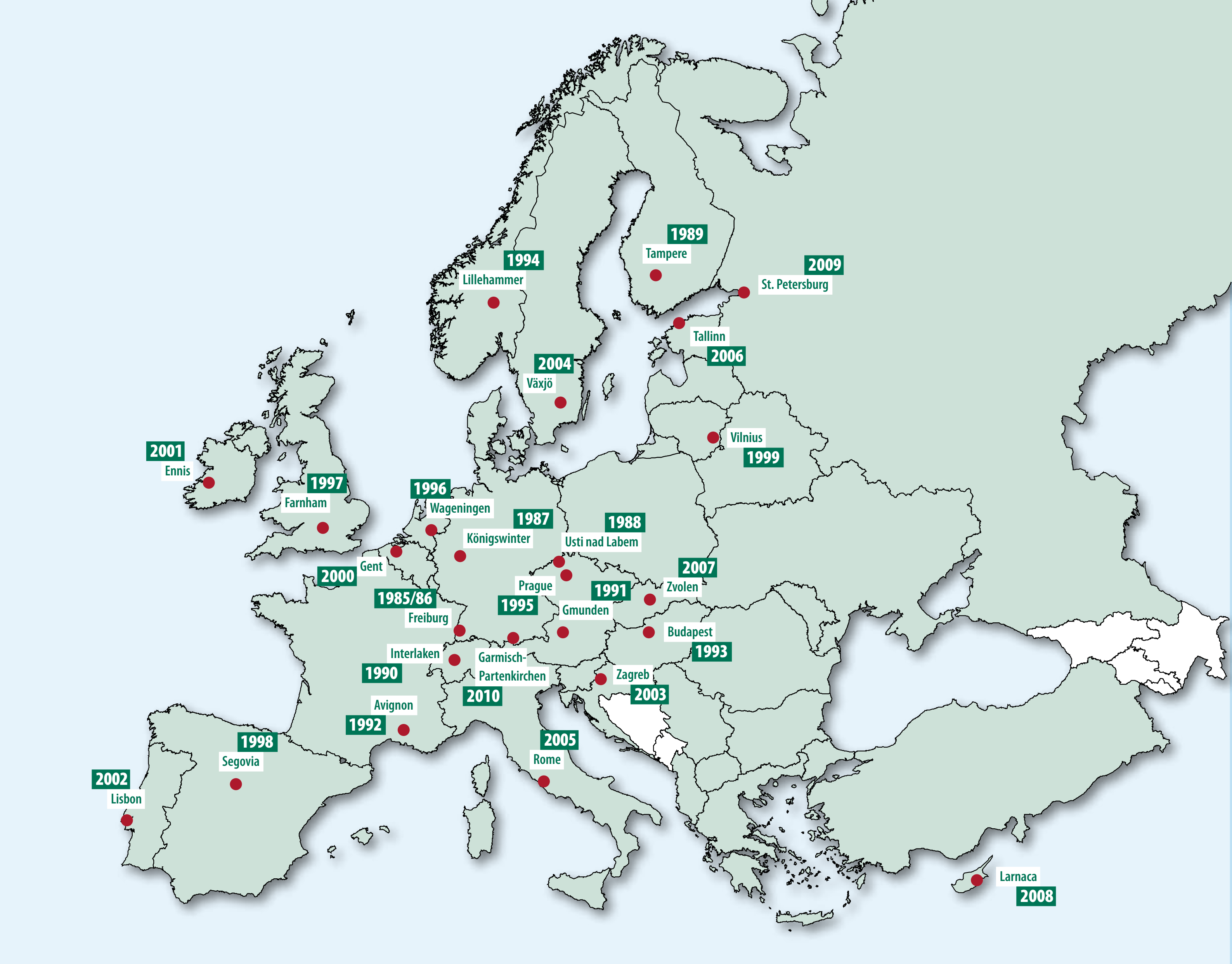
LRTAP
Long-range Transboundary Air Pollution

International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests)

Europe's Forests 1985 2010

25 Years of Monitoring Forest Condition by ICP Forests

Institute for World Forestry



Task Force Meetings of ICP Forests and countries participating in the programme (USA and Canada are not depicted).

