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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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Item 5 (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 2024 and future work: Measurements and modelling**

Implementation plan for the activities of MSC-East of EMEP hosted by the Jožef Stefan Institute (Ljubljana, Slovenia)

Summary

The present report is submitted for consideration by 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 at their tenth joint session, at the request of the Executive Body for the Convention on Long-range Transboundary Air Pollution (Executive Body decision 2023/1).

The report presents an implementation plan for the activities of MSC-East, the international centre of EMEP, hosted by the Jožef Stefan Institute (Ljubljana, Slovenia), as per its revised mandate (Executive Body decision 2019/11) and the 2024–2025 workplan for the implementation of the Convention (ECE/EB.AIR/154/Add.1). It specifies the ongoing and planned efforts of the Centre focused on establishing the practical means required for the fulfilment of its activities, including the operational model assessment of transboundary pollution with heavy metals and persistent organic pollutants (POPs), as well as the research and development of the modelling tools performed in cooperation with subsidiary bodies, international organisations and national experts from the Parties to the Convention.

I. Introduction

1. The present report of Meteorological Synthesizing Centre – East (MSC-East) is submitted for consideration by 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, at the request of the Executive Body for the Convention on Long-range Transboundary Air Pollution (Executive Body decision 2023/1¹).
2. In accordance with the decision of the Executive Body at its forty-third session (Geneva, 11–14 December 2023), MSC-East, the international centre of EMEP, is hosted by the Jožef Stefan Institute (Ljubljana, Slovenia) as of 1 January 2024. The Jožef Stefan Institute (JSI) is the largest research institute in Slovenia. The main research areas are physics, chemistry, molecular biology, biotechnology, information technologies, reactor physics, energy, and the environment. Currently, the institute has 1200 employees, over half of whom are PhD scientists. The mission of JSI is the accumulation and dissemination of knowledge in science and technology to benefit society through education, research, and high-tech development at top international standards.
3. This report presents an implementation plan for the activities of MSC-East of EMEP as per its revised mandate (Executive Body decision 2019/11²) and the 2024–2025 workplan for the implementation of the Convention³. It specifies the ongoing and planned efforts of the Centre focused on establishing the practical means required for the fulfilment of its activities, including the operational model assessment of transboundary pollution with heavy metals and persistent organic pollutants (POPs), as well as the research and development of the modelling tools performed in cooperation with subsidiary bodies, international organisations and national experts from the Parties to the Convention.

II. Operational model assessment

4. According to the revised mandate, MSC-East is responsible for providing scientific support to the Convention with information on modelling heavy metals (lead (Pb), cadmium (Cd), and mercury (Hg)) and persistent organic pollutants (POPs, including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), dibenzo-p-dioxins and dibenzofurans (PCDD/Fs), and hexachlorobenzene (HCB)). This operational activity involves preparing various input data for model assessments, including a complete set of anthropogenic and geogenic emissions, meteorological parameters, atmospheric concentrations of chemical reactants and particulate matter; global and regional simulations of pollution levels and transboundary transport of pollutants; and evaluating the modelling results against observations.
5. Since its inception at the beginning of the year, the new Centre has made significant efforts to prepare for the EMEP operational modelling tasks. This includes arranging sufficient computer resources at institutional and national supercomputer clusters, installing and adapting the necessary software and modelling tools, and engaging scientific staff. A full set of input data was generated for simulations of 2022, and the most recent stable open-source version of the GLEMOS model was used for operational modelling. Due to the substantial preparatory and capacity-building efforts and the restricted timeframe, the first-year operational simulations conducted by MSC-East in 2024 cover a limited set of pollutants, including three heavy metals (Pb, Cd, Hg) and four polycyclic aromatic hydrocarbons (PAHs) among POPs. The model assessment results of pollution levels, transboundary transport of pollution among the Parties to the Convention, research activities, and other information are presented in the EMEP Status Report 2/2024.
6. Persistent organic pollutants not covered in this year's simulations (PCBs, PCDD/Fs, HCB) will be included in the operational modelling in 2025. The inclusion of these substances

¹ Available at www.unece.org/env/lrtap/executivebody/eb_decision.html.

² ECE/EB.AIR/144/Add.1.

³ ECE/EB.AIR/154/Add.1.

will be accompanied by a gradual update of the GLEMOS parameterizations of POP multi-media processes.

III. Research and development of modelling tools

7. Multiple modelling and data processing tools have been installed and prepared for operational simulations. The open-source version of the GLEMOS model (v2.2.2, <https://github.com/glemos-model>), developed by MSC-East in previous years, was technically updated and adapted for simulations on supercomputer clusters. All physical and chemical parameterizations of the model were kept unchanged to maintain consistency with the previous assessment results of the Centre. Additional modelling tools installed to prepare input data for modelling include the Weather Research and Forecasting model (WRF, v3.7.1) for generating meteorological fields, the global chemical transport model GEOS-Chem (v14.2) for providing air concentrations of various chemical reactants, and the pre-processor of mineral dust wind suspension to simulate the re-suspension of heavy metals and POPs from natural surfaces. Furthermore, a new visualization system was developed for plotting pollution maps and other graphical products.

8. MSC-East has continued and initiated new research activities aimed at improving model parameterizations and evaluating model performance. The ongoing research is primarily focused on updating the model chemical scheme for Hg incorporating the latest findings on oxidation and reduction mechanisms from the literature, as well as refining air-vegetation and air-water exchange processes to enhance predictions of pollution in sensitive terrestrial and aquatic ecosystems. The GLEMOS model also participates in the multi-model intercomparison project MCHgMAP, which aims to analyse long-term trends of Hg pollution using both model simulations and observational data (see paragraph 13).

