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

Working Group on Effects

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Progress in activities of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe in 2021 and future work: hemispheric transport of air pollution

Hemispheric transport of air pollution

Report prepared by the Co-Chairs of the Task Force on Hemispheric Transport of Air Pollution

Summary

The Task Force on Hemispheric Transport of Air Pollution under the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe carries out the activities specified in its revised mandate (ECE/EB.AIR/144/Add.1, decision 2019/9). During the reporting period, it was also tasked with carrying out the activities assigned to it in the 2020–2021 workplan for the implementation of the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/144/Add.2, workplan items 1.1.4.3–1.1.4.7) approved by the Executive Body at its thirty-ninth session (Geneva, 9–13 December 2019).

In accordance with the Convention workplan, the Task Force is requested to present an annual report on its work to the Steering Body of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe. The present report details the progress made by the Task Force since its previous report and provides an overview of upcoming activities through 2021 and proposed activities for the 2022–2023 workplan.

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I. Progress in implementation of the 2020–2021 workplan

1. The 2020–2021 workplan for the implementation of the Convention (ECE/EB.AIR/144/Add.2) identifies five primary sets of activities and expected outcomes or deliverables for the Task Force on Hemispheric Transport of Air Pollution. These sets of activities are listed below, and their status is discussed in the following paragraphs:

(a) Contribution to the review of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol) and discussion with the Working Group on Strategies and Review (workplan items 1.1.3.2 and 2.1.4);

(b) Organization of the development of an updated global emissions mosaic to support future modelling efforts to quantify extraregional contributions to air quality and deposition (workplan item 1.1.4.5);

(c) Investigations on global scenarios and assessment of global sectoral mitigation measures (workplan items 1.1.4.4 and 2.1.3);

(d) Organization of analysis and model improvements needed to improve the estimation of the health and environmental benefits of decreasing ozone through mitigation of methane emissions (workplan item 1.1.4.7);

(e) Continued development of the open-source FAst Scenario Screening Tool (openFASST) tool for screening analysis of future scenarios and implications of global and regional model uncertainties (workplan item 1.1.4.6);

(f) Attribution of long-term changes of mercury (Hg) and persistent organic pollutant (POP) pollution to regional and extraregional (global, secondary) sources (workplan item 1.1.4.3).

2. To contribute to the review of the Gothenburg Protocol (workplan items 1.1.3.2 and 2.1.4), the Task Force leadership team drafted answers to questions posed by the Gothenburg Protocol review group.[1] On 17 March 2021, the Task Force held a virtual workshop to review the draft answers and recommend revisions. In all, 89 experts participated in the workshop. The Task Force leadership team revised the answers based on input from the workshop and submitted two documents to the Gothenburg Protocol review group on 9 April 2021: (a) a summary of the main messages that serves as a draft of the hemispheric transport section of the review report; and (b) A more detailed explanation of the answers to the original Gothenburg Protocol review group questions. A summary of the main messages was presented to the fifty-ninth session of the Working Group on Strategies and Review (Geneva (hybrid), 18–21 May 2021) and both documents were posted on the Task Force's website.[2] The Task Force leadership team expects to update the draft hemispheric transport section and the more detailed question-and-answer document, to respond to comments and feedback, and to incorporate new information as it becomes available. The Task Force leadership team is planning two future updates: the first updated version will be provided before the end of August 2021 and the second update will be provided in January 2022.

3. The development of an updated global emissions mosaic (workplan item 1.1.4.5) to support future modelling efforts to quantify extraregional contributions to air quality and deposition was initiated in March 2020, building on the work of Janssens-Maenhout and others.[3] The work of reconciling and compiling the emissions data provided by different regional partners is being performed by the European Commission Joint Research Centre. A draft version of the compiled data set is expected to be shared with the data contributors during summer 2021 and a public version is expected to be available before the end of 2021.

4. To assess the impact of mitigation measures associated with specific emission sectors in regions outside the geographic scope of the Convention sectors (workplan items 1.1.4.4

[1] See ECE/EB.AIR/2020/3–ECE/EB.AIR/WG.5/2020/3.

