United Nations ECE/EB.AIR/GE.1/2016/11–ECE/EB.AIR/WG.1/2016/4

Economic and Social Council

Distr.: General
1 September 2016

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

Second joint session*
Geneva, 13–16 September 2016
Item 14 of the provisional agenda
Progress in activities in 2016 and further development of effects-oriented activities

Effects of air pollution on forests**

Progress report by the Programme Coordinating Centre of the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests

Summary

The report presents the results of the activities undertaken since the previous report by the Programme Co-ordinating Centre for the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests). The activities and the report on them are in accordance with the request of the Executive Body to the Convention in its 2016–2017 workplan for the implementation of the Convention

* The Executive Body to the Convention agreed that, as of 2015, the Working Group on Effects and the Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe should meet jointly, to achieve enhanced integration and cooperation between the Convention's two scientific subsidiary bodies (ECE/EB.AIR/122, para. 47 (b)).

** The present document is being issued without formal editing.

GE.16-15123(E)
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(ECE/EB.AIR/133/Add.1, items 1.1.1.7, 1.1.1.10, 1.1.1.24, 1.4.1 and 1.4.2) and, the informal document approved by the Executive Body for the Convention at its thirty-fourth session, “Basic and multi-year activities in the 2016–2017 period” (items 1.1.1–1.1.3, 1.1.6, 1.1.7, 1.2.2 and 1.8.1–1.8.3).

The report of the ICP Forests presents the results of its thirty-second Task Force meeting (Luxembourg, 10–13 May 2016) and of activities undertaken since its 2015 report (ECE/EB.AIR/GE.1/2015/12−ECE/EB.AIR/WG.1/2015/5). It particularly refers to a chapter on ground level ozone in the “2015 Technical Report of ICP Forests”[1] and two contributions on deposition of air pollutants and defoliation to the report of the FOREST EUROPE’S Liaison Unit Madrid on the “State of Europe’s Forest 2015”. Relevance is further provided by the ICP Forests community with a number of scientific papers on soil acidification and nitrogen eutrophication, ozone, climate change and other topics.

[1] See http://icp-forests.net/page/icp-forests-technical-report.

I. Introduction

1. This report presents the results of the activities undertaken by the Programme Co-ordinating Centre (PCC) of the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) between May 2015 and May 2016. The activities and the report on them are in accordance with the request of the Executive Body to the Convention in both, its 2014–2015 and 2016–2017 workplan for the implementation of the Convention (ECE/EB.AIR/122/Add.2, and ECE/EB.AIR/133/Add.1 items 1.1.1.7, 1.1.1.10, 1.1.1.24, 1.4.1 and 1.4.2) and, the informal document approved by the Executive Body for the Convention at its thirty-fourth session, “Basic and multi-year activities in the 2016–2017 period” (items 1.1.1–1.1.3, 1.1.6, 1.1.7, 1.2.2 and 1.8.1–1.8.3).

2. Germany is the lead country of ICP Forests and its PCC is hosted by the Johann Heinrich von Thünen Institute, (Federal Research Institute for Rural Areas, Forestry and Fisheries). Approximately 550 participants from 42 Parties to the Convention participate in the activities of ICP Forests.

3. The Fifth Scientific Conference of ICP Forests “Tracing air pollution and climate change effects on forests ecosystems: trend and risk assessments” was held back to back with the thirty-second Task Force Meeting of ICP Forests in Luxembourg, 10–13 May 2016. A Book of Abstracts reflecting all contributions to the Scientific Conference was distributed among the participants. The topics of the Scientific Conference were: a) deposition, outputs and effects of nitrogen, sulphur and heavy metals on forest ecosystems; b) ozone levels, risks and effects; and c) climate, climate change and assessment of ecosystem responses.

4. During the Task Force Meeting the PCC gave an overview on activities and progress since the thirty-first Task Force Meeting (Ljubljana, Slovenia, 20–22 May 2015). The draft of the 2016 Technical Report of ICP Forests was presented along with an outline for the annual glossy brochure (Executive Report). The Chair of ICP on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring) and a representative of ICP on Effects of Air Pollution on Natural Vegetation and Crops (ICP Vegetation) gave reports on their activities and possible co-operation opportunities were discussed. The new ICP Forests medium-term strategy was adopted. The Expert Panels and Committees — working groups installed under ICP Forests — reported on their activities. ICP Forests manual updates proposed by the Expert Panels were adopted. This updating process included also the modification of the access and use of ICP Forests data and further development of the data infrastructure. The PCC reported about ongoing studies with ICP Forests data by internal and external scientists and projected co-operations with external partners. A Letter of Intent between the ‘Wood Buffalo Environmental Association’ (Canada) and ICP Forests about mutual scientific exchange was discussed and accepted by the Task Force. Negotiations on the update of the European Union National Emission Ceilings (NEC) Directive are still ongoing. ICP Forests was actively advocating, by circular letters to our National Focal Centres, to directly refer to ICP Forests parameters and methods already assessed by the Member States of the European Union.