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Preface

Forests are important and diverse habitats which play an essential role in helping to protect the climate and preserve our natural resources. However, they can only achieve this if they are stable and healthy.

This is why ICP Forests has been monitoring the condition of the European forests for the past 25 years. The harmonised transnational monitoring data collected by ICP Forests provides clear evidence of the success of air pollution control measures.

However, pollution inputs are still too high at many sites in Central Europe. This is why it is extremely important for forest monitoring to continue.

In Germany, for instance, some forest areas must be limed in order to prevent the adverse effects of soil and water acidification.

Policymakers, forest managers and the general public are now asking a range of questions: What does climate change mean for our forests? How will the forests respond to higher air temperatures and changes in rainfall patterns? How well-prepared are they for dealing with the far-reaching changes expected? How can we support the forestry sector in adapting the forests to a changing climate?

The search for alternatives to fossil fuels has increased the demand for wood. This in turn is raising new issues. What kind of timber use is sustainable and at what intensity? How many nutrients and micronutrients can be removed from the forests – particularly through the use of thinner material that had previously been left behind after harvesting – without impairing the productivity of the forest soils and their ability to function properly?

Although data from the traditional monitoring programmes can help to answer such questions, it is often necessary to increase the range of parameters monitored and to develop new collection procedures. Combining new and proven measures will continue to be a key element of the work of ICP Forests.

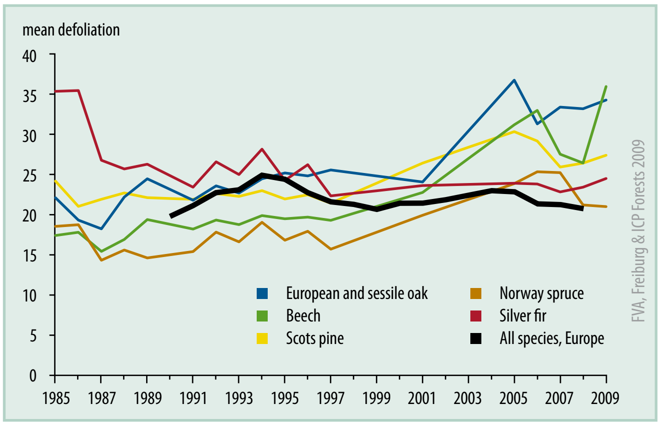
I would like to thank all those involved for their valuable work and wish you continued success.

Ilse Aigner
Federal Minister of Food, Agriculture and Consumer Protection

Ilse Aigner, Federal Minister of Food, Agriculture and Consumer Protection

Timeline

1985 – 1990: Birth of the programme following fears of large-scale forest dieback



Trends in defoliation in Baden-Württemberg, southwest Germany, and for all species in Europe. Harmonized transnational data only became available at the end of the 1980s.

Forest damage of previously unknown extent and intensity became evident in the defoliation of silver fir (*Abies alba*) and other coniferous species in Central Europe in the 1980s. Growing public awareness of a possible link between air pollution and forest damage led to the launch of ICP Forests in 1985 and to the start of transnational forest monitoring. The programme Task Force held its first meeting on 4 October 1985 in Freiburg, Germany, and agreed on the need for a large-scale grid of monitoring plots across Europe for assessing leaf and needle loss in a range of European tree species. Today, it is clear that large-scale forest dieback was prevented. International clean-air policies contributed to this success.

