United Nations ECE/EB.AIR/GE.1/2021/13–ECE/EB.AIR/WG.1/2021/6

Economic and Social Council

Distr.: General
5 August 2021

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

Seventh joint session
Geneva, 13−16 September 2021
Item 10 (c) (i) of the provisional agenda
Progress in activities in 2021 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 2020 and May 2021. The activities and the report thereon are presented in accordance with the 2020−2021 workplan for the implementation of the Convention (ECE/EB.AIR/144/Add.2, table 1, items 1.1.1.5 −1.1.1.6) 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-seventh ICP Materials Task Force meeting (online, 5−6 May 2021). It describes trends for environment, corrosion and soiling during the period 1987–2019, including results from the recently completed trend exposure 2017−2018, 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.

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 2020 and May 2021. It highlights the results of activities undertaken since its previous report (ECE/EB.AIR/GE.1/2020/13−ECE/EB.AIR/WG.1/2020/6), submitted to the sixth joint session of the Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants (EMEP) and the Working Group on Effects (Geneva, 14−17 September 2020). The results are presented here in accordance with the 2020−2021 workplan for the implementation of the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/144/Add.2).

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 thirty-seventh meeting of the ICP Materials Task Force (online, 5−6 May 2021) was attended by 26 participants from 16 countries, including the Chair of the Working Group on Effects.

4. During 2020, the following reports were delivered: "Environmental data report. October 2017 to November 2018";[1] "Trends in pollution, corrosion and soiling 1987–2019";[2] and "Call for data 'Inventory and condition of stock of materials at UNESCO world cultural heritage sites'. Part IV – Relative importance of individual pollutants and the effect of their reduction on the damage cost for selected UNESCO sites".[3]

5. In 2021, the following ICP Materials reports are expected: "Technical manual"; and "Report on application of models with increased resolution (1 km x 1 km) at 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 effects (ECE/EB.AIR/2008/11−ECE/EB.AIR/WG.1/2008/16/Rev.1)[4] 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).

[1] International Cooperative Programme on Effects of Air Pollution on Materials, including Historic and Cultural Monuments (ICP Materials), Report No. 87 (Kjeller, Norway, Norwegian Institute for Air Research, 2020). Available at www.corr-institute.se/icp-materials/web/page.aspx?refid=18.

[2] ICP Materials, Report No. 88 (Kista, Sweden, Research Institutes of Sweden, 2020). Available at www.corr-institute.se/icp-materials/web/page.aspx?refid=18.

[3] ICP Materials, Report No. 89 (Rome, National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), 2020). Available at www.corr-institute.se/icp-materials/web/page.aspx?refid=18.

[4] 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, 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

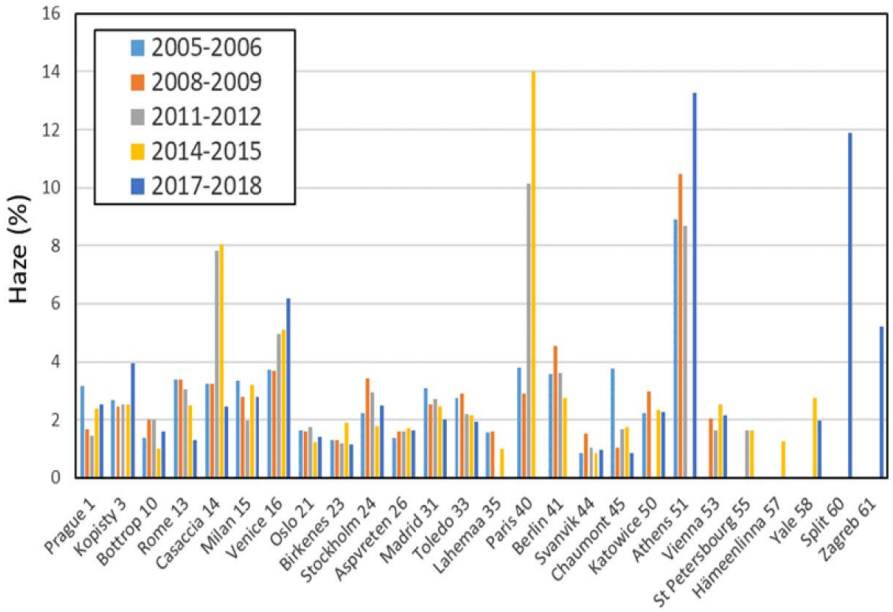
9. Exposures for trend analysis are performed every third year in the network of ICP Materials test sites. The completed exposure (2017−2018) included corrosion samples of carbon steel, stainless steel, weathering steel, zinc, copper, limestone and soiling samples of modern glass, limestone, marble and coil-coated materials. The data were included in the "Report on corrosion and soiling data from the 2017−2018 exposure for trend analysis".[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 Gothenburg protocol review: "What is the observed and projected trend in damage to materials and cultural heritage due to air pollution above threshold levels". (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 zinc, which is not evident when looking at the 1-year values. There are still occurrences of corrosion values above acceptable levels at some places in Europe. For soiling, there is no decreasing trend after 1997 (see figure I below showing results for modern glass) 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 need to be collected for all ICPs together based on pending decisions from the Working Group on Strategies and Review and the Executive Body.

