy of the Working Group on Effects. Besides perennial issues such as ozone, nitrogen deposition and heavy metals, the future work of ICP Forests would focus on the links between air pollution and carbon sequestration, biodiversity and climate change. Lastly, important findings regarding atmospheric deposition of sulfur and nitrogen were presented. A case study had analysed the long-term (1999–2014) ecosystem carbon fluxes of a mixed coniferous/deciduous forest (Brasschaat forest, Belgium), and quantified and discussed the relative effects of multiple environmental and biotic drivers on net forest - atmosphere exchange of carbon dioxide. A continental-scale analysis of forest volume increment data (1995–2010) from approximately 100,000 trees in 442 even-aged, single-species stands across 23 European countries had been carried out in another study. The following key messages could be derived based on those studies: (a) recovery of soils from acidification appeared to improve the carbon sink function of European forests; (b) nitrogen deposition had been documented to be a key driver for forest growth and diversity, with adverse effect occurring at high deposition levels; and (c) effects attributable to ozone (in terms of concentration and flux) on forest growth and health were less univocal.

31. The Chair of ICP Waters provided an overview of recent progress, including key messages from the thirty-sixth Task Force meeting (online, 11 and 12 May 2020), a well-attended event. Results of ICP Waters Report No. 142/2020, entitled “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”, were presented.[5] All 13 regions showed substantial chemical recovery, which was related foremost to decline in sulfate. Nitrate and chloride were also declining but far less than sulfate. Recovery was slowing down in Europe and accelerating in North America, likely as a consequence of differences in rates of declines in emissions of sulfur to the atmosphere. Land

[5] Available at www.icp-waters.no/publications/#nivarep.

use practices such as forestry could slow down recovery, and changes in vegetation that could be related to land use and climate or a combination (insect attacks leading to defoliation) could also set back chemical recovery. One scientific paper proposed that the widespread decline of methylmercury in fish in remote lakes since the 1970s might be related to the decline in sulfur deposition, because sulfate availability was a limiting factor for the production of methylmercury. Nitrate was a factor that had an impact on surface water acidification and eutrophication.[6] ICP Waters would contribute to the ongoing update of empirical loads for nitrogen by: (a) assessing links between algal growth and diversity, and nutrient status of surface waters in remote lakes in Scandinavia; and (b) assessing recent literature. The results would be part of a more broadly focused report on nitrogen, to be finished in 2021, in which trends in nitrogen species in water would be analysed in the light of trends in deposition and climate, as well as differing catchment characteristics, using data from ICP Waters monitoring sites. The main objective was to gain further understanding of the observed differences in nitrate trends. The report would also cover topics such as nitrogen saturation, organic nitrogen and spatial patterns in nitrogen species. For the review of the Gothenburg Protocol, ICP Waters could contribute based on ongoing and recent assessments that reported on changes in water quality indicators, strengths and limitations of monitoring systems. Projections of future water quality had been done previously but did not extend beyond 2020.

32. One of the ICP Integrated Monitoring Co-Chairs presented its main activities, progress related to the 2020–2021 workplan and activities planned for the near future. The main scientific output included three published scientific papers:

(a) A meta-analysis of 161 long-term data sets on species abundance, of which some were ICP Integrated Monitoring data, concluding, inter alia, that biodiversity changes at local scale were often complex and could not be easily generalized to larger scales, but finding increases in richness and abundance with increasing temperature and naturalness;[7]

(b) An analysis of 68 vegetation re-survey studies of semi-natural forests in Europe, of which some were ICP Integrated Monitoring sites, concluding that, among herb-layer species, nitrogen deposition accelerated the extinction of small-ranged, nitrogen-efficient species and colonization by broadly distributed, nitrogen-demanding species, including non-natives;[8]

(c) A study assessing critical load exceedances and ecosystem impacts of anthropogenic nitrogen and sulfur deposition at 17 ICP Integrated Monitoring and European Long-term Ecosystem Research sites, resulting in, inter alia, novel techniques for presenting exceedances of critical loads and their temporal development and evidence of a link between critical loads exceedances and empirical impacts, and concluding that concentrations and fluxes of nitrogen and sulfur deposition and runoff had decreased as a response to decreasing emissions, and that most sites with higher critical loads exceedances showed larger decreases in both inorganic nitrogen and H+ concentrations and fluxes in runoff.[9]

[6] Hans F. V. Braaten and others, "Five decades of declining methylmercury concentrations in boreal foodwebs suggest pivotal role for sulphate deposition", *Science of the Total Environment*, vol. 714 (April 2020).

[7] Francesca Pilotto and others, "Meta-analysis of multidecadal biodiversity trends in Europe", *Nature Communications*, vol. 11, art. No. 3486 (2020).

