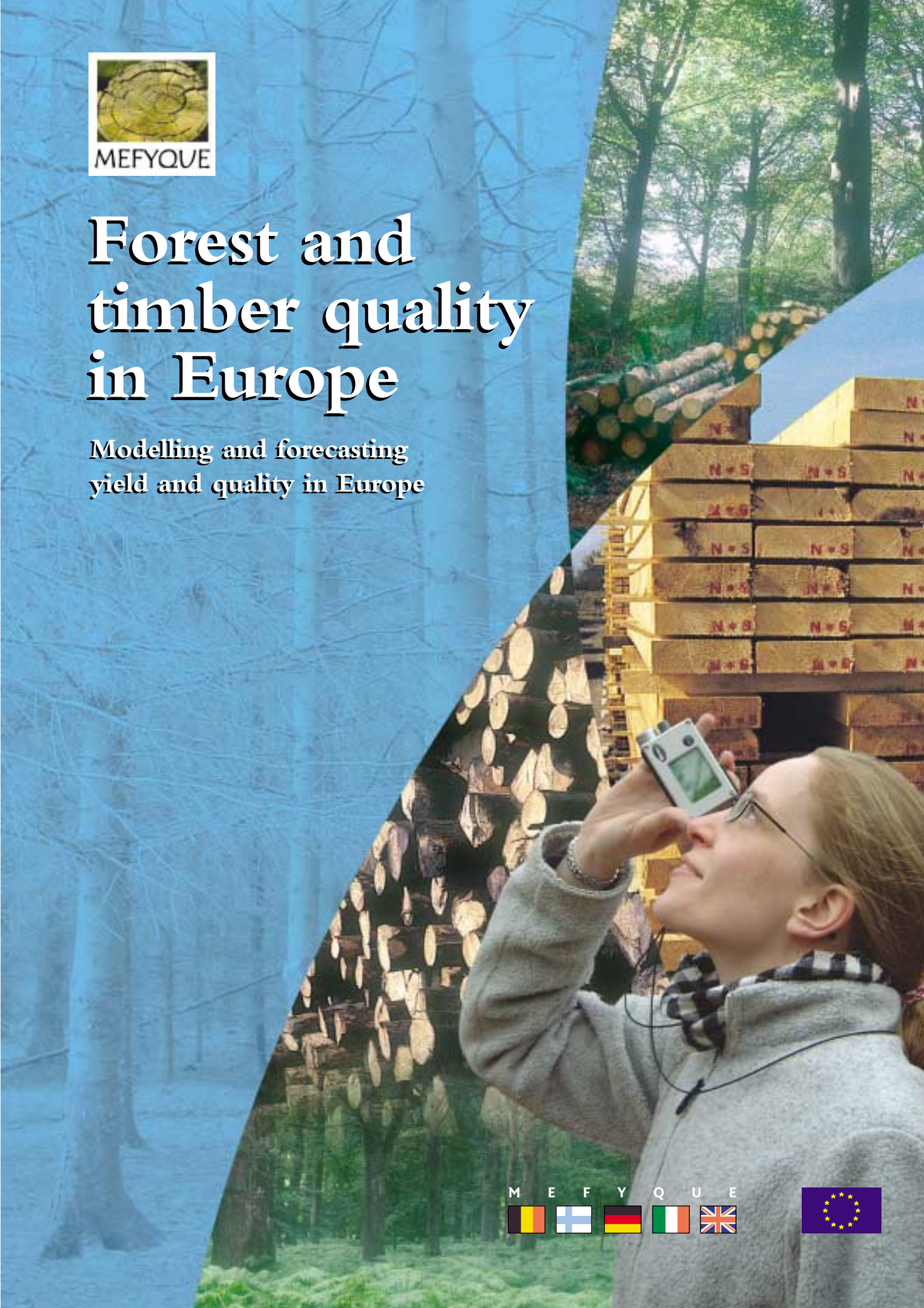
MEFYQUE

Forest and timber quality in Europe

Modelling and forecasting yield and quality in Europe



M E F Y Q U E

Valuing and enhancing Europe's forests

Seven organisations in five European countries – Belgium, Finland, Germany, Italy and the UK – are working closely together to develop a model to help forecast timber growth, yield, quality and marketability for use in the European Union.

Who needs to know?

- Forest managers need guidance to enable them to make decisions.
- Wood products industries need to know that they will have a regular supply of consistent quality timber.
- Policymakers need guidance to inform and recommend local, national and global policies on multi-purpose forestry.
- Environmental and conservation experts need to assess the ecosystem impacts of forest management.
- The public needs reassurance that forests of amenity value are well managed.

Working beech woodland

Why is this project important?

