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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

First joint session*
Geneva, 14–18 September 2015
Item 15 of the provisional agenda
Progress in activities in 2015 and further development of effects-oriented activities

Effects of air pollution on forests**

Report by the Programme Co-ordinating Centre of the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests

Summary

This report presents the results of the activities undertaken 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 on Long-range Transboundary Air Pollution in its 2014–2015 workplan for the implementation of the Convention (ECE/EB.AIR/122/Add.2, item 1.1.16).

The report of ICP Forests presents the results of its thirty-first Task Force meeting

* 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.

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(Ljubljana, Slovenia, 20–22 May, 2015). In particular ICP Forests contributed to the forthcoming trends report of the Working Group on Effects with four contributions (on defoliation, foliar element contents, ozone concentrations and deposition of sulphur and nitrogen). Relevance for international bodies is provided by scientific papers on sulphur and nitrogen deposition and its effects in ecosystems. Scientific papers on mycorrhiza, heavy metals, ozone, and carbon stocks in forests complement respective contributions from the ICP Forests community.

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 2014 and May 2015. The activities and the report on them are in accordance with the request of the Executive Body to the Convention on Long-range Transboundary Air Pollution in its 2014–2015 workplan for the implementation of the Convention (ECE/EB.AIR/122/Add.2, item 1.1.16).

2. Germany is the lead country of ICP Forests; its Programme Co-ordinating Centre (PCC) is hosted by the Johann Heinrich von Thünen Institute.[1] Approximately 500 participants in 42 Parties to the Convention on Long-range Transboundary Air Pollution participate in the activities of ICP Forests.

3. The thirty-first Task Force meeting and the fourth scientific conference "Long-term trends and effects of air pollution on forest ecosystems, their services, and sustainability" were held back to back in Ljubljana, Slovenia from 19 to 22 May 2015.

4. In the Task Force meeting, the PCC presented an overview of the structure of the convention bodies, especially the Working Group on Effects. The 2015 Technical Report, the 2014 Executive Report and an Anniversary Publication were discussed. The Expert Panels – working groups installed under ICP Forests - reported on their activities. The status of the database and progress of the database management system were presented. An ICP Forests strategy discussion initiated at the 2014 Task Force meeting in Athens was continued. The minutes of the meeting are available at the ICP Forests website.[2] The topics of the Scientific Conference were: 'Measuring and modelling air pollution trends and effects in Europe', 'Forest response: health, diversity and growth' and 'New developments'.

II. Outcomes and deliverables in the reporting period

5. In 2015, ICP Forests produced or contributed to the following reports:

(a) 2014 joint progress report on the activities of the International Co-operative Programmes and the Joint Task Force on the Health Aspects of Air Pollution (ECE/EB.AIR/WG.1/2014/3);

(b) Report of the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ECE/EB.AIR/WG.1/2014/5);

(c) 2014 Technical Report of ICP Forests;[3]

(d) The condition of forests in Europe, 2013 Executive Report;[4]

(e) 'Abstracts' of the 3rd ICP Forests Scientific Conference;[5]

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1 See http://www.ti.bund.de/en/startseite/institutes.html.

2 See: http://icp-forests.net.

3 Michel A., Seidling, W., (eds.): Forest Condition in Europe. 2014 Technical Report of ICP Forests. BFW-Dokumentation 18/2014, 164 p. (http://icp-forests.net/page/icp-forests-technical-report).

4 Seidling, W. et al. 2014: The condition of forests in Europe, 2013 Executive Report. ICP Forests, Eberswalde, 36 p. (http://www.icp-forests.org/pdf/ER2013.pdf).

5 Seidling, W., Ferretti, M., Michel, A., Micholpoulos, P., 2014: Impact of nitrogen deposition and ozone on the climate change mitigation potential and sustainability of European forests. 3rd ICP Forests Scientific Conference, Abstracts, 32 p. (http://www.icp-forests.org/pdf/Abstracts_2014_icp_sc.pdf).

(f) Book of abstracts', 4th ICP Forests Scientific Conference;[6]

(g) Report on 'Tree crown condition and damage causes';[7]

(h) Report on 'Level II soil data base';[8]

(i) Report on 'Spatial variation of deposition in Europe'.[9]

6. The main results of the activities carried out are:

(a) ICP Forests prepared four contributions (long-term trends in defoliation, foliar nutrient contents of forest trees, ozone air concentrations at forest sites, wet deposition measurements at forest sites) to the trends report of the Working Group on Effects, to be presented at the next session of the Executive Body;

(b) Parameters measured at ICP Forests intensive monitoring sites and documented in the ICP Forests Manual are foreseen in the drafted revision of the National Emission Ceilings (NEC) Directive, Annex V (Monitoring of effects of pollutants in the environment) as part of the European Union (EU) Clean Air Policy Package;

