United Nations ECE/EB.AIR/GE.1/2022/4–ECE/EB.AIR/WG.1/2022/15

Economic and Social Council

Distr.: General
1 July 2022

Original: English

Economic Commission for Europe

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

Eighth joint session
Geneva, 12–16 September 2022
Item 10 (b) of the provisional agenda
Progress in activities of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe in 2022 and future work: measurements and modelling

Measurements and modelling

Report of the Task Force on Measurements and Modelling on its twenty-third meeting

Summary

The present document contains the annual report of the Task Force on Measurements and Modelling under the Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe, in accordance with the 2022–2023 workplan for the implementation of the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/148/Add.1), and in line with the revised mandate of the Task Force (Executive Body decision 2019/8). The present report summarizes the discussions at and the outcomes of the Task Force's twenty-third meeting (online, 3–5 May 2022).

I. Introduction

1. The present report contains the outcomes of the twenty-third meeting of the Task Force on Measurements and Modelling (online, 3–5 May 2022), including the presentation of activities undertaken since its previous meeting (online, 10–12 May 2021). It describes progress in implementation of the monitoring strategy for the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) for the period 2020–2029 (Executive Body decision 2019/1)[1], in the development of modelling tools and specific ongoing assessments according to the 2022-2023 workplan for the implementation of the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/148/Add.1) as well as current and potential collaborative activities with other bodies of the Convention on Long-range Transboundary Air Pollution (the Convention).

2. In all, 152 experts from the following Parties to the Convention attended the meeting: Austria, Belgium, Canada, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Netherlands, Norway, Poland, Russian Federation, Slovakia, Spain, Sweden, Switzerland, Türkiye, United Kingdom of Great Britain and Northern Ireland and United States of America. Also present were representatives of: the Chemical Coordinating Centre (CCC); the Centre on Emission Inventories and Projections; the Meteorological Synthesizing Centre-East (MSC-East); the Meteorological Synthesizing Centre-West (MSC-W); the Centre for Integrated Assessment Modelling; the European Environment Agency; the European Commission; the Task Force on Integrated Assessment Modelling; the Task Force on Hemispheric Transport of Air Pollution; the Task Force on Emission Inventories and Projections; and the World Meteorological Organization (WMO).

3. Mr. Augustin Colette (France) and Ms. Oksana Tarasova (WMO) co-chaired the meeting. They presented the agenda,[2] highlighted the progress on the 2022–2023 workplan, outlined input already provided by the Task Force and further expectations from the Task Force towards the review of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol), as amended in 2012 (Executive Body decision 2019/4) and the update of the strategies for the scientific bodies of the Convention, i.e. the Steering Body to EMEP and the Working Group on Strategies and Review. That introduction was also an opportunity to advertise a new joint group being set up between the Task Force and the Task Force on Emission Inventories and Projections to further increase collaboration between emission inventory compilers and modellers.

II. Updates from the Convention and Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe Centres

4. A representative of the Convention secretariat provided an update on EMEP and the Convention. He presented updates from the forty-first session of the Executive Body (Geneva, 6–8 December 2021), the sixtieth session of the Working Group on Strategies and Review (Geneva, 11–14 April 2022), the seventh Joint Session of the EMEP Steering Body and the Working Group on Effects (Geneva, 13–16 September 2021) and the Extended Bureaux Meeting of the EMEP Steering Body and the Working Group on Effects (Geneva, 21–24 March 2022). Additionally, he highlighted capacity-building and awareness-raising activities, such as training sessions, workshops and meetings, as well as communication and outreach activities carried out by the secretariat (e.g., a contribution to the International Day of Clean Air for Blue Skies (7 September)). He also provided an update on the Gothenburg Protocol review, including a timeline for 2020–2022 and the key questions to be further addressed and documented.

5. A Co-Chair of the Task Force for International Cooperation on Air Pollution (TFICAP) presented the design and scope of that new Task Force of the Convention. The

[1] All Executive Body decisions referred to in the present document are available at www.unece.org/env/lrtap/executivebody/eb_decision.html.

