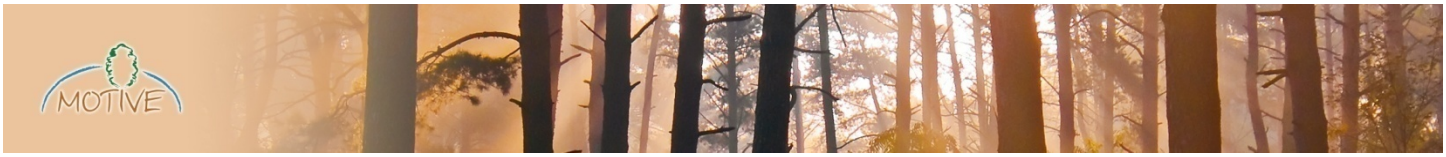


MOTIVE highlights

MOTIVE reached its mid-term goals

The project MOdels for AdapTIVE forest management (MOTIVE) has produced reliable results of impacts of climate change on Europe's forests. The first simulations of adaptive management strategies highlight the need for a clear definition of site-specific forest management goals and an understanding of how the management actions today will impact future forest development and the provision of ecosystem goods and services. The consortium developed a new concept for decision-making under uncertainty and risk enabling MOTIVE to produce improved decision support tools for adaptive forest management.

How?

MOTIVE works with ten case studies which represent a wide variety of European forest conditions. All relevant stakeholders are consulted and involved throughout the whole project. In each of the case studies, adaptive forest management options are developed that are used to simulate the provision of a wide range of ecosystem goods and services (EGS). New methods for handling risks and uncertainties as well as socio-economic evaluation methods are integrated into the adaptive management decision-making.

Why does this matter?

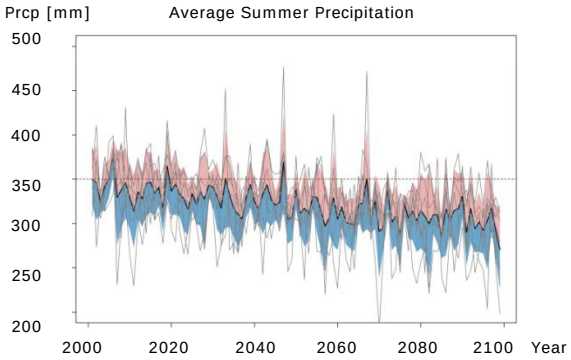
Climate change is likely to have significant impact on Europe's forests. However, there is considerable uncertainty as to what degree of climate change we are facing. Moreover, forests and tree species will respond quite differently to changes in mean and variability of climate. Regions that are suitable for one species might no longer be so in the future, while other species might benefit at the same site. Forest management is challenged here for taking the right decisions early, and before the consequences can be clearly evaluated.

Who is involved?

MOTIVE is a large-scale integrated project (project number 226544) in the 7th Framework Programme of the EU that encompasses 20 partners from 14 European countries. It has an overall budget of almost 9 million Euros. The project is coordinated by the Forest Research Institute of Baden-Württemberg with duration of 4 years.

Baseline trends and possible future climate for the EU

MOTIVE uses an array of modern climate data originating from regional circulation model runs. The data needed to be scaled further to provide a suitable spatial resolution in case study regions. The use of multiple climate model runs is advised because of the high variability in climate output coming from different models; using only one model output would generate too uncertain projections of the future climate and its impacts on forests.



Precipitation trends over Europe show decreasing summer precipitation (above – grey lines indicate seven different regional climate models), but regional development might deviate from the average. Most models agree that summers are becoming dryer in the South and winters get slightly wetter in Europe.[1]

Photo by Michael Maroschek

Currently highly productive, Norway spruce dominated forests might encounter intensified bark beetle disturbance under climate change calling for alternative management strategies

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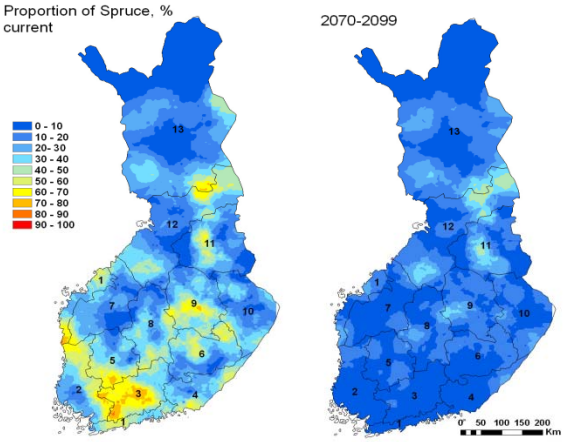
Development of improved models for adaptive forest management