[5] See ICP Materials, Report No. 85 (Kista, Sweden, Research Institutes of Sweden, 2019). Available at www.corr-institute.se/icp-materials/web/page.aspx?refid=18.

Figure I

Comparison of haze (percentage) of modern glass for different exposure periods and sites



Source: Ms. Aurélie Verney-Carron, Laboratoire Interuniversitaire des Systèmes Atmosphériques (Inter-university Laboratory for Atmospheric Systems), Paris.

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

11. In line with the 2020–2021 workplan for the implementation of the Convention (ECE/EB.AIR/144/Add.2, table 1, workplan item 1.1.1.6), 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.

12. The evaluation of the expected cost of the damage due to air pollution was assessed in a report entitled "Call for data 'Inventory and condition of stock of materials at UNESCO world cultural heritage sites'. Part III – Economic evaluation".[6] The relative importance of individual pollutants and the effect of their reduction on the damage cost were presented in a report entitled "Call for data 'Inventory and condition of stock of materials at UNESCO world cultural heritage sites'. Part IV – Relative importance of individual pollutants and the effect of their reduction on the damage cost for selected UNESCO sites".[7] A decrease in the concentrations of nitrogen dioxide in the atmosphere could bring benefits in reducing the damage and therefore the cost of the damage of the corrosion of limestone and in the soiling of glass and a decrease in the concentrations of coarse particulate matter (PM_{10}) could bring benefits in reducing the damage and the cost in corrosion and soiling of limestone and soiling of glass.

13. A case study was performed on five historic and cultural monuments in Italy to evaluate the effects on materials deriving from the reduction of emissions required the