[2] Available at https://projects.nilu.no/ccc/tfmm/.

main objective of TFICAP was to promote international collaboration towards preventing and reducing air pollution to improve air quality globally and it aimed to: act as a forum for international exchange and mutual learning; and facilitate the sharing of science, techniques and policy expertise internationally. He presented the 2022–2023 workplan and current outreach activities ahead of the launch of a new website. The first Task Force meeting would be held in Bristol (United Kingdom of Great Britain and Northern Ireland) on 10–12 October 2022. The Task Force would be heavily involved in the Saltsjöbaden VII workshop (Gothenburg, Sweden, 13–15 March 2023). Several questions were raised for participants to answer through an online survey regarding capacity-building activities currently ongoing under the Task Force on Measurements and Modelling, potential areas of collaboration between the Task Force and TFICAP and materials and tools that the Task Forces had developed that TFICAP could promote. A representative of WMO noted the link with the United Nations Framework Convention on Climate Change and the Global Stocktake, an important process into which to feed.

6. A representative of MSC-W gave a presentation on MSC-W activities during the period 2021–2022. Presented results included long-term model simulations over the period 2000–2019 and their evaluation against in situ measurements currently available under an improved online interface[3]. She stressed the importance of including condensable organics in that modelling. Large changes in emissions in the past 20 years had led to large reductions in concentration and deposition of sulfate (S) and nitrogen (N) species and concentration of particulate matter (PM). She demonstrated an overall consistency between model runs and observations (except for organic carbon, nitrogen oxides (NO_x) and deposition of oxidized nitrogen). Additionally, she spoke about the use of satellite data to evaluate emissions in countries of the Western Balkans region and the Eastern Europe, the Caucasus and Central Asia region where limited number of surface observations is available. The next steps in preparing for the EMEP field campaign devoted to volatile organic compounds (VOCs) were also presented.

7. A representative of CCC provided an update on CCC activities with a focus on open data and fairness. He presented the EBAS database[4] – developed and operated by the Norwegian Institute for Air Research (NILU) and partly funded by EMEP. He highlighted the FAIR (Findable, Accessible, Interoperable, Reusable) Guiding Principles for scientific data management and stewardship and the persistent identifiers and digital object identifiers used in the EBAS database, underscoring the importance of including a thorough data licensing policy in order to protect and acknowledge data providers. Additionally, he discussed data licensing, noting that NILU wished to license all open data in EBAS with clear attribution to EBAS/NILU, as well as relevant frameworks (such as EMEP, the Aerosols, Clouds and Trace gases Research InfraStructure (ACTRIS) Network or the Global Atmosphere Watch (GAW) Programme), and even recommended contacting data originators when the use of data would benefit from their involvement (referred to as “substantial use”). CCC would prepare a note as a basis for discussion on that issue at the eighth joint session of the EMEP Steering Body and the Working Group on Effects (Geneva, 12–16 September 2022). He also presented the European ACTRIS consortium, to be established in the current year, and concluded the presentation with information about a workshop on monitoring of chemicals of emerging concern planned for 2023.

8. A representative of MSC-E gave a presentation on new assessment of heavy metals (HMs) and persistent organic pollutants (POPs) pollution. MSC-E was engaged in numerous research and cooperation activities and the speaker highlighted three, which were related to: mercury (Hg) pollution, including a contribution from MSC-E to the cooperative studies in support of the Arctic Monitoring and Assessment Programme Mercury Assessment.; HMs and POPs from wildfires, including a study on the effect of natural wildfires on benzo[a]pyrene (B(a)P) and HMs (lead (Pb)) pollution levels in the EMEP region. He also presented activities on and contaminants of emerging concern, including their monitoring and modelling. He stressed a need for further research on atmospheric chemistry of Hg, additional research on wildfire emissions, as well as further collaboration on measurement

[3] Available at https://aeroval.met.no/evaluation.php?project=emep-trends&exp_name=2000-2019.
[4] Available at https://ebas.nilu.no/.

and modelling of contaminants of emerging concern, which would be the topic of a workshop to be held in 2023.

III. Thematic session: General country and international organization updates

9. A Co-Chair of the Task Force and representative of WMO provided an update on the WMO GAW Programme. GAW had conducted the Quadrennial GAW Symposium (online, 28 June–2 July 2021), with over 300 participants from 70 countries, receiving input on the GAW Implementation Plan: 2024–2027. Initial brainstorming on the new Implementation Plan had identified the need to make atmospheric composition more prominent in advancing science, policy and services. She provided an update on the work of GAW to support environmental and climate policy and the health sector, as well as updates on the Measurement-Model Fusion for Global Total Atmospheric Deposition (MMF-GTAD) and the Integrated Global Greenhouse Gas Information System. She also highlighted several highly successful outreach events hosted by GAW at the twenty-sixth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (Glasgow, United Kingdom of Great Britain and Northern Ireland, 31 October–13 November 2021), as well as how GAW was contributing to the integration of urban-related activities with the launch of three documents[5] ahead of a related workshop (Geneva (hybrid), 13–15 June 2022).