The combination of a large variety in climate and climate change impacts across Europe with a large variety of forest ecosystems and management practices creates an enormous modelling challenge. Through synchronised development and application of regionally available models, MOTIVE is able to capture the complex impacts and adaptation options. The first appealing results are seen now. Most regional cases have produced reliable results of impacts of climate change, and some can deal with adaptive management regimes already.

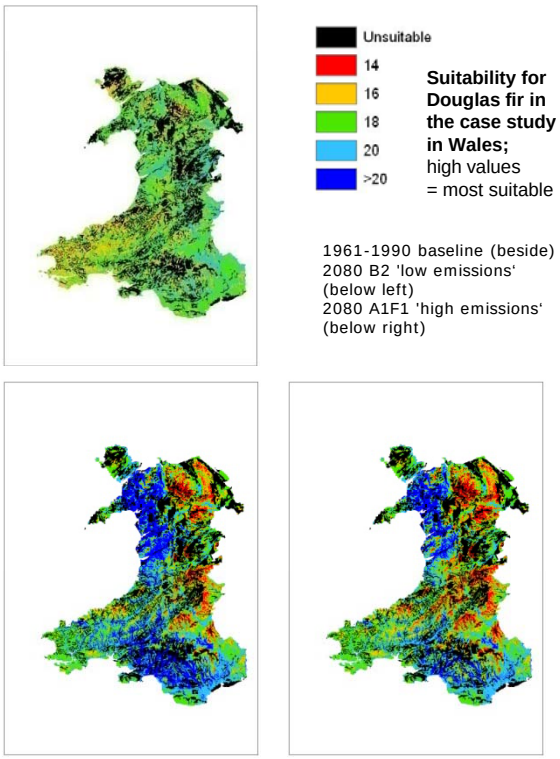
The variety within Europe with e.g. storm impacts in the Atlantic zone, drought impacts in the south, and beetle impacts in central Europe, is visible through the multiple regional cases. Here, a few cases are highlighted.



In **southern Finland**, the proportion of Norway spruce is expected to decline as a result of climate change, if species composition is not actively controlled in forest management. The decrease is likely to be largest on soils with lower water holding capacity, where Scots pine and birch will outcompete Norway spruce in the future climate. Adaptive management strategies will be needed to respond to these changes in species suitability. [2]

In **Wales**, the future suitability and yields of the sites for Douglas fir was analysed for two different climate change scenarios with low and high CO_2 emissions.

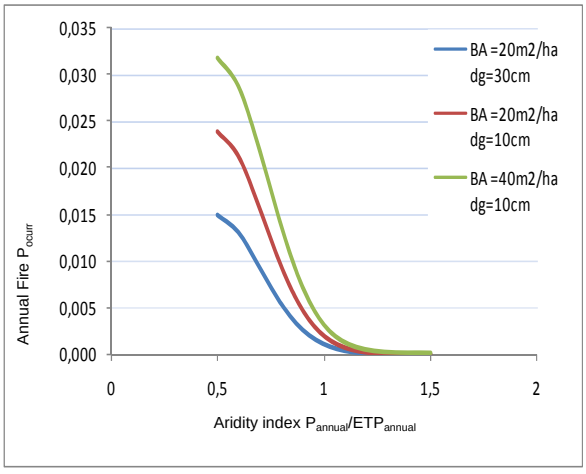
Whereas in the coastal areas the site suitability improved, more inland areas were projected to face reduced site suitability. Advice on where to continue with Douglas fir regeneration can be distilled from this, but must still be combined with storm risk models as well. [3]