Forestry in Europe is evolving a multi-purpose role in which concerns over the environment and the provision of amenity and recreational facilities match the more traditional requirements of timber production. As this policy evolves and the impact of diversifying management practice becomes apparent, the demand for forecasting and decision-support systems to inform the management of multi-purpose forests also increases. In turn, robust modelling systems require the availability of quantitative data reflecting the current and future range of growth conditions and management practices of European forests.

Overall objective and main deliverable

The overall objective of the project is to increase understanding of the relationships between site conditions and forest growth, yield and timber quality for current and future scenarios of atmospheric and climate change. This will be achieved by developing a prototype modelling system operating to forecast timber growth, yield, quality and marketability. The system will also incorporate carbon and energy budgeting modules to assist in the cost–benefit analysis of forest management.

Such a forecasting system must account for the reshaping of European forestry through policies aimed at the optimisation of sustainable management, the provision of renewable resources and the protection of the global and local environment.
In particular the role of forestry in the carbon cycle will be incorporated.
A fully integrated approach to pre- and post-production activities is thus required in order to develop a tool suitable for use by both the timber industry and national/international policy decision-makers.

The principal deliverable of the project is an integrated modelling system that will assist forest managers, the timber industry and policymakers in deciding whether management of forests should be primarily for production, conservation or amenity outputs, within the context of multi-purpose forest management.

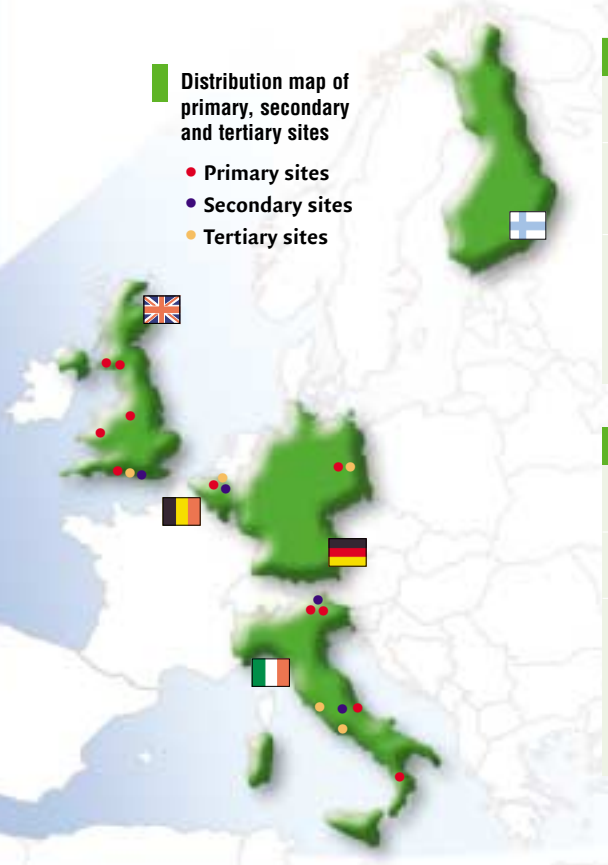
Sighting a tree as part of measurement in a primary site forest

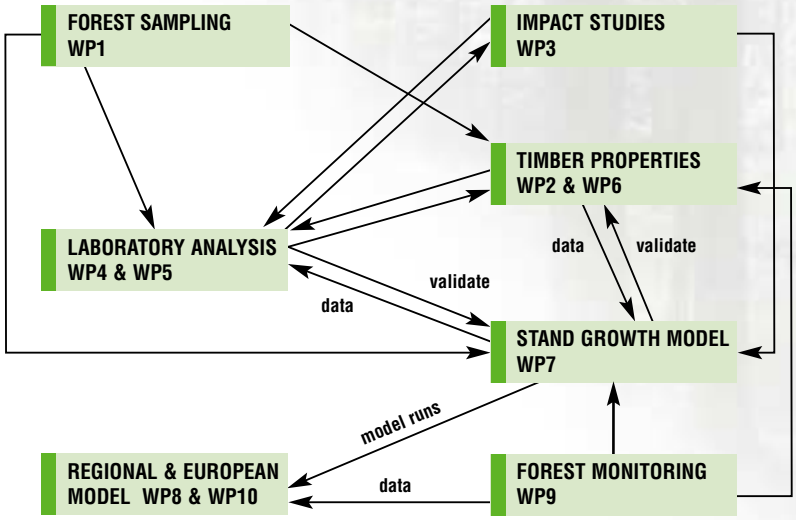
MEFYQUE: information network

Consortium partners are in regular contact with policymakers and both the production and processing industries to ensure the appropriateness of outputs to end-users.

Achieving the integrated approach

Recognising the importance of a fully integrated approach, the work of the project is structured around four main components: monitoring, manipulative, laboratory and modelling. Results from each of these activities will be assessed to inform and develop the modelling system. Each component has a set of structured work packages (WPs). The descriptions that follow include examples of work packages to illustrate the in-depth nature of the work involved.