10. An expert from Environment and Climate Change Canada, provided an update on the WMO MMF-GTAD The Initiative took a "science for services" approach in order to assess the impacts of atmospheric deposition on the environment and the Sustainable Development Goals by providing the best possible atmospheric deposition maps produced operationally on a global scale. She also briefly highlighted the MMF-GTAD Implementation Plan for 2021–2026,[6] which provided more information about the motivation behind the Initiative, identified potential stakeholders and users and laid out objectives and plans. Upcoming activities included the release of global pilot output, stakeholder meetings and consultations and an MMF-GTAD techniques workshop, which would include a virtual science symposium (19–23 September 2022) and an in-person expert meeting (6–7 October 2022).

11. A representative of Spain provided an update on the Spanish National Ozone Plan. He reviewed trends from 2008 to 2020 at selected stations in Span and spatial variability of ozone over the country during the period from 2015 to 2019. Exceedances of the human protection target largely occurred around the hot spots of Barcelona, Madrid, Valencia and in southern Spain, but such exceedances could also be found across the country. In 2020, for the first time in its history, Spain had not exceeded the ozone (O_3) protection threshold established by the World Health Organization (WHO) on the Mediterranean coast, although that threshold had been exceeded elsewhere, particularly around Madrid. That situation was likely the result of cruise ships being absent during that time period due to the coronavirus disease (COVID–19) pandemic. He noted that particular regions in Spain, including the regions of Catalonia, Madrid and Valencia, were O_3 hotspots with the highest number of days per year on which the O_3 protection threshold had been exceeded and that these are the regions to be specifically targeted in the National Ozone Plan He referred to the studies related to the role of VOCs in Spain and future policies that would target those constituents given their potential to lead to O_3 formation.

12. An expert from Spain gave a presentation on modelling activities towards the design of O_3 mitigation strategies in Spain. The motivation behind that work was to advance understanding of key processes controlling tropospheric O_3 formation and development of episodes combining monitoring and modelling techniques, as well as designing emission reduction scenarios. He provided a brief overview of the various modelling tools used, including the Multiscale Online Nonhydrostatic AtmospheRe CHemistry model and the

[5] Available at https://community.wmo.int/meetings/launch-3-urban-reports.
[6] Available at https://library.wmo.int/doc_num.php?explnum_id=10831.

High-Elective Resolution Modelling Emission System version 3,[7], discussed the results of emission scenarios results and how those would be used the design of specific measures to reduce O_3 in Spain.

13. An expert from Italy gave a presentation on Weather Research and Forecasting model coupled with Chemistry (WRF-Chem) air quality simulations for the AIRFRESH project,[8] which aimed to estimate air pollution in removal capacity by urban trees and shrubs by a reforested test area in Aix-en-Provence (France) and Florence (Italy). She provided a brief overview of the WRF-Chem experimental design, including the model set-up, forcings, domains and scenarios analysed, which included simulations with current vegetation, without vegetation, and with reforestation. The preliminary results demonstrated that the simulations of NO_2 represented the reanalysis but with more resolved spatial patterns and reproduced observational data. She noted, however, that simulation results were not always comparable with point observations due to differing spatial resolutions. The simulation results for O_3 systematically overestimated O_3 concentrations. Lastly, for $PM_{2.5}$, the simulation differed from reanalysis but was in line with observations.

IV. Thematic session: Advances in modelling and monitoring techniques

14. An expert from the Netherlands gave a presentation on the evaluation and development of regional air quality modelling and data assimilation. The Copernicus Atmospheric Monitoring Service (CAMS) included a regional air quality service with an ensemble of nine chemistry transport models that provided daily forecasts over Europe. To improve the quality of the CAMS regional air quality service, an in-depth assessment of CAMS regional forecasts had been conducted. Additionally, best practices for coupling forecasts to analyses had been identified and model-agnostic tools for data assimilation developed. The evaluation had proved to be very useful in identifying general and model-specific issues, allowing for potential improvements in description of different physical and chemical processes. She concluded with several general recommendations from the evaluation, such as: integrating a benchmark test into CAMS regional service operations; including a specific focus on natural components such as desert dust; moving towards dynamic emission modelling for anthropogenic emissions; and improving the representation of dry and wet deposition.