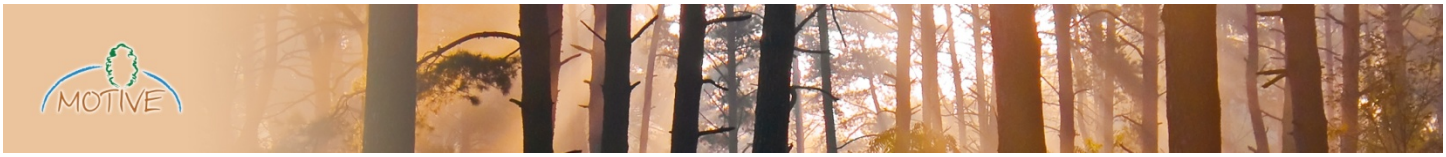


Suitability for Douglas fir in the case study in Wales;
high values
= most suitable

1961-1990 baseline (beside)
2080 B2 'low emissions' (below left)
2080 A1F1 'high emissions' (below right)

In **Catalonia**, Spain fire occurrence in forest stands was simulated in relation to future anticipated droughts and different management alternatives. In this region management can directly influence the risk of fire occurrence, and reduce it by keeping the stands at a low basal area, but preferably with few thick trees. The figure below documents decreasing fire occurrence probability with reduced basal area (BA) and larger average diameter (dg). [4]



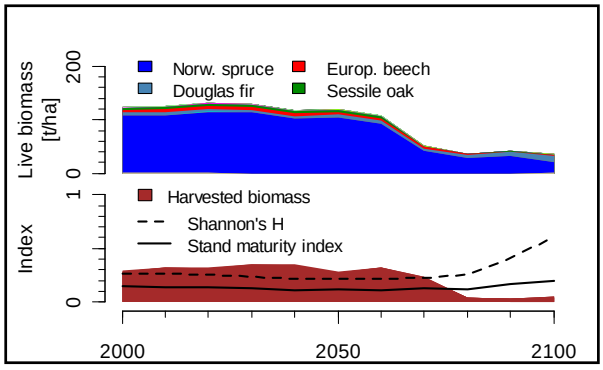


Testing and evaluating management options and risks in the Black Forest, Germany [5]

Similar to other Central European regions, climate change in the Black Forest is anticipated to threaten the persistence of Norway spruce forests. The case study assessed how both forest management and climate change affect the development of forest landscapes. Work is focusing on the temporal development and the interdependences between timber production and biodiversity, which are the most valued ecosystem goods and services (EGS) in the Black Forest.

Mid-term results

First results indicate increased drought-induced mortality of Norway spruce under all climate change scenarios with the greatest amount of mortality occurring predominantly towards the end of this century. As an example, the upper panel in the figure below shows declining Norway spruce biomass under an intermediate climate change scenario and under the assumption that forests continue to be managed as even-aged Norway spruce plantations. If climate change magnitude as well as future inter-annual climate variability is assumed to be larger, the mortality events will be more severe and will occur earlier in the century. The lower panel shows that the provision of timber cannot be maintained under future climatic conditions.



These results underpin the necessity of implementing adaptive management practices that promote drought-adapted tree species and/or increase the adaptive capacity of forests by promoting both tree species diversity and stand structural diversity. A comparison of EGS provisioning under different adaptive management scenarios revealed trade-offs but also synergies between timber production and the promotion of biodiversity.

Key messages

Two key messages have emerged from this work so far. First, the realized trade-offs between different EGS are dynamic through time and highly dependent of forest management. Second, these results highlight the need for a clear definition of site-specific forest management goals and an understanding of how the management actions taken today will impact future forest development and the provision of EGS.

The challenges facing forest managers and the approaches science may take to support decisions [6]

The exact degree of climate change remains uncertain, but does, will or should that matter for the way forests are managed? Clearly, if current management regimes are the best choice under any climate future, the decision problem is a simple one, and the challenge for decision makers is negligible. However, if better alternatives can be identified, a different question arises: When should the decision maker change to an alternative management and to which?

Two-tier approach

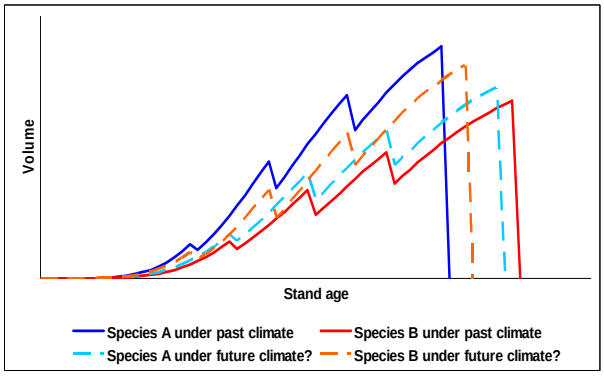
- MOTIVE investigates how forest owners relate to the current climate change debate, discourse and reality, both in terms of their stated attitudes and actions.
- MOTIVE develops modelling approaches, which can embed different types of decision makers, their use of information and formation of beliefs related to climate change.