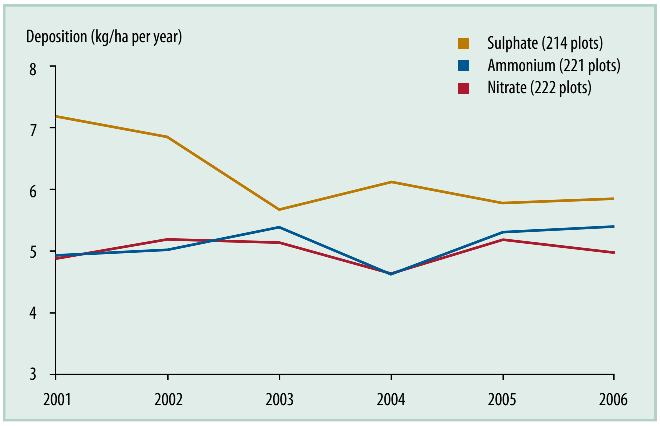
1990 – 1995: Monitoring intensifies, as does cooperation with the EU

Level II plot in Germany with permanent circumference measurement tapes (foreground), throughfall and stemflow deposition samplers.

Better understanding of the causes of change in forest ecosystems required more detailed analyses. Intensive monitoring plots (Level II plots) were established during this period, and measurements of air pollution, soil condition, tree nutrition, tree growth and crown condition began. Measurements of crown condition were retained because this constitutes an early-warning system for forest health. Monitoring has been co-financed by the EU since 1986 and the first joint report was published in 1992. Expert Panels worked intensively on monitoring manuals for harmonized methodologies. Intensive monitoring based on harmonized methods and cooperation with the EU are still mainstays of the programme today.

1995 – 2000: From forest health monitoring to complex analyses of ecosystem functioning

Successful international 'clean-air' policies caused a significant fall in sulphur deposition. Little change in nitrogen deposition increased its political interest and inputs across Central Europe are still high today. The first sets of harmonised transnational monitoring data from the Level II plots became available and made it possible to compare levels of sulphur and nitrogen in deposition with concentrations in foliage and soils. Statistical analyses showed complex relationships between site conditions, stress factors, and the biological and chemical condition of trees and soils. It became clear that the effects of air pollution were dependent on the stand, stand history, site conditions and the weather.



Mean annual atmospheric deposition of sulphur and nitrogen on the Level II plots. There is a clear fall in sulphur but little change in nitrogen.

2000 – 2005: How do forest ecosystems react to reduced air pollution?

Acidified soils affect the rooting systems of trees. After heavy storms, trees on plots with acidic soils showed higher levels of storm damage than those on less acidified plots. Sulphur inputs are a main driver for soil acidification. Results from statistical models suggested that acidified soils would take decades to recover. High nitrogen inputs, and possibly higher temperature, were increasing forest growth. But how much nitrogen can forest ecosystems absorb? Plants retain little extra nitrogen on nitrogen-saturated soils and deposition is mostly leached into groundwater in the form of nitrates. While forests were reacting slowly to reductions in air pollution, new policy questions related to climate change and biodiversity were beginning to emerge.

Storm damage in the Tatra mountains, Slovak Republic, 2004.

Members of the programme Task Force and cooperating institutions on an excursion near Rome, Italy, in 2005.