Work packages	
WP1	Stand growth and yield data in field conditions for a range of management practices
WP2	Analyses of qualitative properties in standing timber
WP3	Qualitative properties in manipulative experiments
WP4	Anatomical properties of wood in laboratory conditions
WP5	Biochemical properties of wood in laboratory conditions
WP6	Physico-mechanical properties of wood in laboratory conditions
WP7	Modelling of wood quality and tree growth at stand scale across Europe
WP8	Development of the energy budget sub-model
WP9	Protocol for model integration and upscaling
WP10	Validation and application of model integration and upscaling

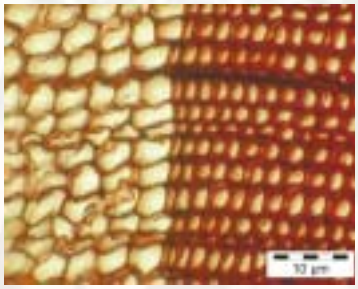
The monitoring component

The monitoring component is designed to characterise the relationships between site conditions, growth, yield prediction and timber quality and how they will vary as a function of multi-purpose forest management practices. It combines field studies of site conditions and forest growth with assessments of the quality of standing timber at sites representative of a range of silvicultural management options where existing long-term monitoring is already carried out (see Work locations).

WP1	Stand growth and yield in field conditions for a range of management practices
Objective	To produce stand growth and yield data in field conditions for a range of management practices.
Methodology & study materials	Integration of available stand and yield data with ongoing annual monitoring data on growth and yield assessments for a representative range of conditions.
Deliverables	• Standardised methodology and protocol for describing site characteristics. • Database of site characteristics and physiological parameters. • Calibration and validation data for a coupled empirical – mechanistic model.

WP2	Analyses of qualitative properties in standing timber
Objective	To apply a standard classification system for assessing quality in forest stands, consistent with requirements of the processing industry.
Methodology & study materials	Assessment of timber quality by evaluation of stem straightness and branchiness in conifers.
Deliverables	• Standardised methodology for timber quality assessment for forest stands. • Database on timber quality assessment for forest stands for a range of species, environmental conditions and management practices. • Calibration and validation data for the model described in WP1.

Open top chamber used to manipulate CO_2 levels in WP3



Scots pine (*Pinus sylvestris* L.): difference in cellular structure between early wood (light) and late wood (dark)

Forest monitoring plot

WP3	Qualitative properties of wood in manipulative experiments
Objective	Analyses of qualitative properties of timber from manipulative experiments.
Methodology & study materials	Saplings and juvenile trees of selected species grown in chambers which provide the opportunity to raise temperature and CO_2 levels and modify water and nitrogen availability. Seasonal measurements: bud burst, photosynthesis, stomatal conductance, transpiration, leaf and needle loss. Annual growth measurements. Biomass sampling of leaves, buds, stems, fine and coarse roots.
Deliverables	• Standardised methodology and protocol for assessing growth patterns and allocation in juvenile plants. • Database of growth patterns and allocation from individuals for a range of species, management practices and environmental conditions, including climate and atmospheric change scenarios. • Calibration and validation data for the modelling system.

The manipulative component

The manipulative component uses established experimental infrastructure to manipulate the individual and combined effects of enhanced CO_2 and altered temperature and precipitation to produce new juvenile plant material for use in assessing timber growth and quality.

WP4	Anatomical properties of wood in laboratory conditions
Objective	To correlate anatomical modifications with changes identified through biochemical and biomechanical analyses.
Methodology & study materials	Studies on both juvenile and adult material. Microscopic examination of thin sections of wood to assess changes in the proportions of cell types.
Deliverables	• Standardised methodology for determining selected anatomical wood properties. • Database on the anatomical properties of wood for the range of conditions described in WP3.