Some mid-term results

A survey was implemented among forest owners in Sweden, Germany and Portugal. Preliminary results indicate substantial differences in attitudes between forest owners in case study areas. Not only in the way they manage their forests, but also in the way they acquire and apply information, and in their beliefs about climate change.

A conceptual framework for decision making approaches was developed, spanning this heterogeneity. It enables MOTIVE to evaluate decisions from business-as-usual, over reactive, to a trend adaptive or a fully forward looking adaptive decision making process. Each using different information sets, including beliefs about future climate.

Ongoing work focuses on long term decisions like species choice. To illustrate the challenge, consider a forest owner deciding between species A and B. If he relies on business as usual and experiences with past climate, the decision is easy. If he thinks climate change may affect species performance, he faces a complex decision depending on his belief about timing and scale of climate impacts.



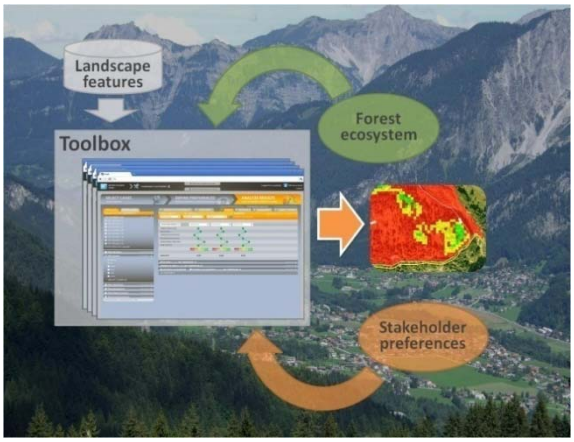
Improved decision support in adaptive forest management – Central Alpine case study, Austria [7]

The central alpine case study features 7,000 ha of mountain forests mainly stocked with Norway spruce. The main issues in the case study region are

- how climate change may affect the provision of demanded ecosystem services (timber production, biomass for energy production, protection against natural hazards, carbon sequestration, provision of drinking water, nature conservation, recreation), given that current management practices are continued, and
- to explore, how the vulnerability of current management approaches can be reduced by adaptive measures.

Trade-off relations between different services are likely to change due to climate change and eventual adaptation of forest management. Especially the protective functions are in public focus and thus communication of planned management measures is of paramount importance.

To deliver practical tools for the assessment of ecosystem services and their management is a major goal of the MOTIVE toolbox for adaptive forest management. To this end an ecosystem service assessment tool was developed to assist the local manager. It allows virtual experimenting in protective forest management and supports the communication with stakeholders by visualizing the effects of management and climate change on the provision of ecosystem services.



The Ecosystem Service Assessment tool within the MOTIVE toolbox for adaptive forest management. The appraisal is based on forest structure and composition, stakeholder preferences, and landscape features (e.g. a digital terrain model).

The ecosystem service assessment tool calculates state and flow indicators for protective effects against snow avalanches, rock fall, erosion, landslide and debris flows and flooding, as well as timber production and carbon sequestration. Furthermore the tool provides interactive input functionalities for stakeholder preferences and maps the resulting ecosystem service indices into the landscape.

On site discussions and planning meetings are efficiently supported by the tool, as well as the rationality and the transparency of decision making processes regarding adaptive management are enhanced.

What is coming up next in MOTIVE

- Scenario calculations will quantify impacts on ecosystem goods and services in case studies across Europe under alternative management strategies.
- Results of the calculations will show possibilities for advanced methods in adaptive forest management. The individual results and improved methods will be integrated in a decision support tool box for adaptive forest management.
- As socioeconomic impact MOTIVE will provide assessments of the efficiency of current and future adaptive forest management strategies in terms of wood production trends under changing climate, reduced greenhouse gas emissions, carbon sinks, or forest conservation.
- By applying decision support tools to different regional case studies representing the variable bio-geographical and socio-economic conditions, the best available know-how will be made available across Europe.

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