

15 July 2024

English only

---

## **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**

**Ninth joint session**

Geneva, 9-13 September 2024

Item 4 (c) (i) of the provisional agenda

**Progress in activities of the Working Group on Effects in 2024 and future work:  
air pollution effects on materials, the environment and crops:  
air pollution effects on materials**

### **Effects of air pollution on materials**

**Progress report by the Programme Coordinating Centre of the  
International Cooperative Programme on Effects of Air Pollution  
on Materials, including Historic and Cultural Monuments**

#### *Summary*

The present report by the Programme Coordinating Centre of the International Cooperative Programme on Effects of Air Pollution on Materials, including Historic and Cultural Monuments (ICP Materials) under the Working Group on Effects presents the results of the activities undertaken by ICP Materials between May 2023 and May 2024. The activities and the report thereon are presented in accordance with the 2024–2025 workplan for the implementation of the Convention (ECE/EB.AIR/154/Add.1) and with the revised mandate for ICP Materials (Executive Body decision 2019/19)<sup>a</sup>.

The Programme Coordinating Centre report presents the results of the fortieth ICP Materials Task Force meeting (Madrid, 5-7 May 2024). It describes trends for environment, corrosion and soiling during the period 1978-2021, including results from the recently completed trend exposure 2017-2021, and summarizes the status of the call for data and future plans on inventory and condition of stock of materials at risk at United Nations Educational, Scientific and Cultural Organization World Cultural Heritage Sites.

<sup>a</sup> Available at [www.unece.org/env/lrtap/executivebody/eb\\_decision.html](http://www.unece.org/env/lrtap/executivebody/eb_decision.html).

## I. Introduction and overview of deliverables

1. The present report by the Programme Coordinating Centre for the International Cooperative Programme on Effects of Air Pollution on Materials, including Historic and Cultural Monuments (ICP Materials) describes the activities carried out by ICP Materials between May 2023 and May 2024. It highlights the results of activities undertaken since its previous report (ECE/EB.AIR/GE.1/2023/INF.9–ECE/EB.AIR/WG.1/2023/INF.9), submitted to the ninth joint session of 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 (Geneva, 11-15 September 2023). The results are presented here in accordance with the 2024–2025 workplan for the implementation of the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/2023/1).
2. ICP Materials is co-chaired by Mr. Johan Tidblad (Sweden) and Ms. Teresa La Torretta (Italy), with Mr. Tidblad also acting as the head of the ICP Materials Programme Coordinating Centre. Participating in the work of ICP Materials are nearly 30 experts from the following 17 countries: Austria, Croatia, Czechia, Estonia, Finland, France, Germany, Greece, Italy, Norway, Poland, Slovakia, Spain, Sweden, Switzerland, United Kingdom of Great Britain and Northern Ireland, and United States of America.
3. The fortieth meeting of the ICP Materials Task Force (Madrid, 6-7 May 2024) was attended by 21 participants from 12 countries, including the Chair of the Working Group on Effects and representatives from the secretariat of the Convention on Long-range Transboundary Air Pollution.
4. During 2023, the following reports were delivered: “Trends in pollution, corrosion and soiling 1987-2021”;<sup>1</sup> and “Call for data “Inventory and condition of stock materials at UNESCO world cultural heritage sites”. Part VII Application of models with increased resolution in the study of damage at selected UNESCO sites – Switzerland”<sup>2</sup>.
5. In 2024, the following ICP Materials reports are expected: “Report on dose-response functions for trend materials”; and “Part VIII – Risk assessment for selected monuments based on retrospective trends in 2000, 2010 and 2020 and EMEP 01°x01° data”.

## II. Workplan items common to all International Cooperative Programmes

### A. Guidelines for reporting on the monitoring and modelling of air pollution effects

6. The guidelines for reporting on the monitoring and modelling of air pollution effects (ECE/EB.AIR/2008/11–ECE/EB.AIR/WG.1/2008/16/Rev.1)<sup>3</sup> specify that, for effects of particulate matter on materials, the degree of soiling should be reported, and for multiple pollutant effects on materials, the corrosion of indicator materials (carbon steel, zinc and limestone) should be reported. This is part of the ongoing activities of ICP Materials (for exposure of materials for trend analysis, see section III.A below).