(c) In total 29 scientific papers were published between June 2014 and May 2015 by ICP Forests members with at least partly including data from the ICP Forests database or data from ICP Forests monitoring plots. They cover the following subjects: Climate change (n=6), effects of nitrogen and sulphur (n=5), tree mineral nutrition (n=4), ozone (n=3), carbon sequestration (n=3), soil nutrients (n=2), deposition (n=1), phosphorous (n=1), heavy metals (n=1), biodiversity (n=1), data management (n=1) and monitoring network (n=1). For a full list of the papers see the ICP Forests website.[10]

III. Expected outcomes anddeliverables over the next period and in the longer term

7. In the second half of 2015 and in 2016, ICP Forests is going to contribute to or produce the following deliverables indicated in the 2014–2015 workplan and to deliverables foreseen for the 2016-2017 workplan as well as decision taken at the Task Force meetings of ICP Forests:

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

(b) Further implementation of the guidelines (ICP Forests Manual) for assessing, evaluating and reporting of air pollution effects on forests;

(c) The 2015 progress report on policy-relevant scientific findings ((ECE/EB.AIR/GE.1/2015/3–ECE/EB.AIR/WG.1/2015/3);

(d) The Technical Report of ICP Forests for 2015;

[6] Seidling, W. (ed.) 2014: Long-term trends and effects of air pollution on forest ecosystems, their services, and sustainability. Book of abstracts, 4th ICP Forests Scientific Conference, Slovenian Forests Institute, 49 p. (http://www.icp-forests.org/pdf/Abstracts_2014_icp_sc.pdf).

[7] Wellbrock, N., Eickenscheidt, N., Haelbich, H., 2014: Tree crown condition and damage causes. BFW-Dokumentation 18/2014: 11-71.

[8] Cools, N., De Vos, B., 2014: A harmonized Level II soil database to understand processes and changes in forest condition at the European level. BFW-Dokumantation 18/2014: 72-90.

[9] Fischer, U., Seidling, W., 2014: Spatial variation of deposition in Europe. BFW-Dokumentation 18/2014: 91-101.

[10] http://icp-forests.net/page/scientific-publications.

(e) The Executive Report of ICP Forests for 2014 (probably renamed as ‘Report’, since ‘Executive Report’ originates from former European Union reporting obligations);

(f) A 30 years’ Anniversary Report.

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

8 Under the umbrella of the Working Group on Effects, ICP Forests has a long-lasting cooperation with the ICP on Effects of Air Pollution on Natural Vegetation and Crops (ICP Vegetation) in the field of ozone induced symptoms on forest trees and on forest edge species (LESS). From both sides this co-operation is intended to be continued. Ozone flux modelling bears also a considerable potential for further collaboration with ICP Vegetation and other external partners. Plot-specific calculations of critical load exceedances performed for ICP Forests sites should bear a potential for co-operation with the ICP on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (ICP Modelling and Mapping). Soil solution studies on intensive monitoring plots bear a high potential for collaboration, especially with the ICP on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring).

9 ICP Forests has in the past extensively used data from the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) for the calculation of plot-specific deposition estimates in order to verify its measurements on its intensive monitoring plots or to perform correlation studies on its large-scale monitoring network.

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

10. Countries of Eastern and South-Eastern Europe and Western Asia (Turkey) are fully integrated mainly in the extensive Level I monitoring of ICP Forests, however, the intensive Level II monitoring of forest ecosystems is rarely performed. Some countries have in recent years, however, stopped their Level I activities (this not only in Eastern Europe).

11. Up until today, neither the states of the Caucasus region nor those of Central Asia are part of the ICP Forests network. As large parts of Central Asia are covered with steppe vegetation, forests are generally of minor relevance, except for sites along rivers and at the foothills of mountain ranges (the Caucasus, the Tien Shan).

12. ICP Forests reveals a loose co-operation with the Acid Deposition Network in East Asia (EANET) in many fields of forest monitoring air pollution and its effects on forests. Intensifying the cooperation is hampered from both sides due to limited financial and personal resources.

VI. Scientific and technical cooperation activities with relevant international bodies

13. While in the past there was a close co-operation between ICP Forests and the European Union, this relationship has become rather restrained. Co-operation at field level with the Long-term Ecological Research Network Europe (LTER)[11] is given due to the fact that around 60 ICP Forests Level II plots are also part of the LTER network. However, a higher level of cooperation is indented.

