

**Economic and Social Council**Distr.: General
12 August 2022

English only

Economic Commission for EuropeExecutive 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 (c) (i) of the provisional agenda

Progress in activities in 2022 and further development of effects-oriented activities:**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 2021 and May 2022. The activities and the report thereon are presented in accordance with the workplans for the implementation of the Convention for 2021 and 2022 (ECE/EB.AIR/144/Add.2, table 1, items 1.1.1.5–1.1.1.6 and ECE/EB.AIR/148/Add.1, table 1, 1.1.1.9–1.1.1.10) and with the revised mandate for ICP Materials (Executive Body decision 2019/19).^a

The Programme Coordinating Centre report presents the results of the thirty-eighth ICP Materials Task Force meeting (online, 3–5 May 2022). It describes trends for one- and four-year corrosion during the period 1997–2021, including results from the recently completed trend exposure 1997–2021, 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.

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

* The present document is being issued without formal editing.



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 2021 and May 2022. It highlights the results of activities undertaken since its previous report (ECE/EB.AIR/GE.1/2021/13–ECE/EB.AIR/WG.1/2021/6), submitted to the seventh 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, 13–16 September 2021). The results are presented here in accordance with the workplans for the implementation of the Convention for 2021 and 2022 (ECE/EB.AIR/144/Add.2, table 1, items 1.1.1.5–1.1.1.6 and ECE/EB.AIR/148/Add.1, table 1, 1.1.1.9–1.1.1.10).
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 Programma 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 thirty-eighth meeting of the ICP Materials Task Force (online, 3–5 May 2022) was attended by 26 participants from 16 countries, including the Chair of the Working Group on Effects.
4. During 2021, the following reports were delivered: “Call for data ‘Inventory and condition of stock of materials at UNESCO world cultural heritage sites’. Part V – Application of models with increased resolution in the study of damage at selected UNESCO sites - Campania, Italy”;¹ and “Technical manual for the trend exposure programme 2017–2021”.²
5. In 2022, the following ICP Materials reports are expected: “Corrosion and soiling data”; and “Study on the relationship between the environmental and the artefact on selected UNESCO sites”.

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 effects³ 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.⁴ This is part of the ongoing activities of ICP Materials (for exposure of materials for trend analysis, see sect. III.A below).

¹ ICP Materials Report No. 90 (Bologna, National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), 2021). Available at www.ri.se/sites/default/files/2021-09/Report-90-UNESCO-Call-for-Data-Part-V.pdf.

² ICP Materials Report No. 91 (Kista, Sweden, Research Institutes of Sweden (RISE), 2021). Available at www.ri.se/sites/default/files/2021-09/Report-91A-Technical-manual-2017-2021.pdf.

³ 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).

⁴ ECE/EB.AIR/2008/11–ECE/EB.AIR/WG.1/2008/16/Rev.1, tables 4 and 7.

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, in particular in the context of 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 a new 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

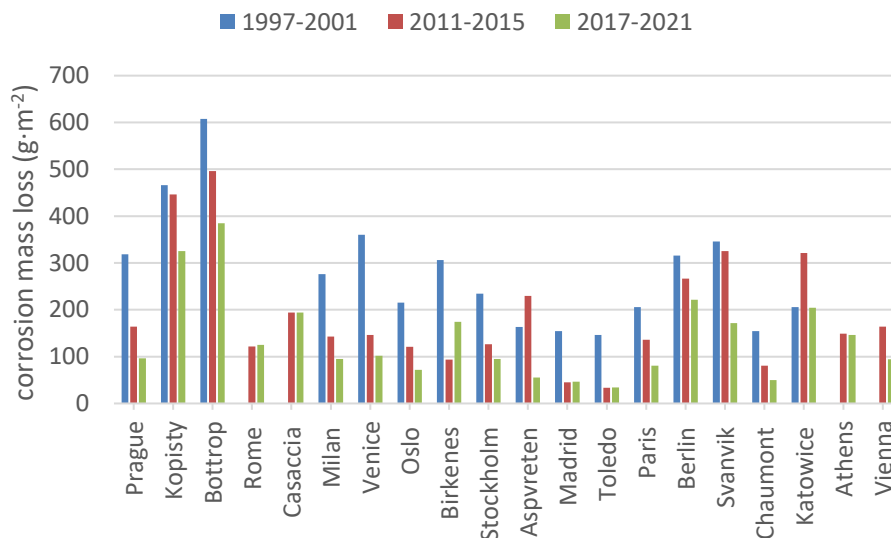
A. Corrosion and soiling of selected materials under different environmental conditions

9. Exposures for trend analysis are performed every third year in the network of ICP Materials test sites. The completed exposure (1987–2019) included corrosion samples of carbon steel, stainless steel, weathering steel, zinc, copper, limestone and soiling samples of modern glass, limestone, marble and coil-coated materials. The data were included in “Trends in pollution, corrosion and soiling 1987–2019”.⁵