[8] Ingmar R. Staude, "Replacements of small- by large-ranged species scale up to diversity loss in Europe's temperate forest biome", *Nature Ecology and Evolution*, vol. 4, pp. 802–808 (2020).

[9] Martin Forsius and others, "Assessing critical load exceedances and ecosystem impacts of anthropogenic nitrogen and sulphur deposition at unmanaged forested catchments in Europe", *Science of the Total Environment*, vol. 753, art. No. 141791 (January 2021).

33. During the period 2020–2021, the ICP Integrated Monitoring database would be moved from the ICP Integrated Monitoring Programme Centre to the Swedish University of Agricultural Sciences, to which one of the Co-Chairs was affiliated. Further developments included participation in the review of the Gothenburg Protocol, increased cooperation and use of EMEP data in evaluations of ICP Integrated Monitoring data, and deepened cooperation with European Long-Term Ecosystem Research. Work to establish a less intensive Integrated Monitoring programme (working name "IM light") would be intensified and the aim was to have draft protocols in 2021. That included plans to extend the integrated monitoring to other land use types than forests, especially grasslands.

34. The Chair of the ICP Vegetation Task Force and the Head of the Programme Centre summarized the highlights of the thirty-third Task Force Meeting (Riga, 27–30 January 2020). They reported on progress with 2020–2021 workplan items and on planned activities for 2020–2021. The key messages were:

(a) ICP Vegetation had been preparing for the upcoming Gothenburg Protocol review by reviewing and reintroducing parameterizations to allow for large-scale modelling of impacts of ozone on crops and semi-natural vegetation;

(b) Updates to scientific knowledge suggested that ozone critical levels did not need to be modified to account for nitrogen availability in crops. However, reductions in nitrogen use efficiency could occur with increasing ozone pollution;

(c) The results from the previous moss survey (2015/16) had been published. There was a call for data for the period 2020–2022 (extended sampling year due to COVID-19). Some countries had already indicated their participation, with some also participating in a pilot study to investigate the presence of microplastics in mosses;

(d) Outreach activities continued, to raise awareness and to share skills and expertise.

35. The Steering Body and the Working Group:

(a) Noted that the reports relevant for the evaluation of progress in implementing the workplan for 2020–2021 had been prepared by the centres under the Working Group on Effects on time and were all available on their respective websites;

(b) Welcomed and approved the work carried by the centres under the Working Group on Effects in 2020 as presented at the current session and in their 2020 reports and other publications available on the websites of the respective international cooperation programmes, the Task Force on Health and CIAM and briefly described in the official documents for the sixth joint session and summarized in the 2020 joint report (ECE/EB.AIR/GE.1/2020/3− ECE/EB.AIR/WG.1/2020/3);

(c) Recommended further work on a common Working Group on Effects portal to better promote the effects-oriented work and to improve access to relevant information, data and publications, and requested the Extended Bureau of the Working Group to discuss the issue at its next meeting in March 2021.

VI. Progress in activities under the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe in 2020 and future work

A. Emissions

36. The Co-Chair of the Task Force on Emission Inventories and Projections reported on the results of the twenty-first joint meeting of the Task Force and the European Environment Agency (EEA) European Environment Information and Observation Network (online, 11–14 May 2020). The Co-Chair presented recent progress made by the Task Force, highlighting the:

(a) Publication of the 2019 version of the *EMEP/EEA air pollutant emission inventory guidebook* (EMEP/EEA Guidebook),[10] with a European Union-funded Russian translation available in the near future;

(b) Update of the annex I emissions inventory reporting template;

(c) Establishment of a BC working group, which had been liaising with the United Nations Framework Convention on Climate Change and developing information for inclusion in the EMEP/EEA Guidebook;

(d) Full redesign and update of the Task Force website.[11]

37. Regarding future work, the Task Force was preparing to support the Gothenburg Protocol review as requested, and noted the document entitled "Questions to Subsidiary Bodies of the Convention for the Gothenburg Protocol Review" prepared by the Gothenburg Protocol review group. The Task Force Co-Chair noted that it would be helpful if the Task Force also reviewed the emission inventory reporting guidelines, and provided its conclusions and recommendations to contribute to the Gothenburg Protocol review. As resources needed to be allocated to support the Gothenburg Protocol review, it was likely that several other proposed tasks in the Task Force's work programme would need to be postponed. The Co-Chair indicated that the Task Force would likely form a Gothenburg review ad hoc group, which would provide a mechanism for timely responses to requests for input. The Task Force Co-Chair asked for clarification about the governance/management and funding of the work needed to make further progress on the "condensables" issue.