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

14 The following findings are largely derived from the field work of countries contributing to the ICP Forests as well as from scientists working within one or more of the ICP Forests structures (Expert Panels, Scientific Committee, Data quality assurance committee, PCC). Published findings having certain relevance for environmental policy are highlighted in the following:

(a) A decrease in sulphate (SO_4^{2}—sulphur (S)) deposition was statistically significant at the plot level in the period 2001–2010. For deposition of inorganic nitrogen (N) compounds, relative changes were smaller and significant decreasing trends were found for about a quarter of the several hundred forested sampling plots. The strongest decreasing trends were found for sites in Western Central Europe with relatively high deposition fluxes, whereas stable or slightly increasing N deposition during the last 5 years was found in and East of the Alpine region as well as in Northern Europe;

(b) No generally-significant temporal variations in phosphorus (P) deposition over periods of up to 19 years were evident for 246 terrestrial locations, of which 82 per cent were in Europe and in North America. The global atmospheric transport of dust has varied over the last 10,000 years, but there may have been variation in the transport of coarser, primary biological aerosol particles, and local transfer of P amongst ecosystems is likely a continual process. Results from a simple model suggest that local transfers effectively redistribute P over the terrestrial landscape. Research into the atmospheric transport of P from fertilised agricultural land to natural and semi-natural ecosystems should be warranted;

(c) A review paper concludes that atmospheric deposition has significant effects on nutrient-acidity status in terms of elevated nitrogen and sulphur concentrations in forest foliage and soil solution and relates to soil acidification in terms of elevated aluminium and/or base cation leaching from the soil. Relationships of air pollution with crown condition, however, appear to be weak and limited in time and space, while climatic factors appear to be more important. For tree growth, monitoring results indicate a fertilization effect of N deposition on most European forests. However, field evidence for impacts of ambient ozone exposure on tree growth seems less clear;

(d) There is statistical evidence of an impact of N deposition on soil chemistry, tree nutrition and growth in temperate forests in Southern Europe. Measured N deposition (NO_3-N + NH_4-N) amounting to 4-29 kg ha^{-1} yr^{-1} was found to exceed critical loads at several monitoring sites, to augment foliar N-ratios (particularly N : P and N : potassium (K)) and to promote growth and carbon sequestration. A time lag for detrimental N effects is suggested, but also that under continuous high N input, the reported positive growth response may not be sustainable in the long term;

[11] See www.lter-europe.net.

(e) A significant decreasing trend in foliar P concentration in common beech, pedunculate oak and Scots pine was found. The deterioration of tree mineral nutrition may partly be explained by insufficient soil nutrient supply for meeting the increasing nutrient demands of faster growing trees, possibly because of increasing atmospheric carbon dioxide (CO_2) or of still too high N deposition. When evaluating forest carbon storage capacity and planning to reduce CO_2 emissions by increasing use of wood biomass for bioenergy, nutrient limitations for forest growth should be considered as well. Another study on foliar P concentration in beech confirmed the generally decreasing trend;

(f) At large scales, mycorrhizal richness and evenness declined with decreasing soil pH and root density, and with increasing atmospheric nitrogen deposition. Nitrogen critical loads were determined for moderate (9.5-13.5 kg N/ha/year) and drastic (17 kg N/ha/year) changes in below ground mycorrhizal root communities in temperate oak forests. Species of fungi were described that individually and/or in combination with others can be used as indicators;

(g) The ICP Forests network has tremendous potential for science and conservation, and can be a future platform for large-scale mycorrhizal studies to inform science, management, conservation, and policy about distributions, diversity, hotspots, dominance and rarity, and indicators of forest changes;

(h) The mean current level of heavy metal (HM) deposition in Estonia is low compared to previous decades, especially the 1980s. The effect of the previously significantly higher exposure of HM emissions and deposition is preserved in the older part of soil organics (OF layer), where the highest stocks and concentrations of HMs (with the exception of zinc) are currently found. The HM proportions in fly ash of oil shale and in the OF layer of soil were very similar with regards to nickel (Ni) and chromium (Cr) – indicating their origin from the oil industry in the North-East region. According to spatial distribution analysis, the greatest accumulated storages of Ni and Cr in the OF layer of coniferous forest soils are characteristic to South-Western Estonia;

(i) Forest monitoring networks are valuable infrastructures not only for assessing the status and trends of forest condition. Their multi-functionality makes them also essential for addressing a wide range of environmental and societal concerns such as investigations of the risks posed by ground-level ozone to vegetation and human health;

(j) A range of benchmark values of carbon (C) densities and stocks, readily available for use in forest soil organic carbon (SOC) models, operational from plot to continental scale, could be provided. A substantial amount of C is stored in the forest floor, showing the importance of this compartment for C accounting. For EU forest soils, the dominant predictors were humus form and tree species for forest floor SOC stocks, parent material for peat soils, reference soil group, ecoregion, mean annual precipitation and humus form for the SOC stocks in mineral soil.

VIII. Publications

15. For a full list of ICP Forests publications and references for the present report, please visit the ICP Forests website.[12]

[12] See http://icp-forests.net/page/publications.