10. Highlights from the report are to be presented in the fact sheet for responding to question 2.5. to subsidiary bodies (ICP Materials in this case) related to the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol) review: “What is the observed and projected trend in damage to materials and cultural heritage due to air pollution above critical levels and loads?” (ECE/EB.AIR/2020/3–ECE/EB.AIR/WG.5/2020/3). In summary, when looking at observed trends, corrosion and pollution have decreased significantly since the early 1990s and a shift in the magnitude was generally observed around 1997 from a sharp decrease to a more modest decrease or to a constant level without any decrease. Sulfur dioxide levels and carbon steel and copper corrosion have decreased even after 1997, a trend that is more pronounced in urban areas, while corrosion of the other materials shows no decrease after 1997, when looking at 1-year values. When looking at 4-year values, however, there is a significant decrease after 1997 for carbon steel, which is not evident when looking at the 1-year values (see figure I below showing results for carbon steel). There are still occurrences of corrosion values above acceptable levels at some places in Europe. For soiling, there is no decreasing trend after 1997 and, consequently, larger areas in Europe are above acceptable levels, therefore the focus of future development of the programme is on exposure of new soiling materials, for example coil-coated materials and stone materials. The main pollutant responsible for soiling of materials is particulate matter. For projected trends, it is possible to make an analysis based on existing dose-response functions using pollution and climate data for different scenarios. However, this information is not currently available and needs to be collected for all international cooperative programmes together based on pending decisions by the Working Group on Strategies and Review and the Executive Body.

⁵ See ICP Materials Report No. 88 (n.p., RISE, 2020). Available at www.ri.se/sites/default/files/2021-06/Report-88-Trends-in-pollution-corrosion-and-soiling-1987-2019.pdf.

Figure I
Comparison of 4-year corrosion mass loss ($\text{g}\cdot\text{m}^{-2}$) of carbon steel for different exposure periods and sites



Source: Ms. Kateřina Kreislová, SVUOM S.R.O. Prague.

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

11. The 2022–2023 workplan for the implementation of the Convention (ECE/EB.AIR/148/Add.1, forthcoming, workplan item tab 1.1.1 line 1.1.1.10), 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 the six following Parties to the Convention: Croatia, Germany, Italy, Norway, Sweden and Switzerland.

12. ICP Materials Report No. 90 presents a study to evaluate the effect of the application of air quality models with increased resolution at selected UNESCO sites to assess the damage on materials due to air pollution. Two models were considered, and each compared at two different spatial:

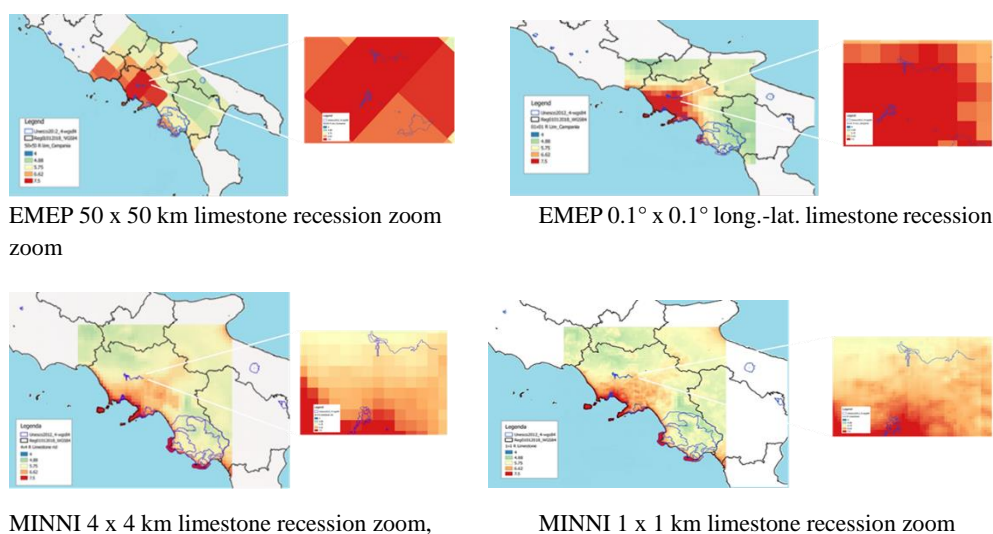
(a) EMEP Meteorological Synthesizing Centre-West: previous EMEP50 with resolution of 50×50 km, and EMEP01 with resolution $0.1^\circ \times 0.1^\circ$ (longitude/latitude);

(b) Atmospheric Modelling System-Italian National Integrated Assessment Model (AMS-MINNI) models with resolution of 4×4 km and with resolution of 1×1 km.

13. By applying the dose-response functions developed by ICP Materials, maps of the Campania region (Italy) were produced representing estimated recession rates for limestone, estimated number of years necessary to reach 35 per cent loss in reflectance for limestone and estimated number of days necessary to reach 1 per cent haze for glass.

14. In figure II below, urban sites with high population density, developed industry and naval ports are highlighted in dark red. However, the UNESCO Cilento site is characterized by light colours in all maps. Because 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, by reducing the area of the cell, the estimation of the concentration value of a pollutant in the zone of interest is improved. Increasing the resolution of models makes it possible to have more information to assess the damage at heritage monuments due to atmospheric pollutants in greater detail.

Figure II
Limestone recession rate, micrometres (μm), first year of exposure



Source: Ms. La Torretta, ENEA, Bologna, Italy.

15. At the thirty-eighth meeting of the ICP Materials Task Force, the study on the relationship between the environment and the artefact at three selected UNESCO sites (St. Domnius Cathedral, Split, Croatia; Würzburg Residence, Würzburg, Germany; Royal Palace, Caserta, Italy) was discussed. The results will be presented in ICP Materials Report No. 93, expected later in 2022.

IV. Messages for the attention of other bodies

16. A new update of the mapping manual including soiling (2021) with dose-response functions for transparent (glass), as well as non-transparent materials (painted steel, white plastic and polycarbonate membrane) is available.

17. 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. 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). The study on the relationship between the environment and the artefact on three selected UNESCO sites is expected in 2022.