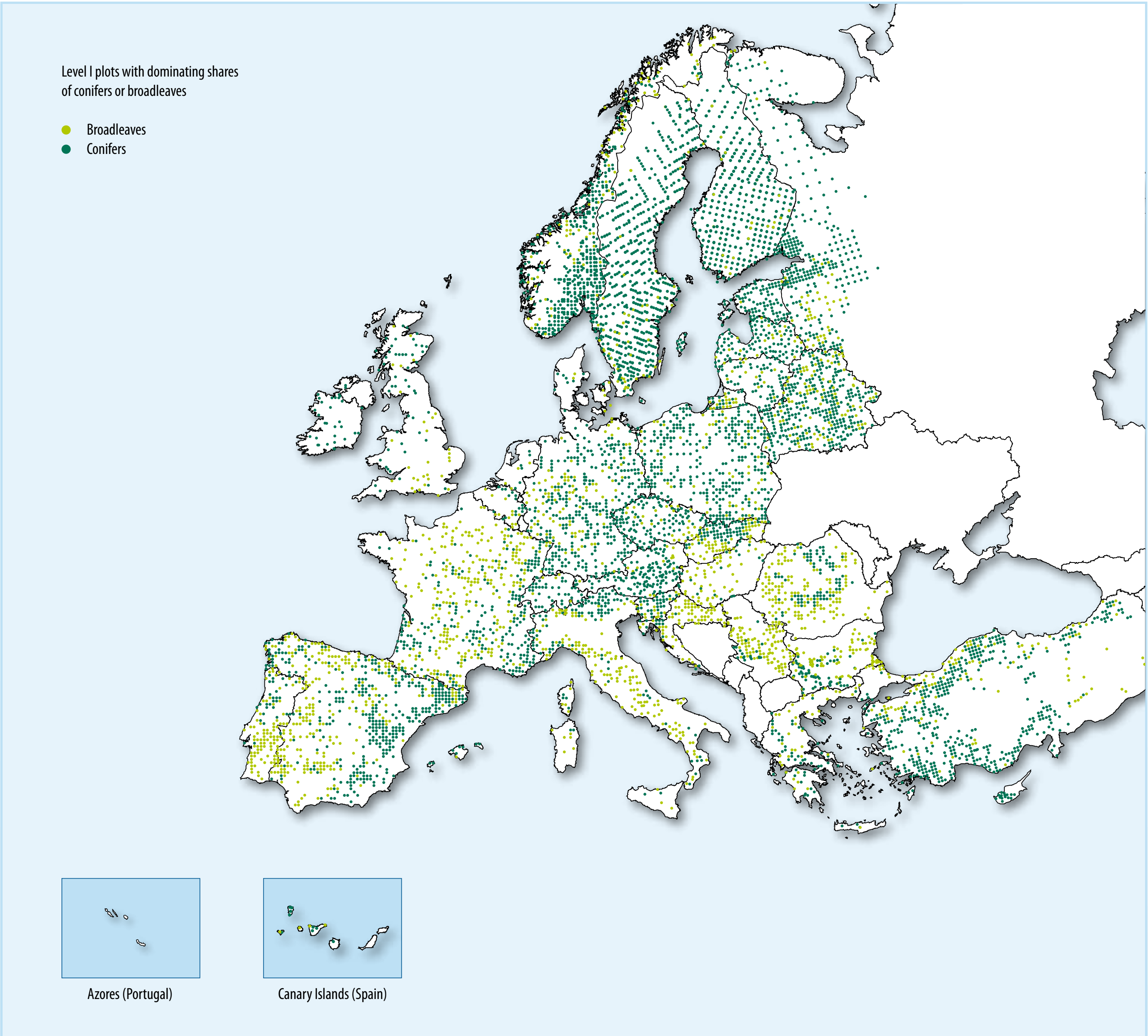
2005 – 2010: The programme today

A unique monitoring system

The ICP Forests programme operates under the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP). It includes large-scale representative monitoring of health and vitality on around 5000 so-called 'Level I' plots. Intensive monitoring, undertaken on 'Level II' plots, addresses crown condition, foliar chemistry, soil chemistry, tree growth, ground vegetation (700–800 plots), atmospheric deposition (558 plots), meteorology (235 plots) and, on a smaller number of plots, stand structure, epiphytic lichens, soil solution chemistry, ambient air quality, phenology and litterfall. Data are collected using harmonized methods. 41 countries presently participate in the programme.