II. Outcomes and deliverables in the reporting period

5. ICP Forests produced or contributed to the following publications and reports:

(a) ICP Forests gathered and recorded data on, in total, 13 domains describing forest ecosystems. This activity was reported in the WGE and Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of

Air Pollutants in Europe (EMEP) 2015 joint progress report (ECE/EB.AIR/GE.1/2015/3–ECE/EB.AIR/WG.1/2015/3);

(b) Annual report of ICP Forests to EMEP Steering Body and WGE (ECE/EB.AIR/GE.1/2015/12–ECE/EB.AIR/WG.1/2015/5);

(c) 2015 Technical Report of ICP Forests;

(d) Executive Report of ICP Forests 2014 (glossy brochure);

(e) Anniversary report — '30 years of monitoring the effects of long-range transboundary air pollution on forests in Europe and beyond';

(f) Book of abstracts of the Fifth Scientific Conference of ICP Forests;

(g) Report 'The monitoring system of ICP Forests';

(h) Report 'Tree crown condition and damage causes';

(i) Report 'Relationship between defoliation of forest trees and modelled nitrogen deposition';

(j) Report 'Ground level ozone concentrations and exposures from 2000 to 2013';

(k) Report 'Spatial variation of deposition in Europe 2013';

(l) Four contributions to the WGE Trends Report.[2]

6. In total 20 scientific papers had been published between May 2015 and May 2016 based on ICP Forests data or with a considerable use of the ICP Forests infrastructure. The publications cover the following fields: biogeochemistry including acidification nitrification (4), nitrogen deposition (3), foliar (nitrogen and phosphorous) nutrition (4), carbon allocation (2), climate change effects (2), ozone effects and metrics (2), fungi and insects (2) and one introductory paper. Moreover, the PCC prepared mid-term information on implementing the revised long-term strategy of the effects-oriented activities.

III. Expected outcomes and deliverables of the next period and in the longer term

7. In the second half of 2016 and in 2017 ICP Forests is going to carry out the following activities and provide the deliverables indicated in the 2016–2017 workplan as well as to implement the decisions taken at the ICP Forests Task Force meetings:

(a) Continuation of data collection activities on condition and development of forest ecosystems and efforts to improve the data quality as well as the data management system;

(b) Further implementation and further development of the guidelines (2016 update of the ICP Forests Manual) for assessing, evaluating and reporting of air pollution effects on forests.

[2] Heleen de Wit, Jean-Paul Hettelingh and Harry Harmens, eds., *Trends in ecosystem and health responses to long-range transported atmospheric pollutants*. NIVA Rapport L.Nr. 6946–2015 (Oslo, 2015, 17, 28–32, 48–50).

IV. Cooperation with other groups, task forces or subsidiary bodies, notably with regard to synergies and possible joint approaches of activities

8. In the course of the long-lasting co-operation with ICP Vegetation in the field of ozone impact on forest trees and plants at forest edges, a joint workplan item has let to common evaluation efforts of data collected under ICP Forests.

9. As a joint activity between ICP Forests and EMEP Meteorological Synthesizing Centre-West, comparisons between measured deposition values and modelled values are continued.

V. Strengthening the involvement of countries of Eastern and South-eastern Europe, the Caucasus and Central Asia in the work under the Convention

10. The countries in South-eastern Europe: Bulgaria, Croatia, Greece, Serbia, Slovenia, and Turkey contribute constantly to the extensive ICP Forests Level I monitoring and all — except Turkey — contribute also to the intensive monitoring network (Level II). The 2014 Task Force Meeting of ICP Forests was held in Athens, Greece, and the 2015 Task Force Meeting was held in Ljubljana, Slovenia.

VI. Scientific and technical cooperation activities with relevant international bodies

11. ICP Forests delivered two contributions to the Criterion 2 'Maintenance of forest ecosystem health and vitality of the 'State of Europe's Forests 2015 report'.[3,4]

12. Cooperation with the Acid Deposition Network in East Asia (EANET) is ongoing and might be intensified in 2016.

13. A Letter of Intent between the 'Wood Buffalo Environmental Association' (Canada) and ICP Forests intends to foster the scientific exchange on air pollution effects on forests in many fields of activity.

VII. Highlights of the scientific findings: policy-relevant issues

14. The ICP Forests community published a total of 20 papers in peer-reviewed journals between May 2015 and May 2016. From them seven (two merged) are highlighted as relevant for environmental policy issues:

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[3] Marco Ferretti and others, *Indicator 2.1 Deposition of air pollutants*. In: Michael Köhl, Jesus San-Miguel Ayanz and G. Domíngues Torres, coordinating authors: Criterion 2: Maintenance of Forest Ecosystem Health and Vitality, FOREST EUROPEAN LIASON UNIT MADRID, State of Europe's forests 2015 report, (Madrid, 2015, 90–95).