38. The Head of CEIP provided information on the status of reporting of emissions data regarding their completeness and consistency. As at 1 September 2020, 48 out of 51 Parties had submitted data. No emission data had been received from Albania, Azerbaijan or Bosnia and Herzegovina. In 2020, Armenia, Belarus, Kyrgyzstan and the United States of America had only reported inventories for 2018. Furthermore, Georgia (2007–2018), Malta (2005–2018), the Republic of Moldova (1990–2017), the Russian Federation (2010–2018) and Ukraine (2016–2018) had not reported the full time series. CEIP had noted partly improved reporting from some countries in Eastern Europe, the Caucasus and Central Asia (EECCA). However, it was vital to improve the quality of reported data and provide feedback from those countries to the review findings. Forty-two Parties had submitted an Informative Inventory Report (IIR). In most cases, annex III - Declaration on the publication of the IIR was not included, possibly resulting in limited access to IIRs via the CEIP website in the future.

[10] Available at www.eea.europa.eu/themes/air/air-pollution-sources-1/emep-eea-air-pollutant-emission-inventory-guidebook.

[11] See www.tfeip-secretariat.org/.

39. Thirty-eight Parties had reported BC emissions, with thirty-three Parties submitting emission time series (2000–2018). However, reported data continued to be limited in its consistency. EMEP Status report No.1/2020 contained a brief assessment of reported BC emission data.[12] CEIP had cooperated with the Arctic Monitoring and Assessment Programme (AMAP) on the assessment of BC data and availability of calculation methods. An overview of all data submitted by Parties during the 2020 reporting round could be accessed via an interactive data viewer.[13] In order to improve reporting of BC, estimation methods and emission factors in the EMEP/EEA Guidebook must be improved and a more accurate definition of BC established.

40. The Head of CEIP reiterated the need for transparent reporting of activity data to facilitate the inventory review process. CEIP recommended that Parties report activity data, emission factors and emissions per fuel type in Excel format as attachments to their IIRs.

41. The Head of CEIP also reported on the stage 3 review performance in 2020 and plans for 2021. The review of Bosnia and Herzegovina had been cancelled, as no data had been submitted since 2011. In 2020, an in-depth review of five Parties (the European Union, Iceland, Kyrgyzstan, North Macedonia and Switzerland) had been performed and completed as a desk review. However, the expert review team had stressed the importance of a review meeting and required that review meetings be organized in the future. Kazakhstan, Liechtenstein and Monaco had provided data after the deadline and could not be reviewed in the current year. It was recommended that Bosnia and Herzegovina, Kazakhstan, Liechtenstein, Monaco and Montenegro be reviewed in 2021, contingent however, upon data being provided to EMEP within the deadlines. In addition, it was planned that the assessment of the implementation of findings from the previous reviews would begin in 2021. The way to carry out future reviews after 2021 had been discussed. For the reviews in 2022 and 2023, rather than starting a new "country cycle", it was proposed to focus on specific topics that could be considered and reviewed for a larger number of Parties within one year. Topics could include: gridded data; large point source data; inclusion of condensables in PM emissions; selected sectors/Nomenclature for Reporting categories (for example, 3F); implementation of previous review findings; national system; and projections. The Implementation Committee, MSC-East, MSC-West and the Task Force on Emission Inventories and Projections would be consulted regarding the choice of topics. As far as possible, the review activities would be harmonized with the review performed under the European Union National Emission Ceilings Directive.[14]

42. In 2020, CEIP had assessed reporting of information on condensables. Twenty-two Parties had provided information on inclusion of the condensable component in particle matter (PM_{10} and $PM_{2.5}$) emission. The condensable component had not been consistently included or excluded in reported emissions. For most source categories of PM emissions, Parties had indicated that it was "unknown" whether the condensable component was included in the PM emissions. The assessment of reporting would continue in 2021.

43. CEIP reported that, in 2020, gap-filled and gridded data sets had been calculated for 2018 (main pollutants and PM, heavy metals and persistent organic pollutants (POPs)) in the first half of the year. CEIP had developed a semi-automated process for gap-filling for the main pollutants, PM and BC. For the main pollutants, gap-filled and gridded data sets for the years 2000 to 2017 would be provided in the second half of 2020. To increase reliability of emission data for modellers, it was important that most of the Parties submit gridded data in 2021. Parties should also provide historical gridded emissions in the 0.1° x 0.1°

[12] See https://emep.int/publ/reports/2020/EMEP_Status_Report_1_2020.pdf.

[13] See www.ceip.at/data-viewer.

[14] See https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2016.344.01.0001.01.ENG&toc=OJ:L:2016:344:TOC.

longitude/latitude grid for the years 1990, 1995, 2000, 2005 and 2010. Gridded data reported in the old 50 km x 50 km resolution and data submitted after the deadline of 1 May could not be included in the data set for the modellers. Like in 2019, CEIP had gridded the BC emissions (2018); however, gap-filling or replacement was necessary for 22 Parties. Shipping emissions had not been reported by Parties. Emissions for the sea regions had been calculated using the Copernicus Atmosphere Monitoring System (CAMS) global ship data set for 2000–2018. The CEIP website (currently accessible with mobile devices) had been relaunched, with improved navigation and the implementation of further technical improvements.

