

## **MOTIVE: New features developed for adaptive forest management models**

Climate change is already affecting European forests today. Growth rates have increased in northern latitudes, while some tree species have declined on dry sites close to their southern distribution limits. Climate projections show the trend in temperature increase and a changing distribution of summer and winter precipitation with an expected increase in winter and a decrease in summer precipitation, but with outstanding regional differences.

The MOTIVE project (MOdels for AdapTIVE forest management), which started in 2009, has recently published its 2<sup>nd</sup> periodic report. Halfway through the project duration, MOTIVE has produced a number of results documenting the impacts of climate change on Europe's forests. Amongst these results, a consistent set of high-resolution climate scenarios has been developed based on a multitude of Regional Circulation models – a so called 'ensemble' of climate change projections. A hybrid species distribution model including realistic tree migration has been developed and applied to the climate change scenario ensemble.

This model illustrates that only early successional (pioneer) tree species, for example birch, may reach migration rates which are sufficiently large (ca. 1 km per year) to track recent rapid climate change. Late successional species, for example European beech or oaks, reveal very low migration rates which are totally insufficient to track ongoing and accelerated climate change. For these tree species, therefore, major biome shifts under rapidly changing climatic conditions will only be possible with human intervention such as assisted migration.

The risk of fire and storm damage has been implemented in process-based and empirical simulation models. First simulation runs show that management strategies aimed at decreasing stand density can significantly decrease the risk of fire damage.

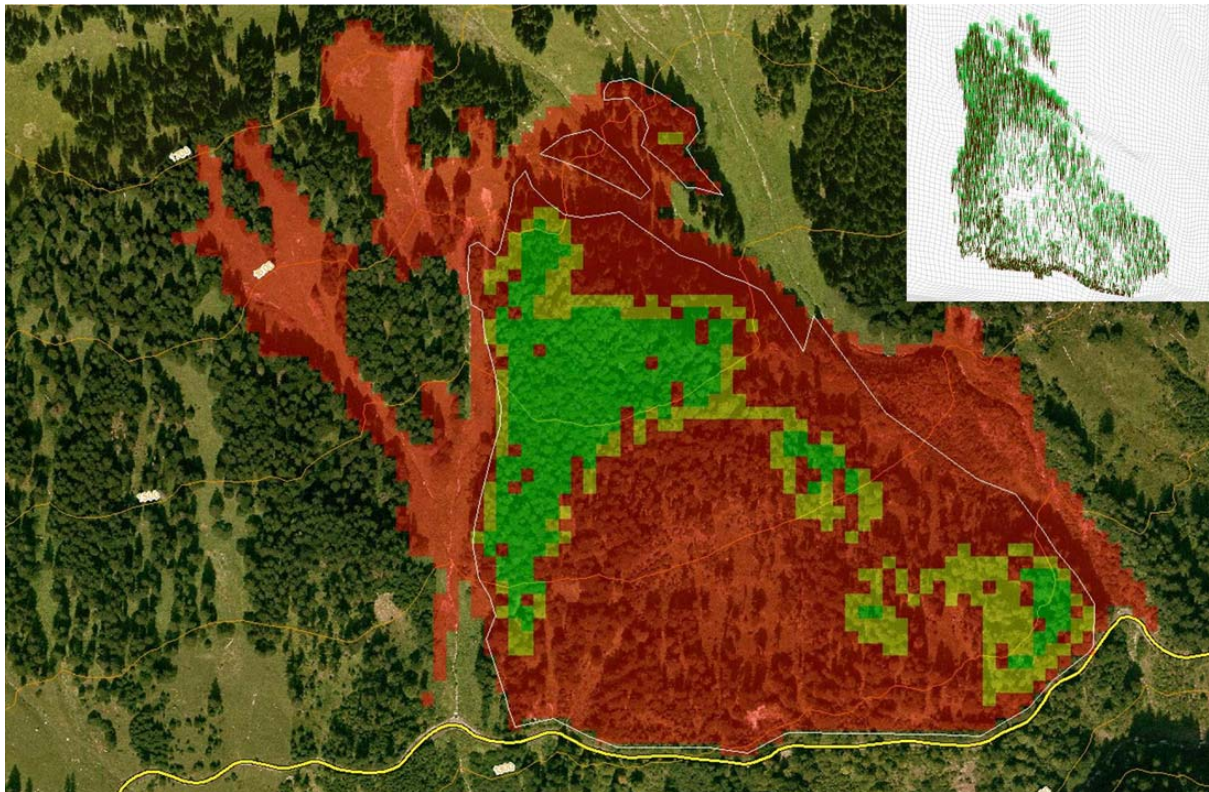
### **Assessment of ecosystem goods and services in the alpine case study**

MOTIVE works with ten case studies which represent a wide variety of European forest conditions. In one of the case studies, the alpine case study Montafon, several new features have been implemented in the PICUS model. The main aim of the alpine case study is to develop and analyse alternative management strategies to counteract potentially negative impacts of climate change on the demanded goods and services. Different management scenarios considering alternative strategies with regard to tree species composition, management intensity and design of harvesting actions will be evaluated. The hybrid model PICUS is a major tool for this analysis.

In an enhanced version of the PICUS model, both the spatially explicit simulation of stands and management as well as the appraisal of forest goods and services has been implemented. For the latter, an ecosystem service assessment module (ES) for the protection against natural hazards has been added to PICUS. The assessment scheme developed for forest practitioners by Frehner et al. (NaiS (Nachhaltigkeit im Schutzwald), 2005) covers the protection against (i) snow avalanche release (ii) landslide, erosion and debris flow (iii) rock fall and (iv) flooding and torrential processes. The criteria and indicators used by the NaiS assessment scheme are used in the ES, to assess the protective functions on the scale of several hundred hectares based on PICUS outputs.

The results for each protective function are made available as a 10 x 10 m grid. The results for the different protective functions are based on one or more indicators, and are displayed in the same classes the indicators are judged (ideal thresholds met, minimal thresholds met, and thresholds not met; cf. Frehner et al., 2005). The results can be viewed directly in the Ecosystem Service assessment

module in a three dimensional view, or exported as grid file to a GIS. For easy communication the classes can be displayed in colours similar to traffic lights (green, yellow, red) as shown below.



Assessment results for the initial state of the forest (insert) with regard to protection against rock fall in the transit zone (rock size: 0.2 – 5 m<sup>3</sup>) in a GIS environment with a recent ortho-photo. The forest road at the base of the road ist displayed in yellow. Green=ideal thresholds met, yellow=minimal thresholds met, red=thresholds not met.

With the Ecosystem Service assessment module, forest development, disturbance and climate change impacts, as well as management activities and their influence on the protection against natural hazards can be assessed. This will allow the development of improved adaptation strategies in forest management under climate change, including an assessment of the most important ecosystem service impacts in the case study region.

### **Outlook**

In the remaining 15 months of the project duration, MOTIVE will develop new silvicultural methods suitable for adaptation to a changing climate and its associated risks and uncertainties. Scenario calculations under alternative management strategies will quantify impacts on ecosystem goods and services in case studies across Europe. The results of the calculations will show the possibilities for advanced methods in adaptive forest management. The individual results and improved methods will be integrated in a decision support toolbox for adaptive forest management. MOTIVE will provide assessments for the efficiency of current and future adaptive forest management strategies in terms of wood production trends under a 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 disseminated across Europe.

MOTIVE is a large-scale integrated project in the 7<sup>th</sup> 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 a duration of 4 years. The project is ongoing until April 2013.

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