Federal Ministry
of Food
and Agriculture

UNECE

Convention on Long-range
Transboundary Air Pollution

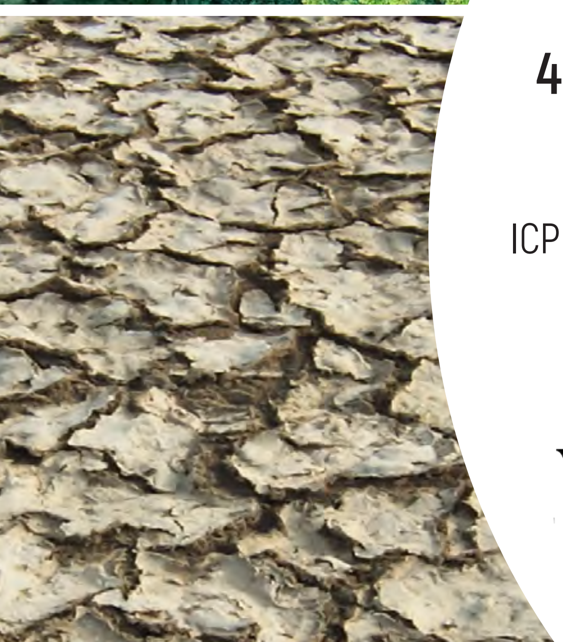
40 YEARS

ICP FORESTS

On the Pulse of European Forests

40 years of Pan-European Forest Monitoring:
From Air Pollution to Climate Change

ICP Forests 40th Anniversary Report under the UNECE Convention on Long-range Transboundary Air Pollution (Air Convention)



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PART 1

ICP Forests: A policy relevant, science-driven monitoring infrastructure

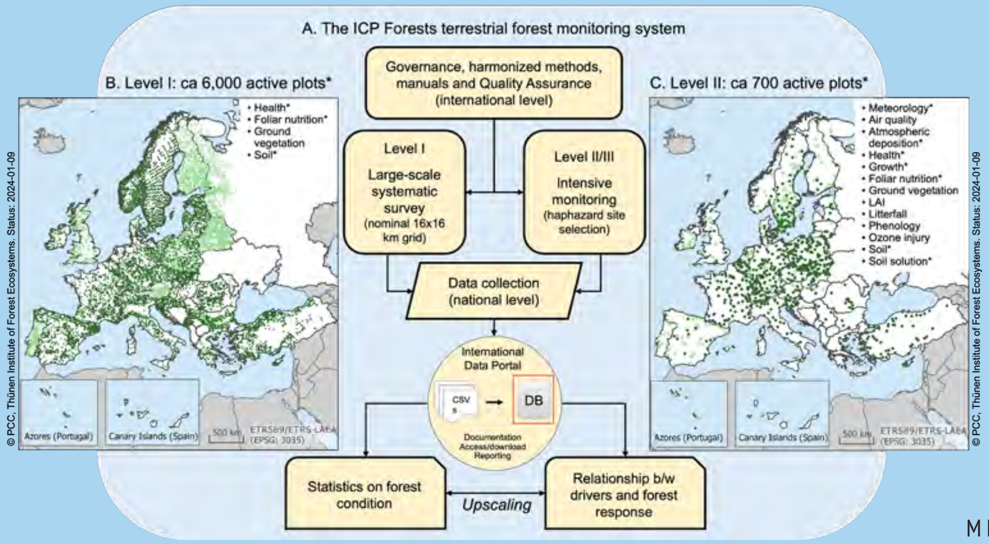
ICP Forests across 40 years of changes

Marco Ferretti, Kai Schwärzel

International forest monitoring is experiencing a renewed interest (Ferretti, 2021). The increasing pressure from climate change and climate change-driven disturbances has prompted a new series of initiatives to promote internationally harmonized forest monitoring systems (EC, 2023; Breidenbach et al., 2024; Ferretti et al., 2024; Wellbrock et al., 2024). This international and harmonized dimension is seen as essential due to the transboundary nature of climate change, forest-related interests, and the growing need for internationally comparable data. These concerns are not new. A similar situation arose in the 1980s in relation to another issue of transboundary nature (air pollution) and when extensive forest damage was observed in Central Europe, although the connection between the two was largely debated (Schütt and Cowling, 1985; Skelly and Innes, 1994; Kandler and Innes, 1995). During that period, an international harmonized forest monitoring system was not only advocated but also conceived and put in place. This system is the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests), and – after 40 years – is still operative.

Forest dieback at the German-Czech border, 1988, Revier Rauschenbach, Forstbezirk Marienberg, Ore Mountains.