15. A representative of MSC-W gave a presentation on the modelling impact of condensable organics from 2005 to 2019, highlighting a research project supported by the Nordic Council of Ministers. The project revised historical $PM_{2.5}$ emissions from residential wood combustion to consistently include condensable organics and assess the implications for the Gothenburg Protocol. The project covered important issues such as the range of uncertainty in estimates of the condensable component, the importance of volatility distribution and how to connect to the results of the Greenhouse gas – Air pollution Interactions and Synergies (GAINS) model. The project was expected to conclude in June 2022. Preliminary results had shown that including condensables consistently led to results (trends and bias) that were in better agreement with observations for organic carbon and $PM_{2.5}$. Additionally, the project had found that, although the scenario relying on the highest assumption for emission factors agreed best with observations overall, it was overestimating $PM_{2.5}$ in many countries. The model set-up mattered for trends and source receptor results, with higher emission scenarios tending to show the largest negative trends with better comparison to observed trends, and assumption about volatility seemed to be important. In the conclusions, further potential developments were cited, including the fact that results would be made more robust when data over longer time series than ten years became available, or when intermediate volatile organic compounds (IVOCs) and semi-volatile organic compounds (SVOCs) from other activity sectors than residential wood burning were included.

[7] See https://gmd.copernicus.org/articles/13/873/2020/.
[8] See www.life-airfresh.eu/.

16. An expert from France gave a presentation on the determination of IVOC emissions and their impact on air quality. In the EVORA project the challenges related to SVOCs and IVOCs modelling were addressed through measuring the distribution by volatility of organic compounds of different representative passenger cars, estimating IVOC emissions from other sectors and evaluating the impact on air quality with the CHIMERE model.[9] The expert briefly explained the experimental set-up, sampling strategy and analytical strategy of the project, before revealing top line conclusions, including contributions to total IVOC emissions from the solvent, road traffic and wood burning sectors, as well as the impact of IVOC emissions on ambient PM concentrations using the CHIMERE model. He also noted that the sampling methodology could be improved in the future to strengthen the quantitative volatility distribution of all VOCs.

17. A representative of Spain gave a presentation on the Research Infrastructures Services Reinforcing Air Quality Monitoring Capacities in European Urban and Industrial Areas (RI-URBANS) Horizon 2020 project. The overall objective of the project was to provide a road map for upscaling sustainable interoperable Air Quality Monitoring Networks-Research Infrastructure services, which would be achieved through several subobjectives focusing on measurement, mapping and modelling. The project covered the 11 following European cities: Amsterdam, Athens, Barcelona (Spain), Birmingham (United Kingdom of Great Britain and Northern Ireland), Bucharest, Bologna (Italy), Helsinki, Milan (Italy), Paris, Rotterdam (Netherlands) and Zürich (Switzerland). However, it was noted that several other cities had been accepted for upscaling. The project would use the European Union ACTRIS and would involve urban air quality, health, urban mapping, modelling (including from CAMS) and citizen science experts, as well as the private sector, which would provide advanced instrumentation. In the conclusion, a review of some of the data from the project's focus cities was provided.

18. A Co-Chair of the Task Force and representative of the French National Institute for Industrial Environment and Risks (INERIS) gave a presentation on regional modelling of future air quality scenarios in the CAMS policy service. CAMS provided relevant Europe-wide information products to support policymakers, including air quality forecasts, emission inventories and policy tools. The CAMS policy service was led by INERIS, with contributions from NILU and the Netherlands Organization for Applied Scientific Research, and covered assessment reports, the Air Control Toolbox, source-receptor analysis in European Union member States and prospective scenario analysis. Additionally, workshops and collaborative studies were conducted to improve interaction with policy users. The presentation focused on multimodel prospective scenario modelling combining global and regional modelling tools to assess potential air quality policies by 2050. Specific work was devoted to the analysis of methane mitigation scenarios and their impact on various O_3 indicators. The analysis continued with a more quantitative evaluation, exposure averaged by country and generalization of the multimodel evaluation. European analysis was set to be completed by summer 2022 and the model output could be made available for national analyses. That modelling work would be particularly relevant to follow-up jointly between the Task Force and the Task Force on Hemispheric Transport of Air Pollution on the issue of methane mitigation strategies.