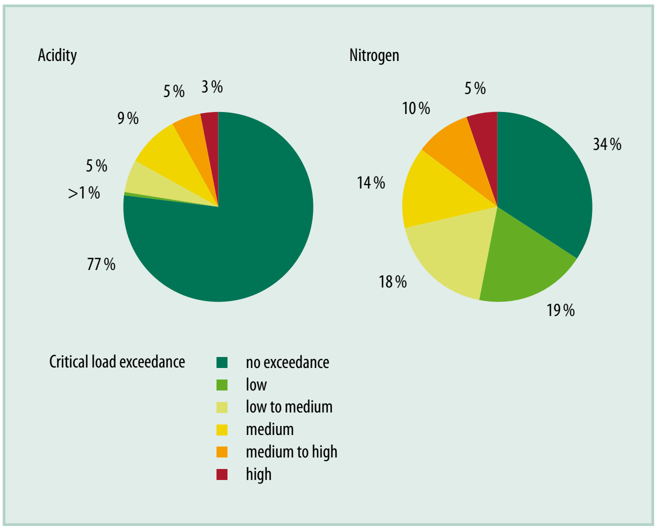
Part of a collaborative network

The ICP Forests programme involves over 300 national experts. This collaborative network forms the basis for policy contributions at the national, regional and international level. At the international level, the programme provides information on a number of criteria and indicators for sustainable forest management, as defined by the Ministerial Conference on the Protection of Forests in Europe (MCPFE), and contributes to the UN-FAO Global Forest Resources Assessments, and to the work of the UN Framework Convention on Climate Change (FCCC) and the Convention on Biological Diversity (CBD). Close links are maintained with the Acid Deposition Monitoring Network in East Asia (EANET). Good cooperation with the EU over many years, including the co-financing of monitoring activities, is still the mainstay of the programme's success.



ICP Forests Level I plots provide an excellent basis for large-scale monitoring of European forests.

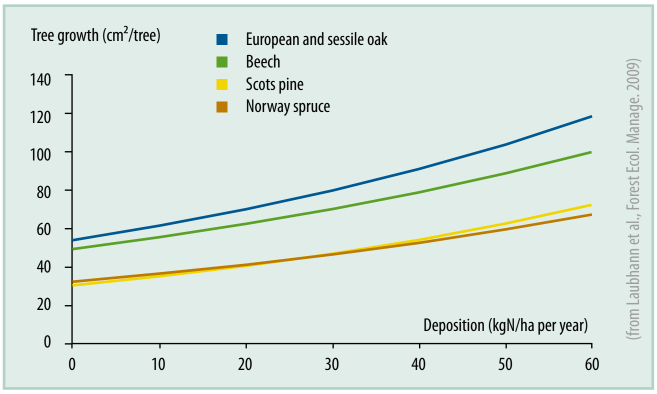
Present Results



Exceedance of critical loads for acidity and nitrogen deposition on 187 Level II plots.

Air pollution still critical on many plots

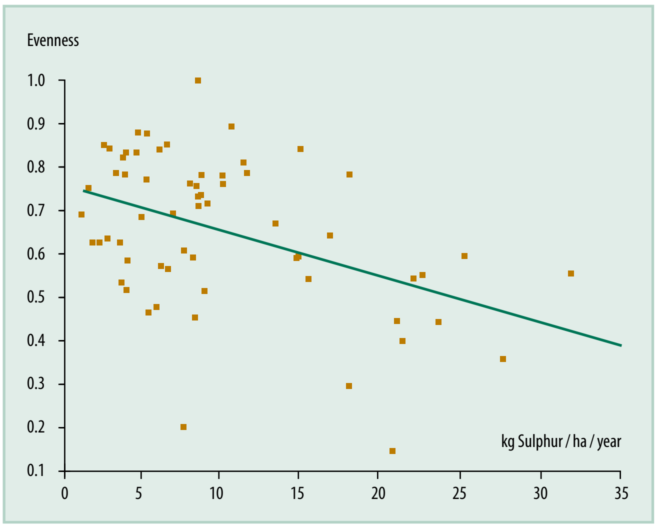
As a result of air pollution control measures implemented under CLRTAP, acidic deposition has decreased. But, despite this success, critical loads for sulphur are still exceeded on a quarter of the monitoring plots studied. Critical loads for nitrogen are exceeded on over 65% of the plots studied, particularly those in Central Europe. This indicates a risk that atmospheric deposition may be adding to the pollution of soils, surface waters and groundwaters. Critical loads are thresholds derived from ecosystem models below which environmental damage is not expected to occur. Ecosystem stability is maintained as long as inputs are below the critical loads. The ecosystem models used to derive the critical loads for sulphur and nitrogen rely on the extensive data sets generated by the monitoring programme.