Born international. The ICP Forests was conceived with an international focus. It received its mandate from the 1979 UNECE Convention on Long-range Transboundary Air Pollution (in short: Air Convention), the first legally binding multilateral international agreement to combat air pollution at the pan-European scale. The international origin of ICP Forests makes a huge difference when compared to other country-based systems because it forced immediate attention to ensuring data comparability at an international level. ICP Forests was officially launched on October 4, 1985, during the first Task Force Meeting in Freiburg (Germany). A few months later, in 1986, the European Union launched its Scheme on the Protection of Forests against Atmospheric Pollution (EEC, 1986), which provided essential co-financing for monitoring activities for more than 15 years.

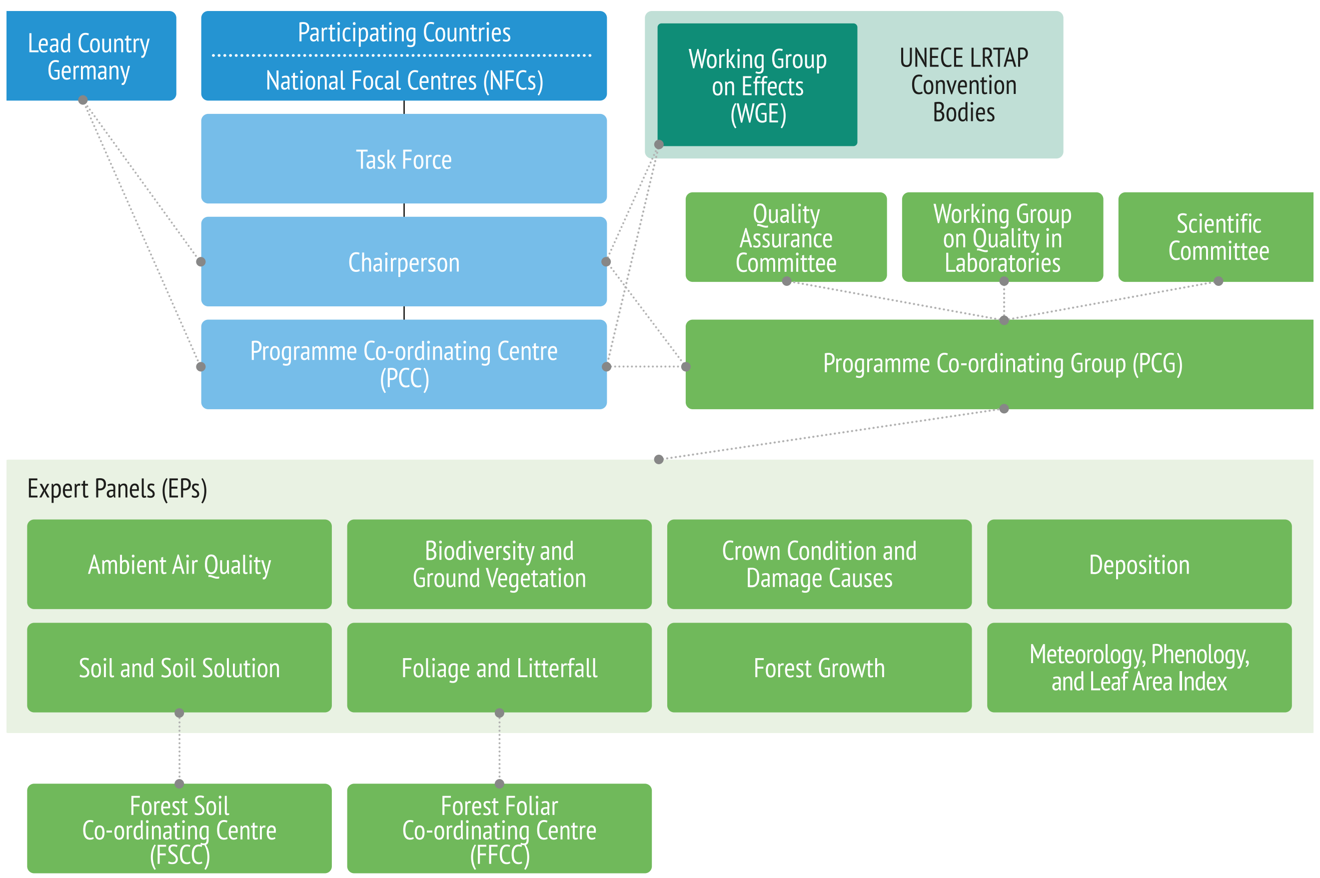


M Ferretti et al., 2024

The ICP Forests concept (A) is based on two differentiated monitoring levels, with two networks (B: Level I; C. Level II; dark green: active plots in 2022; light green: currently non-active plots) installed by participating countries (partly with the co-financing of the European Commission). Level I consists of approx. 6000 plots distributed according to a systematic transnational grid of 16 x 16 km (nominal density). There, tree health is evaluated annually according to a large set of attributes, while other investigations have been carried out on a more irregular and infrequent time basis (soil) or once only (foliar; diversity). Level II consists of approx. 700 intensive monitoring plots equipped with different combinations of measurement devices and located in selected forest ecosystems. There, measurements of biotic and abiotic drivers and forest ecosystem responses are co-located and permit investigation of the status and trends of several attributes and of driver-response relationships. Level I and Level II are connected by a common set of attributes measured according to the same methodologies. The system functions according to internationally harmonized methodologies for both Level I and II (see list of harmonized methods within each map) and nationally co-ordinated data collection. Asterisks identify networks/surveys/methodologies for which provisions have been published in the Official Journal of the European Union. All methodologies are available on the ICP Forests Website. Field data are validated at national and later at central level, used for reporting, and available upon request from the Programme Co-ordinating Centre (PCC).

Co-operatively developed. Since its establishment, the program has been developed co-operatively by the 42 participating countries and operated under an international governance in which all countries are involved. This governance combines a bottom-up science-based approach, where Expert Panels provide the scientific-technical basis for decision-making, with a top-down decision-making process, where the Task Force of ICP Forests makes official decisions based on the recommendations from the Expert Panels.