[4] Marco Ferretti, Alexa Michel and Walter Seidling, *Indicator 2.3 Defoliation*. In: Michael Köhl, Jesus San-Miguel Ayanz and G. Domíngues Torres, coordinating authors, Criterion 2: Maintenance of forest ecosystem health and vitality, FOREST EUROPE LIASON UNIT MADRID, State of Europe's forests 2015 report, (Madrid, 2015, 98–100).

(a) A very comprehensive study using Spanish Level I and Level II monitoring data together with data from the Spanish and the Catalonian national forest inventories focused mainly on foliar nitrogen (N), phosphorous (P) and potassium (K) element concentrations and their ratios as response variables with a broad variety of statistical approaches. Besides distinct effects from species and higher phylogenetic clades on foliar element concentrations and ratios, meteorological conditions and N deposition were found to influence foliar N and also P concentration as well as N:P ratios. Both high foliar N and relative low foliar P concentrations are significantly fostered by N deposition;

(b) N concentrations in wet deposition, soil solution, and foliar nutrition were studied on in total 201 ICP Forests Level II sites across Europe and 43 sites of the Swedish Throughfall Monitoring Network. Critical limits for nutrient N in soil solution were exceeded at one third to one half of the sites. Both low magnesium (Mg) concentrations in foliage and needle/leaf discoloration were rare events, however, seemed to be more frequent at sites with exceeded CL values in soil solution. On one third of the plots with exceedance of N deposition critical loads show temporary indications of N saturation and one third permanent indication of N saturation. In general foliar nutrition is more dependent on concentration of N in soil solution than on N in throughfall deposition;

(c) Dissolved organic nitrogen (DON) and dissolved organic carbon (DOC) in deposition and soil solution was studied at five intensive monitoring (ICP Forests Level II) plots in Flanders (Belgium). Due to recovery from acidification following strong reductions of sulphur (S) inputs in the 1990s and moderate reductions of N inputs a stronger increase in DON compared to DOC was expected in soil solution and could be confirmed for this limited area;

(d) Based on 5 year integrated ozone measurements with passive samplers at remote ICP Forests Level I sites in northern Italy (Trento) 2007 to 2011 (mean altitude 1318 m) amended by conventional ozone measurements in urban sites (mean altitude 213 m) maps of ozone risk to forests - defined as accumulated ozone exposure over a threshold of 40 parts per billion (ppb) (AOT40) — and human health defined as — information threshold (IT) 180 micrograms (µg) averaged over one hour — were prepared with considerable accuracy (root-mean-square deviation — RMSD 12.31 against a mean of 92 µg m^{-3}). Ninety three to ninety eight per cent of the area with forests and semi-natural vegetation appeared to be potentially at risk. For human population in that area the highest percentage exposed to medium or high exceedances was 43 per cent in 2011. The dense Level I network enables a spatially explicit modelling of ozone (O_3) concentrations and risks for vegetation (and human health), which can be modified if ozone uptake would be considered;

(e) Accumulated stomatal ozone flux values above a threshold of 1.6 nanomoles (nmol) O_3 per square meter per second ($m^{-2}s^{-1}$) — AF_{st} 1.6 revealed to be a better predictor for visible ozone injury in beech leaves than AOT40. Seasonal (June to September 2008) mean ozone concentrations was 37 ppb, which was lower than those found there in the 1990s (37–52 ppb). Average exceedance of AF_{st}1.6 critical load of 4 mmol O_3 per square meter (m^{-2}) was 160 per cent. In the AOT40 approach, the critical limit of 5 ppm per hour was exceeded only at 4 of the 5 sites. First visible O_3 symptoms on beech leaves were observed at all sites not earlier than September at AF_{st} values between 13–22 mmol O_3 per square meter. It is concluded that visible symptoms are a simple tool for O_3 impact assessment under native conditions;

(f) A modelling study at three French Level II plots showed a more pronounced impact of climate change effects on dominant moss and herb layer species especially in spruce and fir forest ecosystems in comparison to the expected declining impacts of nitrogen deposition. Comparisons between reductions according to current legislation and maximum feasible N reduction scenario showed minor differences;

(g) With ICP Forests Level I data (7569 plots) a new methodological approach was undertaken to cope with both uncertainty in models and uncertainty in future climate conditions. The result was a large-scale species distribution map of common beech. By describing the niche of beech within a Bayesian framework the authors were able to model probability maps even at fine geographical scales applicable for forest management and even more general landscape-related planning. In another study the xeric limit of beech were modelled using ICP Forests Level I data by taking up Ellenberg's climate quotient. In this concept the distance between a given site and the xeric edge was defined as climatic marginality. If information on local climatic site conditions is available, climatic marginality for beech can be mapped, giving a powerful mean to support forestry planning at fine scales.

VIII. Publications

15. For a full list of ICP Forests publications and references for the present report, please refer to the 2016 Technical Report of ICP Forests[5] or visit the ICP Forests website.[6]

[5] Alexa Michel and Walter Seidling, eds., *Forest Condition in Europe: 2016 Technical Report of ICP Forests*. BFW-Dokumentation (Vienna, forthcoming).

[6] See www.icp-forests.net