[2] See htap.org.

[3] Greet Janssens-Maenhout, and others. "HTAP_v2.2: a mosaic of regional and global emission grid maps for 2008 and 2010 to study hemispheric transport of air pollution," *Atmospheric Chemistry and Physics, 15*(19), 11411-11432, 2015.

and 2.1.3), the Task Force has organized a multi-model exercise to: (i) compare the use of source-tagging methods to attribute recent trends to changes in emission sources; and (ii) examine the influence of marine shipping nitrogen oxides on ground-level ozone in the United Nations Economic Commission for Europe region. Three modelling groups have agreed on a common definition of source regions for this analysis based on previous region definitions used in HTAP multi-model exercises: Baltic and North Seas (together); Mediterranean, Black and Caspian Seas (together); Hudson Bay; All Western North American Emission Control Areas together; All Eastern North American Emission Control Areas together; the Eastern North Atlantic (east of 14º West); the rest of the North Atlantic; and the rest of the North Pacific. The modelling groups are in the process of performing their simulations. Initial results are expected to inform updates to the Task Force's contribution to the review of the Gothenburg Protocol. In addition, the Task Force leadership team participated in discussions at the fifty-ninth session of the Working Group on Strategies and Review, along with the leaders of the Task Force on Integrated Assessment Modelling and the Centre for Integrated Assessment Modelling (CIAM), to clarify the needs for future emission scenario development and assessment. The results of this discussion will inform the 2022–2023 workplan.

5. The April 2020 meeting of the Task Force on Hemispheric Transport of Air Pollution (Edinburgh, United Kingdom of Great Britain and Northern Ireland, 22–24 April 2020) laid the foundations for the organization of analysis and model improvements needed to improve the estimation of the health and environmental benefits of decreasing ozone through mitigation of methane emissions (workplan item 1.1.4.7). The Task Force took note of the recently finalized publication *Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions*.[4] Insights from this publication, along with analysis of previous experiments performed by the Task Force and under the Aerosol Chemistry Climate Model Intercomparison Project and the Chemistry-Climate Model Initiative, will inform updates to the Task Force's contribution to the Gothenburg Protocol review. Continued collaboration with other technical bodies inside and outside the Convention are needed to define future methane mitigation scenarios (working with the Task Force on Emission Inventories and Projections (TFEIP) and CIAM), ozone responses to methane changes at the regional scale (working with the Task Force on Measurements and Modelling (TFMM)), and ozone impacts on vegetation (working with the International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops (ICP Vegetation)).

6. The Task Force on Hemispheric Transport of Air Pollution has continued to make progress on the development of the openFASST tool for screening analysis of future scenarios and implications of global and regional model uncertainties (workplan item 1.1.4.6). Progress of the work was slowed by an interruption in funding in early 2021. Work has resumed and is continuing to focus on processing of the HTAP2[5] multi-model experiments for inclusion in openFASST and the implementation of a non-linear parameterization of ozone response.[6] Future work will focus on the ability to support analysis of future scenarios associated with potential revisions of the Gothenburg Protocol.

7. The Task Force and the Meteorological Synthesizing Centre-East (MSC-E) jointly hosted a workshop on 13 April 2021 to identify near-term opportunities and longer-term research needs to improve the scientific basis for assessment of Hg pollution and trends on regional and global scales (workplan item 1.1.4.3). In all, 85 experts participated in the discussions to:

(a) Review recent progress made by (and anticipate future assessment needs of) the Convention on Long-range Transboundary Air Pollution, the Minamata Convention on

[4] A. R. Ravishankara and others (Nairobi, United Nations Environment Programme/Climate and Clean Air Coalition, 2021).

[5] F. Dentener and others, eds., "Global and regional assessment of intercontinental transport of air pollution: results from HTAP, AQMEII and MICS", *Atmospheric Chemistry and Physics*, special issue (2015).