44. The Steering Body and the Working Group:

(a) Reminded Parties to provide "Annex III - Declaration on the publication of the IIR" along with their IIR;

(b) Invited Parties that had not yet provided BC inventories to do so in the next submission;

(c) Invited countries in Eastern Europe, the Caucasus and Central Asia and the Western Balkans to continue with the improvement and regular reporting of their emission data;

(d) Invited Parties that had not yet done so to transfer historical gridded emissions (1990, 1995, 2000, 2005, 2010, 2015) into the 0.1° x 0.1° resolution for the submission in 2021;

(e) Urged Parties to contribute to the work carried out by the EMEP centres on gaps filling and improvement of the emission inventories for modelling purposes, providing relevant information about emission factors and activity data used to report PM emissions, with or without condensable, especially in the residential heating sector;

(f) Approved: the list of Parties for stage 3 emission inventory reviews in 2021 – Bosnia and Herzegovina, Kazakhstan, Lichtenstein, Monaco and Montenegro; and the plan to additionally start the review of the implementation of previous review findings;

(g) Took note of the difficulties in the review process due to the cancellation of physical meetings and the benefits of physical meetings;

(h) Noted with appreciation that Parties had, despite the special circumstances in spring 2020, provided sufficient resources to the invited reviewers for participation in the review process, including calculation of technical corrections, and invited them to continue with such support in the future.

B. Adjustments under the Gothenburg Protocol

45. A representative of CEIP presented the outcome of the review of Parties' requests for adjustments under the Gothenburg Protocol to inventories for the purposes of comparing total national emissions with them (see ECE/EB.AIR/GE.1/2020/10−ECE/EB.AIR/WG.1/2020/21).[15] In 2020, Czechia had submitted new applications, and ten Parties (Belgium, Denmark, Finland, France, Germany, Hungary, Luxembourg, the Netherlands, Spain and the United Kingdom of Great Britain and Northern Ireland) had submitted requests for adjustments approved prior to 2020 (more than 35 cases). The additional guidance adopted in 2014 (ECE/EB.AIR/130) had helped countries to prepare their applications, but additional information had been needed to assess the adjustment requests.

[15] See www.ceip.at/gothenburg-protocol/review-of-adjustments.

46. The adjustment review had been performed alongside the stage 3 review. CEIP had named one lead reviewer and eight sectoral experts from the roster of emission experts. Each reviewed sector had been analysed by two independent reviewers, while the lead reviewer had coordinated the work, ensuring that a consistent approach had been used for all sectors, Parties and years.

47. Parties submitting adjustments approved prior to 2020 had voluntarily prepared and submitted the "Declaration on consistent reporting of approved adjustments", along with annex VII. It was recommended that Parties continue to submit such statements on an annual basis along with the submitted data, and review teams proposed that such a document become a mandatory part when submitting approved adjustments.

48. The representative of CEIP emphasized that, in 2020, most Parties that had submitted adjustment applications had supported the review process in kind by providing an expert. Such technical support was appreciated, and Parties should continue to provide similar support to the review process. Otherwise, it might not be possible to carry out the adjustment review owing to an insufficient number of reviewers. The number of approved adjustments had increased to almost 40 cases. Regular review of all those adjustments required the resources of EMEP and of Parties. CEIP invited EMEP to consider the sustainability of the process and whether there was a need to continue with the review after 2021.

49. As set out in document ECE/EB.AIR/GE.1/2020/10−ECE/EB.AIR/WG.1/2020/21, the expert review team recommended that:

(a) The 2020 new adjustment application submitted by Czechia (Agriculture/Non-methane volatile organic compounds)[16] be accepted;

(b) The adjustment applications of Belgium, Denmark, Finland, France, Germany, Hungary, Luxembourg, the Netherlands, Spain and the United Kingdom of Great Britain and Northern Ireland approved prior to 2020 and resubmitted in 2020 be accepted;

(c) The "Declaration on consistent reporting of approved adjustments" become a mandatory part of reporting.

50. The Steering Body and the Working Group:

(a) Approved all the expert review team's recommendations (see preceding paragraph);

(b) Requested Parties to follow the CEIP recommendations when preparing and submitting applications for adjustments.