Ecosystem-oriented. From its early focus on the effects of air pollution on tree crowns, the scope of ICP Forests has expanded to include other ecosystem compartments (encompassing atmosphere, biosphere, geosphere, and hydrosphere), processes, and other environmental issues. New measurements have been introduced to assess the threats posed by climate change, the dynamics of carbon sequestration, and the provision of ecosystem services. The impact of environmental drivers on forest vitality, productivity, and biodiversity is increasingly reflected in the program's outputs. This progress has been possible thanks to the innovative design concept developed in the 1980s, which includes differentiated monitoring levels and accommodates a variety of monitoring activities. Today, the portfolio of measurements adopted by the ICP Forests allows for tracking changes in key forest ecosystem properties and processes. As a result, ICP Forests has remained relevant even when monitoring priorities have changed, as evidenced by the results presented in this report.



Large portfolio of attributes to monitor forest dynamics

Measurements at the ICP Forests plots include hundreds of variables to investigate the status and changes in forest health, diversity, productivity, and chemistry in response to a variety of biotic and abiotic drivers. Particular emphasis is now placed on air pollution, climate change, biotic damage and their interactions.

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Quality assured. ICP Forests has been striving for a harmonized approach for data collection and processing across its two networks and all surveys. Ensuring data comparability has been a key priority since the program began. Intercalibration courses for field crews and ring-tests for laboratories were established at an early stage and are still carried out regularly. Methodologies for all surveys – such as sampling design, frequency of measurements, standards, assessment and measurement methods – are described in the ICP Forests Manual, which has been developed and continuously updated over the past 40 years (Ferretti et al., 2009). Each survey is subject to Quality Assurance (QA) and Quality Control (QC) measures, including training, intercalibration/cross-comparison courses, field checks, interlaboratory ring tests, data validation procedures, and internal reviewing (Ferretti and Fischer, 2013). This transnational harmonization and QA/QC approach makes ICP Forests unique in the global forest monitoring landscape. Quality-assured data are stored in a central database, managed according to an established data policy, and freely available upon request: There were approximately 350 data requests from all over the world over the past 10 years and over 650 scientific publications based on the ICP Forests infrastructure and/or data.

Development of ICP Forests

1985

Launch of ICP Forests at the 1st Task Force Meeting in Freiburg, Germany

Two Programme Co-ordinating Centres (PCC East and PCC West) were established in Prague and Hamburg, respectively

Start of the development of an **ICP Forests Manual**

1986

2nd Task Force Meeting in Freiburg, Germany

Adoption of the **ICP Forests Manual**

1st Crown Condition Surveys in accordance with the ICP Forests Manual in 20 participating countries

1987

1st Forest Damage Report of ICP Forests

1989

1st Report on the Health of Forests in the European Community 1987–1988

1992

1st Joint Report by the EU and ICP Forests, joint reporting continued until 2003

1994

1st Report on the ICP Forests Needle/Leaf Interlaboratory Test

1994/95

1st Soil Survey on more than 5000 Level I plots in 31 countries

1995

1st Foliage Survey on more than 1,395 Level I plots in 16 countries

1996

1st Transmission of Level II data to the **Forest Intensive Monitoring Co-ordinating Institute (FIMCI)** in The Netherlands