[6] Based on S. T. Turnock and others, "The impact of future emission policies on tropospheric ozone using a parameterized approach", *Atmospheric Chemistry and Physics*, vol. 18, No. 12 (June 2018).

Mercury, the Arctic Monitoring and Assessment Programme and other relevant international forums;

(b) Identify cooperative activities that can be undertaken in the short term (two years) and longer term (five years) to improve the understanding and ability to estimate Hg pollution levels, trends and source attribution.

8. At the above-mentioned workshop, the participants:

(a) Identified the long-term goal of performing a retrospective assessment of Hg pollution changes based on model estimates and measurement data, attribution of Hg concentration and deposition trends to changes in regional and extraregional anthropogenic emissions, analysis of other factors affecting long-term Hg pollution changes, as well as projection of future levels of Hg atmospheric pollution-based emission scenarios. It was recognized that long-term historical or future simulations must take into account changes in secondary Hg emissions and legacy Hg content in the environmental reservoirs. Since the majority of atmospheric chemical transport models do not account for the Hg cycling among and accumulation in the environmental media, several simplified approaches were suggested to take into account the effect of legacy emissions dynamics. As a first phase, it was proposed to conduct an intercomparison of the atmosphere-terrain and atmosphere-ocean exchange fluxes estimated by current models under contemporary conditions where measurement data on Hg air-surface exchange fluxes may be available. A number of scientific groups from various institutions in Europe and North America agreed to take part in such a study with their Hg chemical transport and box multimedia models;

(b) Took note of the number of existing global spatially distributed Hg emission inventories for both historical and current periods, as well as future projections. The workshop participants noted the opportunity to reconcile the differences between existing emissions inventories and to integrate Hg into emissions inventories and scenarios developed for more traditional air pollutant emissions.

9. Following the format of the Hg workshop, the Task Force and MSC-E jointly hosted a workshop on 15 April 2021 to identify near-term opportunities and longer-term research needs to improve the scientific basis for assessment of POPs pollution and trends on regional and global scales (workplan item 1.1.4.3). In all, 81 experts participated in the discussions to:

(a) Review recent progress made by (and anticipate future assessment needs of) the Convention on Long-range Transboundary Air Pollution, the Stockholm Convention on POPs, the Arctic Monitoring and Assessment Programme and other relevant international forums;

(b) Identify cooperative activities that can be undertaken in the short term (two years) and longer term (five years) to improve our understanding and ability to estimate POPs pollution levels, trends and source attribution.

10. At the above-mentioned workshop, the participants:

(a) Discussed the wide range of pollutants and issues that fall under the classifications of POPs and chemicals of emerging concern (CEC). It was noted that polycyclic aromatic hydrocarbons are not included under the Stockholm Convention on POPs, and thus, represent an important topic for analysis under the Convention on Long-range Transboundary Air Pollution. Although there are continuing concerns about legacy POPs that have been banned or restricted, there was general consensus that it is useful to focus on continuing sources of POPs associated with combustion and CEC;

(b) As in the Hg workshop, took note of the number of existing global spatially distributed POPs emission inventories for both historical and current periods, as well as future projections. The workshop participants noted the opportunity to reconcile the differences between existing emissions inventories and to integrate combustion-related POPs into emissions inventories and scenarios developed for more traditional air pollutant emissions;

(c) Discussed the need to better integrate the significant work under the Convention on aerosols, particulate matter and condensables with the work on combustion-related POPs. The participants identified the opportunity to build upon the ongoing effort to

compare models of benzo(a)pyrene that is being conducted under the Task Force on Measurements and Modelling EuroCarb project, extending the comparison to a larger number of global models and potentially to other combustion-related POPs;

(d) Expressed a strong interest in establishing a forum or mechanism to maintain communication and collaboration across the POPs scientific community. Dedicated list servers, quarterly webinars and data sharing sites were discussed as possible mechanisms.