C. Measurements and modelling

51. A Task Force on Measurement and Modelling Co-Chair reported on progress in the 2020–2021 workplan, including highlights of its twenty-first meeting (online, 11–13 May 2020). The focus had been on the expertise of Task Force participants of relevance in the context of the Gothenburg Protocol review. The Task Force had investigated the spatial and temporal evolution of air pollution in recent years, highlighting key features of long-term air pollutant exposure trends and the relative importance of local and distance sources. A second important topic of current Task Force work concerned the multi-model Eurodelta-Carb exercise organized jointly with CAMS and devoted to the analysis of a field campaign

[16] The submitted NO_x adjustment was considered by the expert review team as not needed while Czechia was in compliance with its NO_x emission ceilings.

organized in winter 2017/18 jointly with the Aerosols, Clouds and Trace gases Research InfraStructure Network and the Chemical On-Line cOmpoSition and Source Apportionment of fine aerosoL Cost Action. That work was expected to build support to the inclusion of condensable PM in the emission inventories reported to the Convention.

52. A representative of MSC-E briefly outlined activities undertaken by MSC-E in cooperation with CEIP and CCC on the assessment of POP pollution in the EMEP region. Emphasis was placed on research activities on PAHs as one of the priority POPs defined by the Long-Term Strategy of the Convention (decision 2018/5, annex).[17] That work was considered to be a contribution to Task Force on Health and Techno-economic Issues activities. Updated information on long-term changes in measured and modelled benzo[a]pyrene air concentrations was presented indicating the lack of decrease in pollution levels, exceedances of the air quality guidelines and exposure of the population, which could be considered as implications for the analysis of the POP Protocol's effectiveness regarding PAHs. Additionally, the results of experimental model simulations in order to estimate population exposure to a mixture of 16 toxic PAHs were shown. Thus, consideration of a wider list of toxic PAHs and analysis of their toxicity and content in PM could contribute to more detailed evaluation of adverse effects on human health. Research activities aimed at improving the accuracy of PAH pollution assessment were outlined. Lastly, plans of future work regarding POPs and cooperation with subsidiary bodies and international organizations and conventions (for example, AMAP, the European Chemicals Agency, HELCOM and the Stockholm Convention on Persistent Organic Pollutants) were presented.

53. A representative of MSC-E presented an overview of the activities on heavy metal pollution assessment, including progress made regarding work at CCC, CEIP, its own work, discussions within the Task Force on Measurements and Modelling (TFMM) and plans for work in 2021. He highlighted the cooperation with national experts on a country-scale assessment of heavy metal pollution in Germany. The lessons learned from the study for the EMEP pollution assessment were formulated. He provided information on scientific cooperation on research into mercury atmospheric chemistry and contribution to the AMAP assessment of mercury in the Arctic. He also announced a new research initiative on attribution of long-term changes of mercury pollution in the EMEP and other regions. Particular attention was paid to current and potential future cooperation of MSC-East with the Working Group on Effects.

54. A representative of MSC-W gave an overview of the activities performed at EMEP/MSC-W during 2019/2020. The work on condensable organics, presented in the thematic session on condensables, had been one of the main efforts. Furthermore, a study comparing elemental carbon (EC) emissions reported by the countries to EC emissions from the emission scenario where PM emissions from gridded NFR Sector C had been replaced by the Netherlands Organization for Applied Scientific Research (TNO) bottom-up estimate of PM emissions consistently including condensables (EMEPwRef2C) had been performed, showing large differences in modelled EC concentrations and source receptor matrices. For the first time, EMEP model calculations on a very fine scale for all of Europe (down to 100−250 m resolution) had been performed and showed very promising results for NO_2, and better results (in terms of bias) for PM when compared to observations. Downscaled results for $PM_{2.5}$ for the two emission scenarios (EMEP and EMEPwRef2C) indicated that, for the latter, the increased residential heating emissions caused a higher exposure due to the colocation of residential heating emissions and population.

[17] Available at www.unece.org/fileadmin/DAM/env/documents/2018/Air/EB/correct_numbering_Decision_2018_5.pdf.

55. A representative of CCC outlined the status of the 2018 EMEP observations and of the Parties' implementation of the EMEP monitoring strategy. Despite some improvements, there was a need to focus on increasing coverage for and participation from the EECCA region. In 2018, EMEP observations had been influenced by a prolonged heat wave that summer, giving enhanced concentrations of ozone and aerosols. He reported on the status of the intensive measurement period on source apportionment of carbonaceous compounds from fossil fuel and wood burning during winter 2017/18. Data were currently available on demand. He presented ongoing work on monitoring of chemicals of emerging concern and proposed a targeted workshop on that issue in 2021. He further outlined developments related to data flow, the data reporting system and dissemination and use of EMEP data.