Higher levels of nitrogen deposition result in higher tree growth which results in greater carbon storage.

Climate change and forests

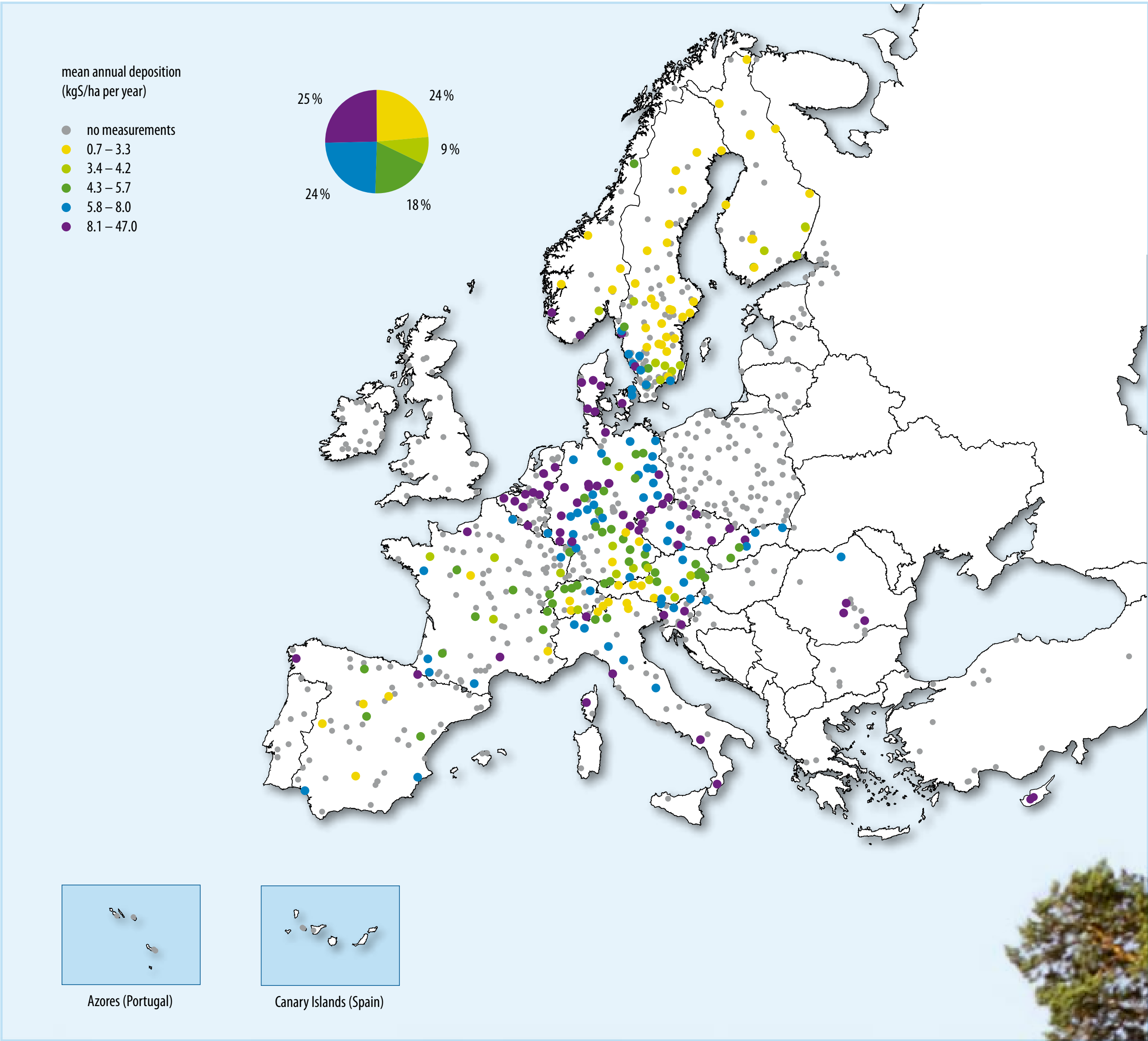
Trees absorb carbon dioxide from the atmosphere and store it in the wood as carbon. Forests can thus help to mitigate climate change by acting as carbon sinks. Future climate change scenarios project increasing air temperatures and changing precipitation patterns across Europe. The long-term data sets generated through the harmonised monitoring network established across Europe by ICP Forests will provide a good basis for investigating the still unknown vulnerability and adaptability of the European forests under a changing climate.