II. Activities during the remainder of 2021

11. Since 2019, the Task Force has been led by Co-Chairs, Mr. Terry Keating (United States of America) and Ms. Heather Morrison (Canada), and Vice-Chairs, Mr. Tim Butler (Germany) and Mr. Jacek Kaminski (Poland). In May 2021, Ms. Rosa Wu (Canada) assumed the Co-Chair responsibilities for Canada. In September 2021, the Co-Chairs, on behalf of the lead parties, will propose to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) Steering Body and the Executive Body that Mr. Butler assume the role of Co-Chair and Ms. Wu assume the role of Vice-Chair.

12. The Task Force will continue implementation of the 2020–2021 workplan with a focus on:

(a) Updating the Task Force contribution to the review of the Gothenburg Protocol taking into account insights from the Climate and Clean Air Coalition global methane assessment, ongoing tagging and shipping analyses and review of methane mitigation scenarios;

(b) Completion of the HTAPv3 global emissions mosaic and exploration of opportunities to expand the mosaic to include Hg and combustion-related POPs;

(c) Continued development of openFASST for scenario screening;

(d) Working with CIAM and others to plan future emissions scenarios for exploring the relative benefits of plausible region- and sector-specific emission reductions outside the geographic scope of the Convention;

(e) Enhancement of the Task Force website[7] to improve coordination and communication between contributors to Task Force analyses.

III. Proposed activities for consideration in the 2022–2023 workplan and beyond

13. Given the progress under the current workplan, the needs of the ongoing review of the Gothenburg Protocol and the science needs expressed in the Convention's Long-term strategy for 2020–2030 and beyond,[8] the contribution of the Task Force to the Convention's 2022–2023 workplan might be organized around three themes identified below that build on the current work. The Task Force leadership team invites discussion with the EMEP Steering Body on the prioritization of work in the following areas:

(a) Global emissions inventories. Under this theme, the Task Force would continue to update the global emissions data sets that provide the basis for estimating the impact of extraregional emissions sources. Specifically, the Task Force might include work to:

(i) Complete the updated global emissions mosaic for traditional air pollutants, working with the Joint Research Centre, TFEIP, and other partners;

[7] See htap.org.

[8] See decision 2018/5, annex, available at https://unece.org/fileadmin/DAM/env/documents/2018/Air/EB/correct_numbering_Decision_2018_5.pdf.

(ii) Incorporate emissions estimates for heavy metals and POPs, working with the Joint Research Centre, MSC-E, TFEIP and other partners.

(b) Global-regional model evaluation and intercomparison. Under this theme, the Task Force would continue to evaluate and intercompare global-regional models for ozone, particulate matter, mercury and POPs, with a focus on improving our confidence in estimating source-receptor relationships at intercontinental scales. Specifically, the Task Force might include organizing examinations of:

(i) The regional ozone response to global methane reductions, working with the Meteorological Synthesizing Centre-West and the Task Force on Measurements and Modelling;

(ii) The air-surface exchange rates of mercury, working with MSC-E;

(iii) The source/receptor relationships of combustion-related POPs and particulate matter, working with MSC-E and TFMM.

(c) Global scenario assessment. Under this theme, the Task Force would continue to develop screening tools as well as detailed simulations to explore the relative benefits of the mitigation of emission sources geographically inside and outside the Convention. Specifically, the Task Force might include work to:

(i) Continue development of openFASST;

(ii) Assess the impact of emissions scenarios developed by CIAM and others to examine: the ozone impacts of methane mitigation inside and outside the Convention, the impact of marine shipping emissions at the intercontinental scale and the impact of climate change mitigation policies on ozone, particulate matter, mercury and combustion-related POPs;

(iii) Assess the impact of intercontinental transport of ozone on vegetation globally, working with ICP Vegetation.

14. The Task Force has identified a number of issues that warrant further exploration, but that would be best addressed in coordination with other subsidiary bodies. These issues include:

(a) Lessons learned from emission reductions associated with coronavirus disease (COVID-19);

(b) Impacts of wildfires on particulate matter, ozone, heavy metals and POPs;

(c) Long-range transport of microplastics;

(d) Long-range transport of CEC.