19. An expert from Czechia gave a presentation on the Non-CO_2 forcers and their climate, weather, air quality and health impacts (FOCI). The project was motivated by the Horizon Europe call for improved understanding of greenhouse gas fluxes and radiative forces, as well as the Intergovernmental Panel on Climate Change Sixth Assessment Report Working Group I findings around knowledge gaps concerning the impact of many non-CO_2 radiative forcers leading to low confidence in the Working Group I report conclusions. Additionally, the presence of a strong group of researchers focused on air quality modelling was a motivating force for the FOCI project, which would run from September 2022 to August 2026 and would improve knowledge of individual and cumulative contributions of non-CO_2 radiative forcers and their precursors, with the main goals focused on assessing the impact of key radiative forcers, where and how they arose and the processes of their impact on the climate system. The project would be overseen by an advisory board consisting of nine

[9] See www.lmd.polytechnique.fr/chimere/.

internationally recognized experts, and would cooperate with numerous relevant projects. Additionally, an extensive global dissemination and communications plan would ensure that the impact and relevance of project outcomes were communicated to stakeholders, including the weather, climate, air quality and health communities.

20. After a series of presentations, participants briefly discussed the state of global and regional modelling of methane and O_3 links. A Co-Chair of the Task Force on Hemispheric Transport of Air Pollutants provided an overview of some of the ongoing work looking at links between O_3 and methane at the global scale, which showed spatial differences in the O_3 responses to global methane changes, likely due to local nitrogen oxides (NO_x) conditions. He noted that, moving forward, there was interest in looking at how varied the O_3 response was to methane changes in regional models, as well as what could be learned from simulations for methane scenarios and how further design work should be carried out in collaboration with the Task Force on Measurements and Modelling. Such collaboration could, for instance, contribute to a better understanding of whether there was a substantial impact of methane at the regional scale directly on O_3 formation, or indirectly involving other co-emitted species.

V. Thematic session: Heavy metals and POP modelling, including Eurodelta-BaP multi model comparison

21. A representative of Poland gave a presentation on the spatial and temporal variability of benzo[a]pyrene (BaP) over Poland based on national high-resolution air quality monitoring and observations. She noted that BaP concentrations showed a decreasing trend over the past decade but average concentrations were much higher than the threshold, and concentrations in 2020 had been influenced by anomalous meteorology and the COVID-19 lockdown. In Poland, seasonal variation of BaP showed maximum concentrations during winter (October-March) due to household heating. Modelling results revealed very good spatial and temporal agreement with observations. Model analysis of reduction scenarios showed that the "Clean Air" Programme[10] could reduce exposure, but the number of zones with exceedances would remain high. Additionally, analysis showed that, by 2026, regional air quality plans would reduce concentrations by up to 60 per cent compared to the base year 2020. Moving forward, collaboration with neighbouring Czechia would be explored and additional scenarios studied, including the impact of the heat cogeneration scenario (at least 70 per cent heat consumption in cities) and potentially a scenario considering BaP estimates based on PM_{10} from the residential sector.

22. A representative of the Meteorological Synthesizing Centre-East (MSC-E) gave a presentation on polycyclic aromatic hydrocarbons (PAHs)/BaP pollution assessments at the global, regional and national scales. He highlighted the contribution to the EuroDelta-Carb model intercomparison project, also involving experts from Finland, France, Italy and Spain, which aimed to evaluate BaP/organic matter emissions from the residential sector, assess BaP pollution levels and exceedances of air quality guidelines, and analyse the transport and fate of BaP and PM components. Additionally, he discussed an ongoing case study on PAH/BaP pollution in Poland, currently in its second phase. He concluded with a review of global scale PAH pollution assessment activities and several proposals for future research initiatives and opportunities for further collaboration.

VI. Thematic session: Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe O_3/VOC intensive measurement period

23. A representative of CCC gave a presentation on the EMEP intensive measurement period (EIMP) scheduled for summer 2022. EIMPs were held every 3 to 4 years, with a focus on specific scientific topics with identified gaps, and involved Parties to the Convention through the Task Force, as well as close cooperation with research programmes and European

[10] See www.gov.pl/web/climate/clean-air-20-programme-launched.

Union infrastructures. Historically, there had been significant interest in aerosol-related topics and there was currently a desire to focus on O_3 formation during summer heatwaves. The upcoming EIMP would be held for one week between mid-June and mid-July 2022. The plans for that one-week EIMP were further explained, including how the specific VOCs and secondary organic aerosols (SOAs) would be measured and which sites would be participating. The sampling equipment was distributed mainly across EMEP sites, but other sampling locations (typically more urban locations) were also welcome to join the initiative. The analysis of the samples would be centralized at laboratories located in Finland, France and Germany. As usual for EIMPs, most financial support was essentially provided by the Parties as part of their commitment arising from the Convention. However, additional financial support would be offered by the European Solvents Industry Group to facilitate the involvement of additional stations. Remaining logistics and coordination were to be finalized in the coming weeks prior to the EIMP.