D. Integrated assessment modelling

56. The Task Force on Integrated Assessment Modelling Co-Chairs reported on: the progress of work on, among other things, the "Ammonia Assessment Report", the report on the Costs of Inaction and the assessment of PM measures that were also effective in reducing BC; and the results of the first meeting of the Expert Panel on Clean Air in Cities (Bratislava, 27 November 2019) and the Task Force's forty-ninth meeting (online, 20–22 April 2020).

57. For most countries, emissions in the period 2020–2030 would become lower than the emission targets set in the Gothenburg Protocol, assuming that the emission limit values in the Protocol's annexes, as well as stated climate policies, were fully implemented. Additional reductions would occur when fossil fuel use was further reduced. The exception was ammonia, where more measures would be needed to reach existing targets. Due to limited reduction of ammonia emissions, nitrogen depositions would remain higher than critical loads in 50 per cent of ecosystems. In 2030, $PM_{2.5}$ concentrations would exceed the WHO guideline value for $PM_{2.5}$ in large areas of northern Italy and parts of Poland due to the high share of primary emissions from solid fuel domestic heating. Health risks and crop damage due to ozone would also remain a problem in Europe, with increasing emissions of nitrogen oxides and methane in the northern hemisphere. Around Europe, NO_x emissions from ships would exceed NO_x emissions on land in the European Union before 2030. Trade-offs between policy areas called for an integrated approach comprised of air quality management, climate and energy policy, as well as agriculture and food policy.

58. For the Gothenburg Protocol review, the most important issue for the Task Force and CIAM was to produce emission projections that took into account recent climate, energy and agricultural policies, new source legislations and updated emission inventories and to assess whether emission reduction obligations would be met and whether they were adequate for meeting the Protocol's long-term environmental and health protection targets.

59. The International Institute for Applied Systems Analysis (IIASA) − the host of CIAM − was currently reorganizing its research programme structure, possibly resulting in delays. CIAM was currently working to assure that there was enough capacity to answer the above-mentioned questions in a timely manner, but prioritization of questions might be necessary.

60. The second meeting of the Expert Panel on Clean Air in Cities would be held virtually on 29 September 2020.[18]

61. The Steering Body and Working Group:

[18] Registration via https://web.jrc.ec.europa.eu/remjrc/screen/meeting/6706/registration-form.

(a) Welcomed the progress on the workplan elements contributing to the Gothenburg Protocol review, in particular projections of emissions and concentrations in the period 2020−2030;

(b) Took note of the future new organization of research programmes at IIASA and of its potential impacts on the CIAM workplan and acknowledged that the contribution of CIAM to the EMEP programme was essential, especially from the perspective of the Gothenburg Protocol review. Therefore, although prioritization of work might be necessary, a smooth transition towards the new organization would be highly appreciated.

E. Hemispheric transport of air pollution

62. Ms. Heather Morrison (Canada), Co-Chair of the Task Force on Hemispheric Transport of Air Pollution (TFHTAP), provided an overview of the Task Force's progress on elements of the 2020–2021 workplan and outcomes of its April 2020 online meeting. She introduced an interactive element of the Task Force's website to promote dialogue between scientists and policymakers around policy-relevant science questions and answers.

63. The Steering Body and Working Group:

(a) Welcomed the progress on the workplan elements contributing to understanding of global emissions, the ozone benefits of methane mitigation, attribution of trends to changes in extra-regional sources, and impacts of shipping;

(b) Suggested that a workshop be held in conjunction with MSC-E to learn about the global assessments of mercury and POPs pollution;

(c) Welcomed the creation of a mechanism to promote dialogue around policy-relevant science questions and answers based on the Task Force's work.

64. The Steering Body and the Working Group:

(a) Noted that all the status reports relevant for the evaluation of progress in implementing the 2020–2021 workplan had been prepared by the EMEP centres on time; the 2020 EMEP status and technical reports, including supplementary reports, were available on the EMEP website[19] and listed in an informal document under agenda item 5 (b);

(b) Welcomed the information on progress made in implementing the 2020–2021 workplan regarding EMEP, as presented during the current session and in related publications and reports;

(c) Welcomed the key messages and deliverables of the work carried out by all EMEP centres and task forces presented at the session and summarized in the 2020 joint report (ECE/EB.AIR/GE.1/2020/3–ECE/EB.AIR/WG.1/2020/3).

VII. Joint thematic session: Condensables

65. The goal of the session was to review the state of the knowledge on the condensable part in PM emissions, which was not systematically taken into account in emission factors and thus in PM emission inventories. The Executive Body (ECE/EB.AIR/144, paragraph 22 (i)) reiterated its request to the EMEP Steering Body to continue its scientific work for accounting for the condensable part of particulate matter in scientific assessments of the Convention, and to report on progress to the Executive Body at its fortieth session.

[19] See www.emep.int.