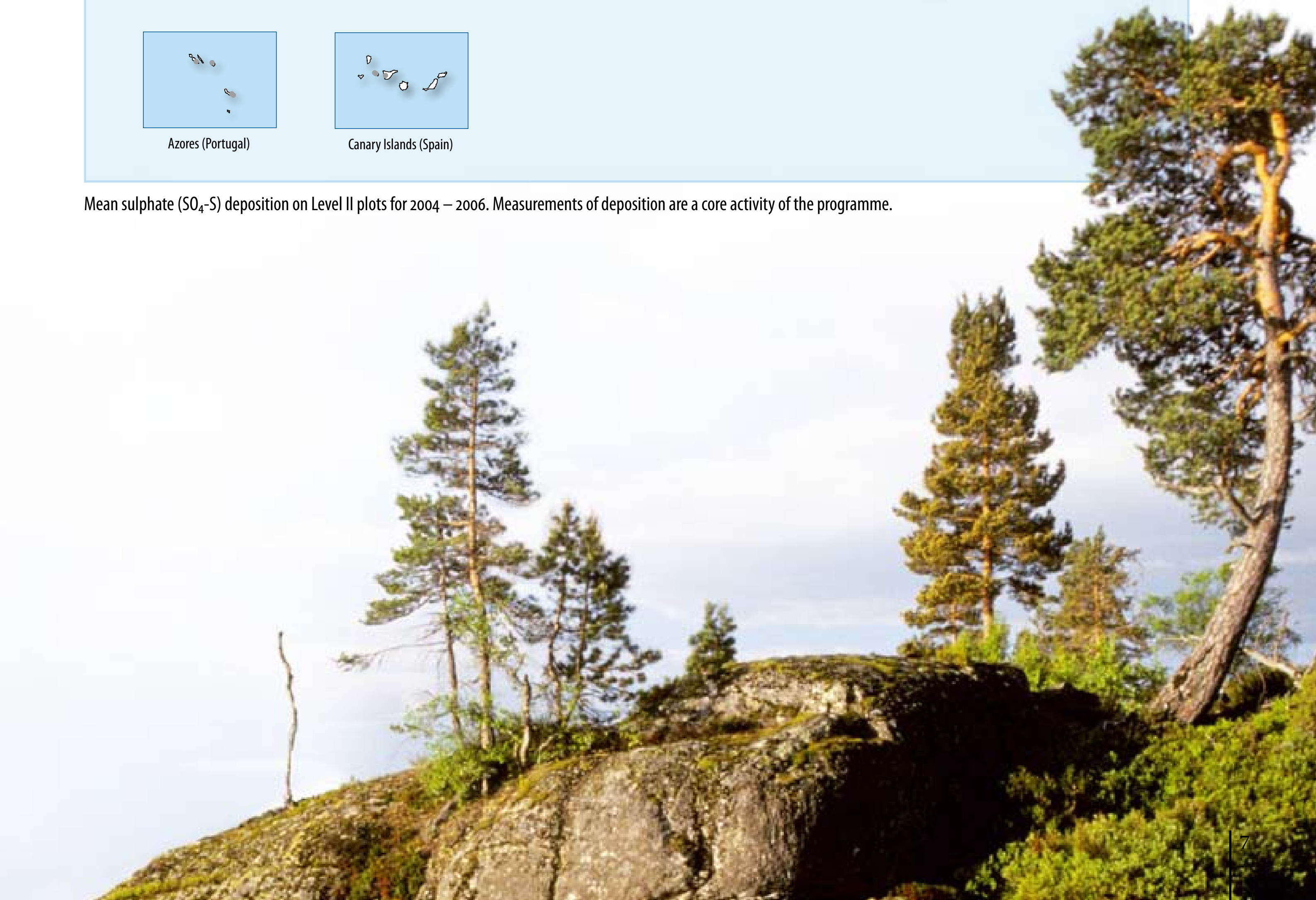
Decreasing evenness of epiphytic lichen species composition indicates that plots with high sulphur inputs become dominated by a small number of species.