<sup>1</sup> ICP Materials, Report No. 95 (Kista, Sweden, Research Institutes of Sweden (RISE), 2023). Available at [https://www.ri.se/sites/default/files/2024-01/Report\\_95\\_Trend\\_exposure\\_%281987-2021%29-Final\\_-\\_Errata.pdf](https://www.ri.se/sites/default/files/2024-01/Report_95_Trend_exposure_%281987-2021%29-Final_-_Errata.pdf)

<sup>2</sup> ICP Materials, Report No. 96 (Bologna, National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), 2023). Available at [https://www.ri.se/sites/default/files/2023-08/Report%2096%20UNESCO%20Call%20for%20Data\\_July2023%201.pdf](https://www.ri.se/sites/default/files/2023-08/Report%2096%20UNESCO%20Call%20for%20Data_July2023%201.pdf)

<sup>3</sup> Approved by the Executive Body for the Convention on Long-range Transboundary Air Pollution at its twenty-sixth session (Geneva, 15–18 December 2008) (ECE/EB.AIR/96/Add.1, decision 2008/1, para. 1).

## **B. Efforts to enhance the involvement of countries of Eastern Europe, the Caucasus and Central Asia**

7. Discussions are being held on a continuous basis but countries of Eastern Europe, the Caucasus and Central Asia do not currently actively participate in ICP Materials work.

## **C. Cooperation with programmes and activities outside the region**

8. ICP Materials and its experts collaborate regarding international standardization work in the field of atmospheric corrosion, specifically the International Organization for Standardization Technical Committee 156 - Corrosion of metals and alloys and European Committee for Standardization Technical Committee 346 - Conservation of cultural heritage. A current activity related to the work of ICP Materials is the preparation of an International Organization for Standardization Standard on procedures for mapping corrosion.

## **III. Workplan items specific to the International Cooperative Programme on Effects of Air Pollution on Materials, including Historic and Cultural Monuments**

### **A. Corrosion and soiling of selected materials under different environmental conditions**

9. Exposures for trend analysis are performed every third year in the network of ICP Materials test sites. A new exposure is planned to start in 2024 including corrosion samples of carbon steel, titanium zinc, ZnAlMg and limestone; and glass soiling samples. At selected sites additional zinc materials will be exposed for validation to ensure the continued use of zinc as a trend material. ZnAlMg is a relatively new material used for example in the support of solar panel structures and is exposed in the network for the first time. An in-depth study will be performed of this material including the effect of particulate matter from non-exhaust emissions.

### **B. United Nations Educational, Scientific and Cultural Organization World Cultural Heritage Sites**

10. ICP Materials continues to gather and process information on policy-relevant and user-friendly indicators on the effects of air pollution on materials. These activities are currently conducted within the scope of the call for data on inventory and condition of stock of materials at risk at United Nations Educational, Scientific and Cultural Organization (UNESCO) world cultural heritage sites launched in October 2015 and involving six Parties to the Convention: Croatia, Germany, Italy, Norway, Sweden, and Switzerland.