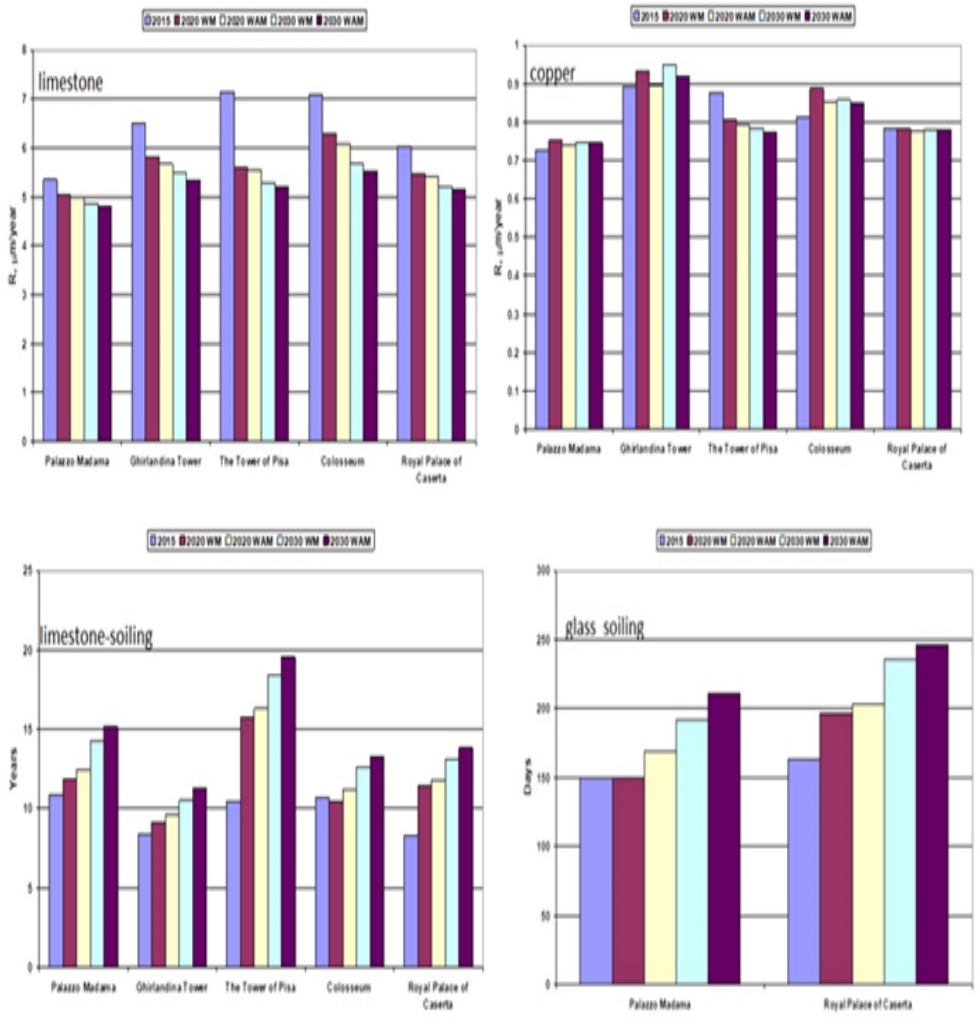
[6] ICP Materials, Report No. 86 (Rome, ENEA, 2019). Available at www.corr-institute.se/icp-materials/web/page.aspx?refid=18.

[7] ICP Materials, Report No. 89. Call for Data "Inventory and condition of stock of materials at UNESCO world cultural heritage sites". Part IV – Relative importance of individual pollutants and the effect of their reduction on the damage cost for selected UNESCO sites.

European Union National Emissions Ceiling Directive[8] Italian national model AMS-MINNI for the scenario years 2020 and 2030 and existing dose-response functions (see figure II below). The expected reduction of concentrations of atmospheric pollutants in Italy by 2030 could lead to a decrease in limestone surface recession and an improvement regarding the soiling of non-transparent (limestone) and transparent (glass) surfaces, with lengthening of the times between two cleaning operations. Overall, no significant improvement can be expected in the corrosion rate of copper.

Figure II

Predicted surface recession of Portland limestone, corrosion rate of copper, times between two cleaning operations for the soiling of limestone and for the soiling of glass for five cultural objects in Italy in the baseline scenario (2015) and for future scenarios (2020 and 2030), by the current national legislation (WM) and additional measures (WAM)



14. At the thirty-seventh meeting of the ICP Materials Task Force, the application of air quality models (EMEP Meteorological Synthesizing Centre-West and AMS-MINNI) with increased resolution at selected UNESCO sites to assess the damage on materials due to air pollution was discussed. Part of the meeting session on UNESCO world cultural heritage sites was dedicated to the discussion of results from models with increasing resolution of grid. The results will be presented in ICP Materials Report No. 90 expected later in 2021.

[8] Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC, *Official Journal of the European Union*, L 344 (2016), pp. 1–31.

IV. Messages for the attention of other bodies

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

16. 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). The effect of increasing resolution of air quality model on estimating the damage of materials is expected in 2021.