66. A representative of MSC-West presented the outcomes of a workshop held online from 17 to 19 March 2020 as part of a Nordic Council of Ministers-funded research project, at which an international panel of experts on emission measurement and inventory, modelling and mitigation had discussed whether and how the condensable part of PM should be considered in air quality policy decisions. The final report of the project was expected by the end of 2020. A preliminary road map had been proposed. It stated that, on the one hand, not accounting for condensable in PM model results brought high inaccuracies and could hamper the relevance and reliability of model responses, in particular when they were used for policy purposes (air quality assessment, scenario simulations and source/receptor relationships used in integrated assessment modelling). On the other hand, quantification of the condensable part in PM emissions remained challenging, as, in several countries, emission factors were established on the basis of filterable measurements that only accounted for the solid part of particles. Moreover, the condensable part in PM depended on activity data (type of appliance, type of fuel, etc.) and the activity description was still incomplete in the IIRs submitted by the Parties.

67. It had been agreed that modelling activities within EMEP should be carried out with best emission estimates. Therefore, expert estimates accounting for the condensables in PM would be favoured as input data for simulations. A first "science-based" emission inventory had been built up by TNO supported by the European Union Earth Observation Programme Copernicus and was available.

68. Another representative of MSC-West presented first air quality simulations (assessment and source/receptor) performed with the TNO emission inventory and compared the results with simulations based on official national emissions. There was a significant improvement that would be further characterized by the Eurodelta-Carb model intercomparison exercise. The aim was to compare about 10 models' responses, running with emission inventories with and without condensable PM, and capacities to simulate the observations of the latest EMEP intensive observation period (winter 2018/19) focused on carbonaceous compounds.

69. A representative of CEIP reported on the inclusion of condensable component in PM national inventories. The main messages included:

(a) In the EMEP/EEA Guidebook, the condensable fraction was not consistently included or excluded in the emission factors;

(b) In 2020, 22 Parties had provided information on the inclusion of the condensable component in PM_{10} and $PM_{2.5}$ emission factors;

(c) Currently, the condensable component was not consistently included or excluded in PM emissions reported by Parties; for the majority of the source categories of PM emission, Parties reported "unknown" if the condensable component was included in the PM emissions, or they provided no information or the information provided was unclear.

70. The representative of CEIP suggested CEIP actions on "condensables" in 2021/22, including the CEIP contribution to the development of guidance for Parties on which additional information should be included in IIRs (for example, on type of stoves).

71. The discussion in the thematic session concluded that the road map proposed by MSC-West should be further detailed, especially regarding the timeline and recommendations to the Parties regarding emission reporting. In parallel, the Executive Body requested the Working Group on Strategies and Review to discuss the policy implications of condensables reporting and to report back to the Executive Body at its fortieth session (ECE/EB.AIR/144, para. 22 (h)). For the science topics, the EMEP Steering Body Chair proposed setting up an ad-hoc experts group gathering skills from national experts and from the EMEP centres and task forces. The Task Force on Health and the Task Force on Techno-economic Issues would

also be invited to participate. The ad hoc group would be established by the EMEP Steering Body Chair before the end of 2020.

VIII. Joint thematic session: Ozone pollution

72. The goal of the session was to review the state of the knowledge on tropospheric O_3 pollution from the perspective of the Gothenburg Protocol review. The discussion was moderated by Mr. Xavier Querol (EMEP Steering Body Vice-Chair) and consisted of two sub-sessions: on atmospheric pollution of tropospheric O_3; and on the effects of O_3. The thematic session brought the following messages:

(a) In summer local/regional pollution episodes, the locally/regionally produced O_3 contribution could reach a considerable load to the 8-hour daily maximum concentrations. Experimental and modelling approaches could be combined to evaluate those contributions with a view to devising cost-effective O_3 abatement strategies. Summer VOCs measurements in Southern Europe evidenced complex VOCs composition profiles that should be taken into account for O_3 modelling. Ozone levels were affected differently by the COVID-19 lockdown across Europe due to the combination of: (i) reduction of emissions of precursors; (ii) different meteorological conditions across Europe during lockdown; and (iii) different VOCs/NO_x regimes for O_3 formation;

(b) The hemispheric contribution for O_3 was greater than for PM, and the most important VOC precursor for that background O_3 was methane. Background methane was continuously increasing and could contribute to summer ozone air pollution in Europe. The contribution of hemispheric transport to background O_3 was higher in spring than in summer. Hemispheric transport had contributed up to 50 per cent of regional O_3 levels (O_3 baseline) in Berlin for a selected period in June–July 2015. Acute episodes of high O_3 were associated with local emissions of anthropogenic NO_x and VOCs and also biogenic VOCs in most regions;