9. Future research and development work at the Centre will include consecutive updates to the GLEMOS model concerning key physical and chemical processes governing the dispersion of heavy metals and POPs in the atmosphere and other media. Particular attention will be paid to the multi-media aspects of POP modelling. A more detailed analysis and model evaluation of PAH pollution will be conducted on a country scale as part of a pilot study for Slovenia and other Balkan countries (see paragraph 12). An updated version of GLEMOS will be distributed via an open-source repository (github.com) to make it available to the wider scientific community and experts from the Parties.

IV. Cooperation

10. MSC-East resumes and continues scientific collaboration with various international and national bodies, aiming to enhance research and assessment approaches applied by the Centre and to disseminate the scientific knowledge gained within the Convention. These bodies include EMEP Task Forces, International Cooperative Programmes of the Working Group on Effects (WGE), and other international conventions and programmes such as the Minamata and Stockholm Conventions, HELCOM, OSPAR, and AMAP.

11. The Centre contributed to the work of the Task Force on Measurements and Modelling (TFMM) by participating in the Task Force's twenty-fifth meeting (Warsaw, 6-7 May 2024). MSC-East presented its ongoing research and development activities, results of the preliminary simulations conducted for 2022, as well as updates of the GLEMOS model, including further development of the chemical scheme for Hg, air-surface exchange fluxes, and POP multi-media processes. MSC-East confirmed its plans to continue country-scale studies of heavy metal and POP pollution and announced a new pilot study for Slovenia and other Balkan countries. Future activities of the Centre will also include contributions to the cooperative EMEP activities on contaminants of emerging concern (*item 1.1.1.2⁴*) and participation in the analysis of BaP health-related effects (*item 1.1.1.8*).

⁴ The 2024–2025 workplan for the implementation of the Convention (ECE/EB.AIR/154/Add.1).

12. The country-scale pilot studies are a long-term research and assessment initiative successfully conducted by MSC-East in cooperation with TFMM. These studies focus on a detailed assessment of heavy metal and POP pollution in individual countries, including fine-resolution modelling, evaluation and refinement of national emission inventories, and improvement of modelling tools. The new study proposed by the Centre will investigate the pollution of the Balkan region with polycyclic aromatic hydrocarbons (PAHs). The first phase of the study will concentrate on country-scale pollution in Slovenia and explore the possibility of extending the study to other Balkan countries. Various types of observational data will be involved, including regular EMEP and AQ e-Reporting atmospheric measurements, campaign measurements of PAH stable isotope composition, as well as moss and lichen archives. The program of the study will include analysis of spatial patterns and source attribution of PAH pollution, involving both fine-resolution simulations and a variety of measurement data.

13. MSC-East continues its long-term collaboration with the Task Force on Hemispheric Transport of Air Pollution (TF HTAP). Currently, The Centre participates in the multi-model research initiative, the Multi-Compartment Mercury Modelling and Analysis Project (MCHgMAP), launched within TF HTAP in cooperation with the Minamata Convention for assessing the effectiveness of current and future mitigation policies (*item 1.1.4.3*). The project assessment consists of a series of model experiments using off-line coupled atmospheric, ocean, and multi-media mass balance models to account for changes in primary anthropogenic and secondary Hg sources as well as environmental conditions in the Hg cycling between land, ocean, and atmosphere. The first phase of MCHgMAP multi-model simulations and the analysis of Hg spatial and temporal trends is currently in progress and is expected to be completed by the spring of 2025. MSC-East will also contribute to another modelling initiative recently started under TF HTAP to study multi-pollutant effects of wildfires and biomass burning (*item 1.1.4.4*). The contributions and plans of MSC-East were highlighted at the recent virtual Task Force meeting held on April 22-25, 2024.

14. The Centre plans to renew its collaboration with the International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops (ICP Vegetation) of the Working Group on Effects (WGE) for a joint analysis of temporal trends and changes in spatial patterns of heavy metal and POP deposition using both model simulations and moss measurements. Other potential collaborations include evaluating levels and trends of heavy metal deposition in forests together with ICP Forests and ICP Integrated Monitoring, and resuming work on exceedances of critical loads of heavy metal deposition in partnership with the Coordination Centre for Effects (CCE).

15. In addition, MSC-East prioritises its cooperation with other international bodies. As part of the MCHgMAP project, the Centre actively contributes to the work of the Open-ended Scientific Group for the effectiveness evaluation of the Minamata Convention on Mercury (*item 1.3.4*). Cooperation with the Marine Conventions (HELCOM and OSPAR) on the assessment of heavy metal and POP pollution in the Baltic Sea and Northern Atlantic waters is currently being renewed as part of multilateral or bilateral contracts. The Centre also considers opportunities for cooperation and data exchange with the Stockholm Convention on Persistent Organic Pollutants (*item 1.3.3*) and the Arctic Monitoring and Assessment Programme (AMAP).

V. Reporting and dissemination

16. Results of MSC-East operational and research activities will be published in annual status reports, technical reports, and presented at the annual joint sessions of the EMEP Steering Body and Working Group on Effects. The progress and results of the Centre for the current year are detailed in the EMEP Status Report 2/2024. Additionally, the development of a new website for the Centre (www.msc-east.org) has been initiated to disseminate assessment results and other relevant information online.