24. An expert from the Institut des Géosciences de l'Environment (France) gave a presentation on the proposed centralized analysis of tracers of SOA components of PM in the 2022 EIMP. The proposed analysis included two analytical runs of mass spectrometers, which could cover a wide range of chemical species and anthropogenic emissions tracers or indicators of biogenic sources. The added value of those analyses was illustrated on the basis of long-term sampling at two locations, Grenoble (France) and Kanal (Slovenia), which were approximately 620 km apart. It was noted that said analyses would be useful in source appointment studies, as well as the synthesis of large databases, and would be compared with results collected by ACTRIS and EMEP.

25. An expert from IMT Nord Europe (France) gave a presentation on VOC centralized sampling and analysis in the 2022 EIMP. Oxygenated VOCs (oxy-VOCs) had been selected due to the fact that they were the most abundant VOCs in ambient air, key compounds as tracers of primary sources and chemical processes, and had adverse health effects. The expert explained implementation during the EIMP, optimization and evaluation of the method, as well as intercomparison studies with other measurement techniques.

26. An expert from Forschungszentrum Jülich (Germany) gave a presentation on canister VOC sampling and analysis in the 2022 EIMP. He noted that many EMEP sites lacked VOC measurements but an easy-to-use sampling system should be available at several sites. He explained how sampling would be done with specific, inert, treated canisters. Samples would be taken over a period of one hour and, once the first four canisters had been filled, they would be shipped to Jülich (Germany) to keep the residence time of the samples in the cylinders short. The canisters would then be pressurized and analysed. An intercomparison would be undertaken for the VOCs also measured by the analytical method proposed by IMT Nord Europe (France) presented by the preceding speaker. He concluded by referring to a number of journal articles on applications of the above-mentioned sampling approach.

27. An expert from the Finnish Meteorological Institute gave a presentation on Tenax tube VOC sampling and analysis in the 2022 EIMP. She began with a brief overview of the VOCs measured with Tenax tubes in the study, as well as additional compounds currently being tested. She then explained how sampling was conducted with a pumped sampling being followed by thermal desorption and gas chromatography and recommendations for both sampling time and flow. She also briefly explained some of the equipment used in both the sampling and the laboratory analysis before explaining, in more depth, the analytical methods used in the study.

28. A Co-Chair of the Task Force and representative of INERIS gave a presentation on the model forecasting during the 2022 EIMP. The intensive measurement period required identifying a one-week period favourable for an O_3 episode within a one-month period (mid-June to mid-July). That presented a significant forecasting challenge, including providing stations with advance warning of 5–7 days. To respond to that challenge, a working group had been established to create a strategy on how to provide early warning by utilizing long-term forecasts (>5 days), extreme indices 7 days ahead, anomalies 4–5 days ahead, and short-term forecasting (<5 days). Meetings would be held several times a week with partner organizations in order to provide the early warning notice one week in advance. The work would also largely involve experts from CAMS operating a range of air quality forecasting

models over Europe. Lastly, he noted that, in the absence of an episode, a final date would be defined after which the sample would be launched.

29. An expert from Germany gave a presentation on the Global Emissions InitiAtive (GEIA) non-methane VOC (NMVOC) emission working group. GEIA was a community initiative that built bridges between environmental science and policy by bringing together people, data and tools to create and disseminate information about emissions. The working group elevated VOC speciation in a global emission inventory by comparing speciation using emission ratios, evaluating dominant source sector contributions, providing guidance on key species for measurements and monitoring, evaluating differences between cities, countries and regions, and identifying the most pressing data gaps. She concluded by noting that comparisons of measured data and extracted cells from global emission inventory showed poor-to-no relationship in the VOC: acetylene ratios and there were substantial limitations based on available measurements and how species were represented in emission inventories, resulting in some sectors not being well represented by measured species. The expert noted that, moving forward, more longer-term and routine measurements of NMVOCs, including more species and measurements of total reactivity, were needed, as well as regular updates to speciation profiles and sectoral emission contributions.

30. An expert from the United States of America, affiliated with the Laboratoire Inter-Universitaire des Systèmes Atmosphériques (France), gave a presentation on the Paris 2022 Atmospheric Chemistry of the Suburban Forest campaign. The campaign was investigating the interaction of urban pollution and rural biogenic emissions, focusing on Paris city centre and urban areas and the surrounding semi-rural and suburban forest areas. The key scientific questions to be answered focused on oxidation processes of anthropogenic VOCs, oxidation processes of biogenic VOCs, oxidant levels, reactive nitrogen speciation, organic carbon component of aerosols and consequences for air quality. He explained that measurements for the study would be collected through urban and Rambouillet Forest sites, as well as the deployment of an aircraft, which would conduct 15 or 16 low-level 3–3.5-hour flights. Moving forward, the next steps include preparing the aircraft for measurement collection, installation of instruments at selected sites and participating in the summer 2022 intensive measurement period.