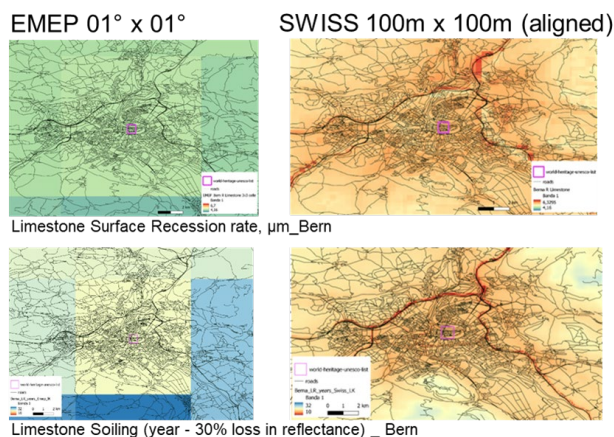
11. ICP Materials Report No. 96<sup>4</sup> concerns the application of air quality models with increased resolution at selected UNESCO sites to estimate what kind of information can be obtained using high resolution models. Two models with different spatial resolutions were considered: the EMEP01 MSC-W Model with a resolution of 01°x01° and a collection of Swiss national models with a higher resolution of 100-1000 meters. These models were applied to four UNESCO sites in Switzerland, particularly: Old City of Berne, Abbey of St Gall, Benedictine Convent of St John at Müstair and Three Castles, Defensive Wall and Ramparts of the Market-Town of Bellinzona.

<sup>4</sup> ICP Materials, Report No. 96 (Bologna, National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), 2022). Available at [https://www.ri.se/sites/default/files/2023-08/Report%2096%20UNESCO%20Call%20for%20Data\\_July2023%201.pdf](https://www.ri.se/sites/default/files/2023-08/Report%2096%20UNESCO%20Call%20for%20Data_July2023%201.pdf)

12. Dose-response functions developed by ICP Materials was used to estimate the effect of atmospheric pollutants on limestone surface recession and soiling at the selected UNESCO sites. Air pollutant concentrations are not elevated for the selected Swiss UNESCO sites investigated: the estimated recession values are below the 2050 target ( $6.4 \mu\text{m year}^{-1}$ ) and the time to reach 30% loss of reflectance is above or very close to the 2050 target of 15 years before action. Maps obtained by a model with low resolution show a uniform colour for a large area of the town, while maps obtained by a model with high resolution show different shades of colour highlighting details such as roads or buildings (see Figure 1 below). The concentration of a pollutant calculated in a cell of a grid represents the mean value of the concentration of that pollutant in the whole area of that cell: the reducing of the area of the cell improves the estimation of the concentration value of a pollutant in the zone of interest. The major evidence of this study is that using a model with a resolution at urban scale it can have more realistic estimation of the effect of air pollutants on cultural and, i.e. values possibly above the targets.

Figure 1

**Surface recession and 30% loss in reflectance calculated using the two models for city of Bern**



Source: Teresa La Torretta, Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Bologna.

13. The fortieth meeting of the ICP Materials Task Force discussed EMEP01 domain maps of risk assessment and the estimation of risk assessment for selected UNESCO monuments based on retrospective trends in 2000, 2010 and 2020 and EMEP  $01^\circ \times 01^\circ$  data. The results will be presented in an ICP Materials Report expected later in 2024.

#### IV. Messages for the attention of other bodies

14. A new trend exposure will start in 2024 including a new material (ZnAlMg) used for example in the support of solar panel structures. An in-depth study will be performed of this material including the effect of PM from non-exhaust emissions.

15. ICP Materials continues to gather and process information on policy-relevant and user-friendly indicators on the effects of air pollution on materials. This activity is carried out within the scope of the call for data on inventory and condition of stock of materials at risk at UNESCO world cultural heritage sites launched in October 2015 and involves six Parties to the Convention: Croatia, Germany, Italy, Norway, Sweden and Switzerland. In total, about thirty monuments have been studied within the framework of the Call for data. Risk factors (pollutants) for different risks to materials constituting the artefacts have been identified (2018), as well as the annual cost of damage attributable to air pollution (2019) and the relative importance of individual pollutants and the effect of their reduction on the damage cost (2020) and the effect of increasing resolution of air quality model on estimating the damage of materials (2021;2023), the relationship between the environment and the artefact (2022). EMEP01 domain maps of risk assessment and the estimation of risk

assessment for selected UNESCO monuments based on retrospective trends in 2000, 2010 and 2020 and EMEP 01°x01° data are expected in 2024.

---