Biodiversity monitoring is increasing in importance

Monitoring results indicate that air pollution and nutrient enrichment remain a threat to vegetation diversity and the functioning of forest ecosystems. Nitrogen-indicating plants occur more often on monitoring plots with high nitrogen deposition and species composition for epiphytic lichens reflects levels of sulphur deposition. The monitoring plots provide a unique opportunity for assessing a wide range of aspects related to biodiversity. With co-financing from the EU, projects have been completed on over 4000 Level I and Level II plots, with the studies aimed at the development and assessment of new biodiversity indicators such as deadwood, stand structure and forest type. The newly developed methods for monitoring biodiversity are currently being integrated into the ICP Forests programme.



Mean sulphate (SO_4-S) deposition on Level II plots for 2004 – 2006. Measurements of deposition are a core activity of the programme.



Conclusions

Three decades ago there was growing fear that air pollution would cause catastrophic forest dieback across Europe.

To what extent have forests been damaged and what was the cause? How is air pollution involved and will 'clean-air' policies succeed? 25 years of European-wide forest monitoring has helped to provide answers to these questions. The transnational monitoring programme established by ICP Forests indicates that, at the large-scale, forest condition has deteriorated far less severely than was feared back in the early 1980s. Also, that most of the defoliation which triggered the initial concern was actually due to natural stresses such as tree age, extreme weather conditions and pests. At the regional and local level, however, studies confirm the hypothesis of classic forest damage. Monitoring data indicate correlations between defoliation and the deposition of pollutants from the air, and the deposition of both nitrogen and sulphur (acidity) exceeded critical loads on many monitoring sites. This implies an ongoing threat to the functioning of forest ecosystems.

These results contributed to the adoption of legally binding protocols on air pollution control by the signatory states to the LRTAP Convention under the UNECE.

Successful implementation of 'clean-air' policies is evident in the decreasing levels of atmospheric deposition measured on the monitoring plots. Models suggest that forest soils will recover from acidification over a period of decades, assuming that emissions of acidifying pollutants continue to reduce as predicted. There is also a need for greater efforts to reduce nitrogen emissions. Nitrogen deposition may accelerate forest growth, but will eventually cause nutrient imbalances in forest trees. Like acidity, nitrogen was shown to alter vegetation diversity.

Policy development is driving the need for more information on relationships between forest condition, climate change, carbon sequestration, and the loss of biodiversity. With EU support, forest monitoring in Europe has begun to be adapted such that it will be able to meet these new information needs.

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