31. A representative of the European Solvents Industry Group (ESIG) gave a presentation on the solvents industry in Europe. She highlighted the significant ways in which the solvents industry contributed to the European economy, including directly employing 7,000 people in Europe, bringing in 5 million tons of solvent sales per year and spending €28 million on research and development per year. ESIG aimed to promote safe and sustainable use of oxygenated and hydrocarbon solvents in Europe, as well as ensure that regulatory frameworks were based on sound science and best practices. As part of its support to the development of scientific evidence, ESIG would be providing financial support for some centralized chemical analysis in the EIMP planned for summer 2022. Additionally, ESIG provided members with advice and guidance to comply with the latest legislation and encouraged members to share ESIG advice on safe use of solvents. She noted that ESIG had 29 members, including 9 Hydrocarbon Solvents Producers Association members and 20 Oxygenated Solvents Producers Association members, most of whom were global chemical players.

32. Participants subsequently engaged in a brief discussion regarding the EIMP for O_3/VOC. An expert from Switzerland made a proposal concerning the possibility of storing remaining filters so that they were available for future analysis if additional research questions arose. Following a question from an expert from France, a discussion was held on the criteria to trigger the sampling period and synchronicity of measurements over Europe. The Task Force initiative to foster VOC sampling at EMEP sites was warmly welcomed by all participants, but it was also noted that such campaigns would also be highly valuable at other typologies of stations, notably in urban or industrial sites. It was concluded that the EMEP move towards better knowledge in VOCs involved in the formation of high O_3 episodes could only enhance interest in and support for such practices for other monitoring networks operating in various sites in Europe.

VII. Thematic session: The 2020 coronavirus disease lockdown as a natural experiment to assess policy effectiveness

33. An expert from the United Kingdom of Great Britain and Northern Ireland gave a presentation on the country's level of $PM_{2.5}$ during the 2020 COVID-19 lockdown. He explained the set-up of the EMEP4UK-Weather Research Forecast model utilized in the study, and the three hypothetical scenarios included in the EMEP4UK COVID-19 calculations. The study had found that a direct reduction of traffic and commuting in the country had substantially reduced NO_2 but $PM_{2.5}$ had not shown a consistent and straight forward reduction like NO_2. Additionally, model scenarios of emission reductions suggested that even large reductions of NO_x emissions across the United Kingdom of Great Britain and Northern Ireland and Europe triggered only a small, non-linear response in ammonium nitrate concentrations, and model results, to date, confirmed that a wide range of emission sources of primary PM and PM precursors, not just traffic, needed to be addressed to effectively reduce $PM_{2.5}$ concentrations. He concluded by re-emphasizing the importance of the need to reduce agricultural ammonia emissions in order to reduce springtime pollution events.

34. An expert from Spain gave a presentation on European primary emissions in 2020 modulated by COVID-19 pandemic-related disruption. The objective of a project initiated under CAMS was to better understand the impact of restrictions at the sector- and species-level and to produce emission data sets that could be used in air quality models. He provided a brief overview of the methodology employed by the study, including using a data-driven approach that assumed that changes in emissions followed changes observed in measured time series representing the main activities of each sector. Additionally, the methodology utilized the construction of adjustment factors, which was the ratio between the measured activity data for a given day and the value of this activity without the influence of COVID-19. Comparisons between "business as usual" and COVID-19 2020 scenarios had found a heterogenous impact across species in NO_x and $PM_{2.5}$ emissions. Drops during the second round of COVID-19 lockdowns had been more than 50 per cent lower than during the first round of lockdowns. The expert noted that those preliminary results of intercomparisons suggested that CAMS COVID-19 adjustment factors were well aligned with changes reported by official inventories and that mobility restrictions had still been affecting road transport emissions in 2021.

35. A representative of Spain gave a presentation on modelling the impact of the lockdown on air quality in Spain. That study had examined whether or not the model responded to emission reductions in a similar way to the observations and whether there were any key policy messages to communicate as a result. She then explained the model set-up and simulations, as well as observation methodology, including weather-corrected observations and 2016–2019 mean observations. The study had found that NO_x emission reductions had increased mean and peak O_3 concentrations in some NO_x source areas of Spain and had also increased human health impacts of O_3 in urban areas. Additionally, O_3 impacts to vegetation had decreased for most of Spain and reductions of SO_x (and NO_x) emissions had probably produced increases in ammonia concentrations across most of Europe. However, she noted that all methods to estimate the impact of lockdown on air quality had considerable uncertainty and the model probably overestimated the extension of areas with concentration increases due to model resolution.