2010

First complete revision and harmonization of the **ICP Forests Manual** as part of the FutMon project

2011/12

Establishment of the Science Evaluation Committee (Scientific Committee from 2017 on) and **launch of the ICP Forests Scientific Conferences**

2013

Relocation of the Programme Co-ordinating Centre (PCC) from the Thünen Institute for World Forestry in Hamburg to the Thünen Institute of Forest Ecosystems in Eberswalde

Publication of the book **Forest Monitoring. Methods for Terrestrial Investigations in Europe with an overview of North America and Asia** authored and edited by the ICP Forests community

40 years of ICP Forests

2025

ICP Forests: Science and policy in a changing world

ICP Forests bridges science and policy through its approach to problem-solving, promotion of dialogue and openness to new demands.

Facts, not opinions: ICP Forests uses state-of-the-art monitoring approaches to produce high-quality data and information. From design to measurement methods and data collection, everything is thoroughly documented, accessible and traceable, and quality-assured. This transparency fosters confidence in our results and allows for credible answers to policymakers. The program's findings have been essential in addressing the scientific information needs of the Air Convention, documenting the success of air pollution abatement measures in Europe, the ongoing concerns, and the emerging challenges (see Part 2, Factsheets). Our data are also increasingly used by the scientific community (see Part 3, Science Stories). In addition, the data and information provided by ICP Forests are highly relevant to many national and international forestry and environmental bodies and processes.

Science to promote dialogue and co-operation. Another way to look at the link with policy and science is the role of ICP Forests in promoting dialogue across countries and institutions at national and international level. One of the program's greatest achievements has been demonstrating the feasibility and effectiveness of transnational forest monitoring (Ferretti and Fischer, 2021). ICP Forests started in the mid-1980s and developed throughout the following decade, during a phase of dramatic political changes in Europe. Despite this political instability, co-operation within the monitoring program has grown and expanded. Several factors contributed to this: the politically neutral framework provided by the Air Convention; the strong political commitment from the European Commission (originally from DG Agriculture, then from DG Environment), which led to an unusually long-term support and to a joint reporting from 1992 to 2003, with cascading effects on non-EU countries; and the outstanding commitment, perseverance, and motivation of hundreds of scientists, foresters, and national funding agencies. In the past twenty years, ICP Forests has also fostered co-operation with other long-term monitoring networks in Europe, North America, and Asia, and dialogue is ongoing with experts from South America.

Science to address new demands. A third key aspect of ICP Forests is its ability to evolve and address emerging environmental issues of international and global relevance. Thanks to its multi-level, integrated design concept, ICP Forests has been able to incorporate research questions not only from the Air Convention (1979) but also from Forest Europe (1990, formerly the Ministerial Conference for Protection of Forests in Europe – MCPFE), the Convention on Biodiversity (1992), the Kyoto Protocol (1998), the European Union National Emission Ceiling (NEC) Directive (2016), and the Paris Agreement (2016). The program's structure, design, portfolio of measured variables, and governance have remained flexible and adaptive, ensuring its continued relevance. This adaptability can provide a solid foundation for the future of EU forest monitoring systems, such as the one suggested by the European Commission (EC, 2023).

ICP Forests and the European Commission: decades of co-operation

There is a long history of co-operation between ICP Forests and the EC. First, the European Union is a signatory to the Air Convention. Second, through the series of regulations beginning with the Reg. 3528/86, subsequent ones (Forest Focus) and programs (Life+ FutMon), the EC co-financed the installation of Level I and Level II plots and monitoring activities in EU Member States almost continuously until 2011. Third, ICP Forests and EC had a joint reporting system from 1992 to 2003. The figure shows the first joint Forest Condition Report published in 1992. Dialogue to foster further co-operation is still ongoing.

ICP Forests today: A model for the future of international forest monitoring

Today, the vision of ICP Forests is for an "European-wide forest monitoring infrastructure, integrating multiple levels and providing high quality, transparent, robust, and FAIR open access data (i) on the status and trends of forest health, vitality, productivity, and biodiversity; (ii) on risks of forests being exposed to anthropogenic and natural stressors (separately and combined), and (iii) on progress in achieving relevant policy goals to diminish risks" (Schwärzel et al., 2022).

At a time of growing concern on the future of our forests and of a demand for a common, harmonized monitoring system, we believe that its vision, international and co-operative nature, ecosystem-oriented approach, enduring emphasis on quality assurance and accessible data, and – last but not least – its 40 years of experience, make ICP Forests not only a successful story but also a useful model for the future, pan-European forest monitoring.

http://icp-forests.net

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