(c) Estimations of O_3 levels that would be reached without European anthropic emissions of precursors evidenced the importance of the O_3 produced from biogenic VOCs and hemispheric contributions. O_3 levels over Europe tended to decrease, but that trend had been attenuated in the past decade. VOC concentrations had decreased by 47 per cent and NO_x by 57 per cent, thus VOCs/NOx ratios might have changed;

(d) Emission profiles of VOCs used for modelling needed to be improved and validated using ambient air measurements. For oxygenated VOCs, there were only three EMEP stations in Europe with detailed measurements. In some cases, the modelling scales were insufficient to reproduce local/regional episodes;

(e) WHO reviews on health effects of O_3 evidenced that the relationship between short-term exposure to O_3 and increased respiratory-related mortality and increases in respiratory-related morbidity was considered casual. Long-term exposure correlated with increased all-cause and respiratory-related, with less evidence on causality of the association; moderate certainty in the evidence for peak exposure and all-cause mortality. The evidence on the association between short- and long-term exposure to O_3 and health effects had been growing, but methodological challenges remained due to complex relationships between O_3 and other pollutants;

(f) In Europe, O_3 concentration profiles had changed, with higher background levels in urban areas and fewer peak episodes. The increase in background O_3 had affected ecosystems and crops. The productivity of specific crops had been significantly reduced due to O_3 effects. Average decreases on productivity had reached 4–5 per cent in Europe for specific crops. With climate change, those impacts would increase.

73. The session identified the following needs and recommendations for further work:

(a) Always specify when trends, contributions, emissions and abatement policies referred to background O_3 and spring/summer O_3 pollution episodes;

(b) Use available modelling and experimental tools to differentiate local, regional, hemispheric and stratospheric contributions and implement accurate sensitivity analysis to evaluate O_3 abatement potential in different regions; Those tools needed to be improved to reduce errors, including VOCs modelling, and the scales required for accurately modelling local contributions and complex meteorological processes;

(c) Better document VOC precursors: VOCs species, regional variability and changes that had occurred in the past decades. VOCs emission factors used for the emission inventories were not speciated enough, and were produced in most cases 20 years previously and should be updated;

(d) Fully implement the EMEP monitoring strategy regarding measurements of all VOCs necessary for O_3 modelling;

(e) Better evaluate what the feedbacks of O_3 and climate were, especially on the expected impacts of climate change on both background and local/regional O_3 pollution episodes;

(f) Better evaluate what the impact of O_3 was on other pollutants, such as $PM_{2.5}$, in urban areas where O_3 increased;

(g) Better evaluate the major health effects of O_3, especially taking into account the complexity of the relationships of that pollutant with others, and the benefits of abating O_3 levels;

(h) Use O_3 fluxes to assess impacts of ozone on crops and ecosystems, and those also allowed climate change effects to be included;

(i) Better understand O_3 precursor emissions' changing contributions in different regions of the world to historical and future trends in background O_3, with emphasis on the contribution of methane and international shipping sources in addition to the major continental source regions.

74. Contributions to the session were provided by representatives of CCC, ICP Vegetation, MSC-West, Spain, TFMM, TFHTAP and WHO.

75. The two thematic sessions had provided a consolidated state-of-the-art starting point for relevant discussions under the Gothenburg Protocol review process.

IX. Conclusions and recommendations

76. The secretariat presented the draft conclusions and recommendations from the sixth session (see the respective presentation and informal document "Informal draft conclusions and recommendations regarding financial matters and adjustments under the Gothenburg Protocol – courtesy translation into FR and RU by the secretariat" under agenda item 8). The Steering Body and the Working Group on Effects agreed on the main conclusions drawn and recommendations made during their sixth session.

X. Election of officers

77. Following elections, Ms. Rouîl was re-elected as Chair of the EMEP Steering Body. Mr. Xavier Querol (Spain) was re-elected as a Vice-Chair. Mr. Mike Holland (United

Kingdom of Great Britain and Northern Ireland) and Ms. Joanna Struzewska (Poland) were elected as new Vice-Chairs. All Bureau members were elected for a two-year term.

78. Following elections, Ms. Rábago was re-elected as Chair of the Working Group on Effects. Ms Sabine Augustin (Switzerland), Mr. Jesper Bak (Denmark), Ms. Alessandra De Marco (Italy), Mr. Thomas Dirnböck (Austria) and Ms. Gudrun Schuetze (Germany) were re-elected as Vice-Chairs. All Bureau members were elected for a two-year term.

XI. Information-sharing by Parties

79. The information presented by Parties could be found in the informal document under agenda item 10.

XII. Closing of the sixth joint session

80. The Chairs of the EMEP Steering Body and the Working Group on Effects closed the online sixth joint session, which had attracted over 140 participants. The two bodies would hold their seventh joint session in Geneva from 13 to 17 September 2021.