VIII. Thematic session: Gothenburg Protocol review – scales and trends

36. An expert from Norway gave a presentation on the application of EMEP/urban EMEP (uEMEP) model for the European Commission review process of the European Union Ambient Air Quality Directive.[11] The task of the Norwegian Meteorological Institute in that

[11] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, *Official Journal of the European Union*, L 152 (2008), pp. 1–44.

study had been to take a range of future scenarios produced by the International Institute for Applied Systems Analysis (Austria) with the GAINS model and calculate pollutant concentrations with EMEP and uEMEP models for the 27 European Union member States. The expert briefly explained the modelling methodology for the project, including downscaling resolutions and emissions scenarios, before reviewing station calculations for several pollutants. The study had found that NO_2 station exceedance calculations indicated that approximately 4 per cent of NO_2 stations measured annual mean concentrations greater than 40 micrograms per cubic metre ($\mu g/m^3$) but that figure would decrease in 2030 and decrease further in 2050. Additionally, $PM_{2.5}$ exposure calculations indicated that approximately 100 million inhabitants were exposed to $PM_{2.5}$ concentrations greater than 10 $\mu g/m^3$ but that figure would decrease to approximately 10 million inhabitants by 2050. However, the expert also noted that there remained some inconsistencies in the national emissions and their spatial distribution that affected details in the study's results, such as national shipping in the Mediterranean, residential combustion emissions in various countries and non-exhaust emissions in Nordic counties, which had not been included in the scenarios.

37. A representative of the Centre for Integrated Assessment Modelling and the International Institute for Applied Systems Analysis gave a presentation on the improved understanding of source contributions to urban $PM_{2.5}$ in Europe and in Eastern Europe, the Caucasus and Central Asia with the GAINS model. A study had been conducted involving a preliminary implementation of new transfer coefficients for an extended domain, which had been complemented by grid-to-grid tracking for primary PM in order to derive sector-specific transfer coefficients and splits for urban areas. Overall, preliminary city specific contributions had been derived for approximately 300 cities across Europe (including 175 cities in countries not member States of the European Union). However, the expert noted that contributions depended greatly on the quality of underlying emission patterns and there was room for improvement regarding data on the urban/rural split. Next steps included refining the urban/rural distribution of the residential sector, determining a 5-year average for sectoral transfer coefficients and additional splits (for the Tajikistan, Turkmenistan and Uzbekistan region and secondary inorganic aerosols contributions from cities) as well as downscaling based on uEMEP.

38. An expert from France gave a presentation on trends in $PM_{2.5}$ and chemical components at the French EMEP sites. Fine particles ($PM_{2.5}$) were known to have an impact on climate, ecosystems and human health, and chemical composition of $PM_{2.5}$ was essential to assess the sources contributing to mass concentrations. A study had been carried out to undertake the chemical specification of $PM_{2.5}$ mass concentrations based on the main ions at five remote sites monitoring $PM_{2.5}$ and its chemical composition in France from 2014 to 2020, and evaluate trends in $PM_{2.5}$ concentrations in association with changes in emission patterns, removing influence from meteorological and long-range transport characteristics. The expert briefly explained the methods used in the study and the conclusions reached regarding $PM_{2.5}$ concentrations.

IX. Conclusion

39. The Co-chairs of the Task Force on Measurements and Modelling closed the meeting with a brief presentation summarizing follow-up action items, upcoming events and workshops of interest. They reminded participants to complete a form regarding capacity-building and international collaboration and to submit feedback on the Gothenburg Protocol review by 27 May 2022. They also noted that all presentations from the event would be made available on the Task Force website for future reference. The Co-Chairs also highlighted several follow-up actions items, including the CCC note on data licensing to be submitted to the Steering Body to EMEP ahead of the eighth joint session of the EMEP Steering Body and the Working Group on Effects (Geneva, 12–16 September 2022), validation of measurements for air quality trends analyses, and ongoing developments related to condensable organics modelling. Additionally, there would be several thematic workshops held by the end of 2022 and several planned for 2023. The Co-Chairs concluded by thanking participants for joining the meeting and noting that the twenty-fourth meeting of the Task Force was tentatively scheduled for 2–4 May 2023.