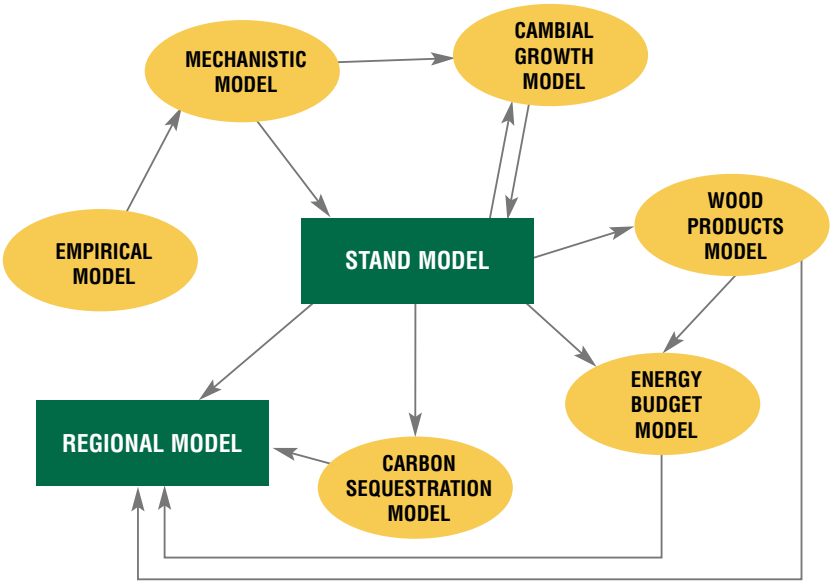
The laboratory component

The laboratory component uses established laboratory infrastructure to look at changes in the anatomy, biochemical composition and mechanical properties of new and existing plant material from the monitoring and manipulative experiments.

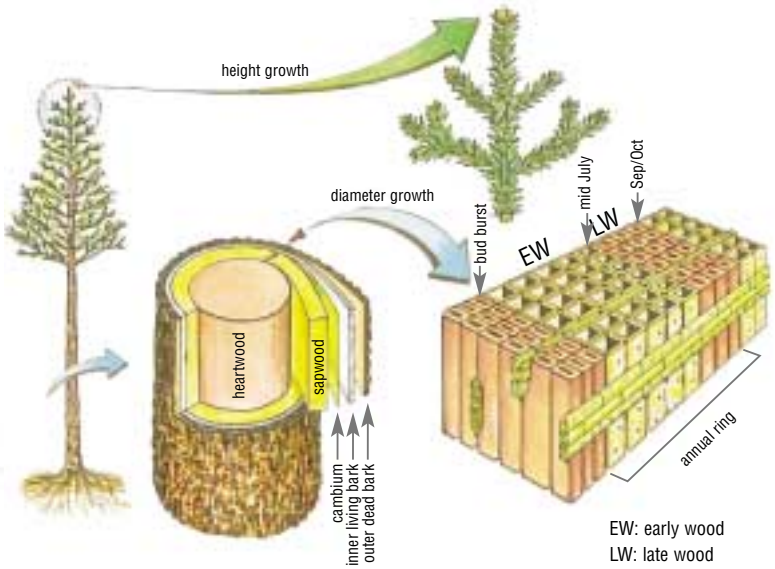
WP6	Physico-mechanical properties of wood in laboratory conditions
Objective	Analyses of physico-mechanical properties of wood from monitoring and manipulative experiments.
Methodology & study materials	Assessments of wood density, mechanical stress, juvenile and compression wood, strength and stiffness of structural timber, and drying distortion.
Deliverables	• Standardised methodology for determining wood physico-mechanical properties. • Database of physico-mechanical properties of wood for a range of species, environmental conditions and management options. • Calibration and validation data for the model described in WP1.

The modelling component

In WPs 7–10, the modelling component will build upon available existing state-of-the-art empirical and process-based models, simulating timber yield at the forest stand scale, integrated with sub-models of (1) timber quality, (2) wood product productivity, (3) energy budgets associated with timber and wood product exploitation, (4) carbon sequestration. The stand scale model will, in turn, inform an existing large-scale scenario model developed in Finland (EFISCEN) which upscales stand features to regional and European levels. Scenarios of atmospheric composition and output from the most recent global climate models will be used to inform the climate input to the new model.



Schematic diagram of the modelling process



Schematic diagram of the cambial growth model
(after Les Jozsa, from SP-34, Forintek Canada Corp., Vancouver, Canada, 1994)

Work locations

Forest sites

Assessments are made on trees in plots on selected forest sites in four of the participating countries – Belgium, Germany, Italy and the UK. A full range of factors such as soil and climate variation and tree species are included in three types of sites: primary, secondary and tertiary.

- **Primary sites** are in managed forests. Standing trees are assessed to generate data for the calibration and validation of the growth and quality model. Samples of plant material are used for anatomical, chemical and structural analyses to identify climatic, management and treatment effects on wood quality.
- **Secondary sites** are at existing monitoring sites. CO_2 and H_2O flux data are collected from currently assessed standing forests, generating datasets for short-term validation of the growth model.
- **Tertiary sites** are close to established field research centres. Work includes anatomical, chemical and structural analyses of plant material to identify single and combined effects of enhanced CO_2, temperature and droughtiness on wood quality. Model calibration and validation makes use of new and existing data.

Raising awareness and understanding

Project findings will be widely circulated and published. Plans are already in place for disseminating information in the following ways:

- Internet site: www.efi.fi/projects/mefyque
- Publications in scientific peer-reviewed journals
- Publications in industry journals and magazines
- International Workshop in 2004 for scientists, policymakers, managers and industry:
  - presentations by project scientists
  - key project findings
  - presentation of the integrated modelling system

Further information

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