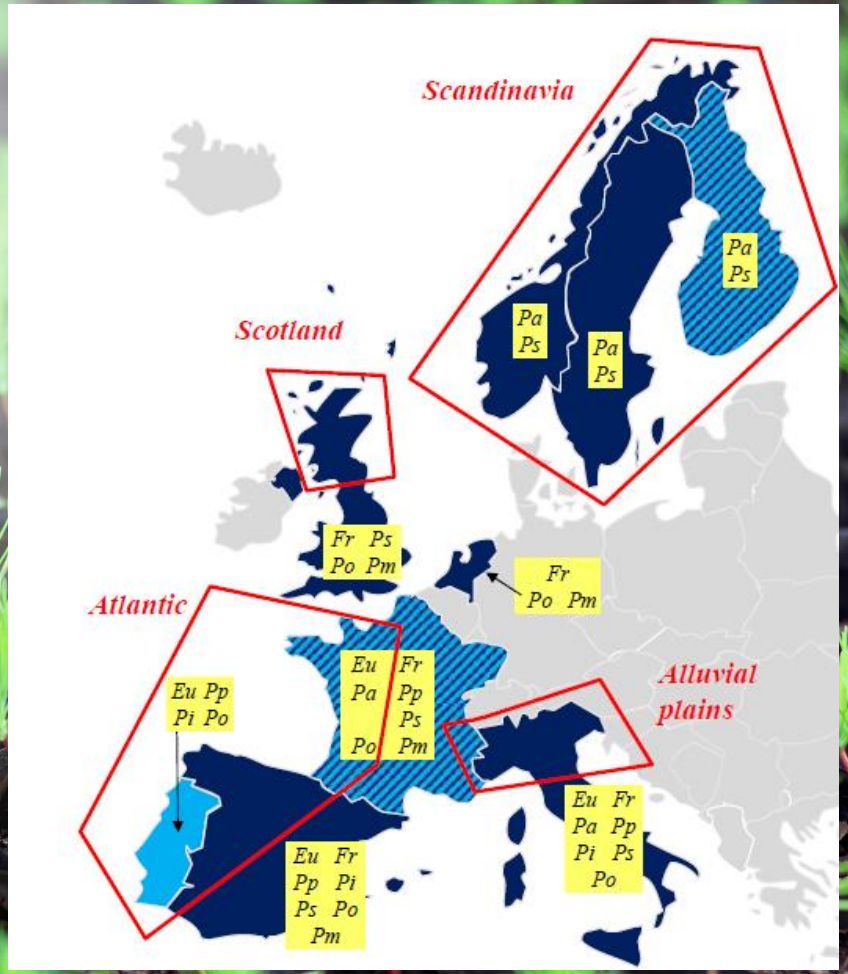
B4est

Case studies for the deployment of improved FRM in different regions of Europe: assessment of benefits, costs and risks



FRM=forest reproductive material

Lisbon, June 2022
Anssi Ahtikoski

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773383

What were the original objectives ?

To increase forest survival, health, resilience and productivity under climate change and natural disturbances

Further, B4EST will provide tree breeders, forest owners, managers and policy makers:

→ Better scientific knowledge of adaptation profiles

→ New and flexible adaptive tree breeding strategies and tools

→ Tree genotypes of high adaptive and economic value

→ Robust management and transfer recommendations for FRM deployment

→ Decision-support tools for the choice and use of FRM

→ Policy recommendations for FRM deployment

Task 5.3

TASK 5.3: Assessment of benefits, costs and risks related to the deployment of improved FRM in different regions of Europe focusing on regionally prevalent challenges

…Task 5.3 will carry out analyses and provide decision support for landscape- and regional-level forestry planning and decision making by indicating the impacts of deployment of improved FRM in four different regions of Europe, with different growth conditions, structure of forests, operational environment of forestry, and expected biotic risks and other impacts of environmental change:

1) Nordic countries

2) Scotland

3) Atlantic range of Southern Europe

4) Alluvial regions of Southern Europe

What have we promised to deliver?

Nordic countries

In Nordic countries (Finland, Norway and Sweden), long-term scenarios will be analysed with emphasis on the effects of improved FRM on biomass production, carbon sequestration, resilience and biodiversity of forests dominated by Pinus sylvestris and Picea abies. Performance of improved FRM in multifunctional and sustainable forest management in changing climate will be analyzed with advanced stand-level simulation optimization tools, which would be updated and further developed (MOTTI, HEUREKA)

What have we promised to deliver ?

Scottish woodlands

In Scotland, opportunities and risks provided by improved Pinus sylvestris FRM under future climate scenarios will be highlighted for a panel of new adaptation management options. The analysis will focus on forest resilience, carbon sequestration, and biodiversity, and in a lesser measure, biomass production

What have we promised to deliver ?

Atlantic range

In the Atlantic range of Southern Europe (France, Spain, Portugal) where maritime pine is of main interest in forestry production but where stone pine could replace maritime pine to offer non-wood production and increased tolerance to drought, the analyses will focus on management scenarios with risk assessment (biotic and abiotic) under changing climate. The analysis will focus on biomass production, carbon sequestration, forest resilience, biodiversity and seed production

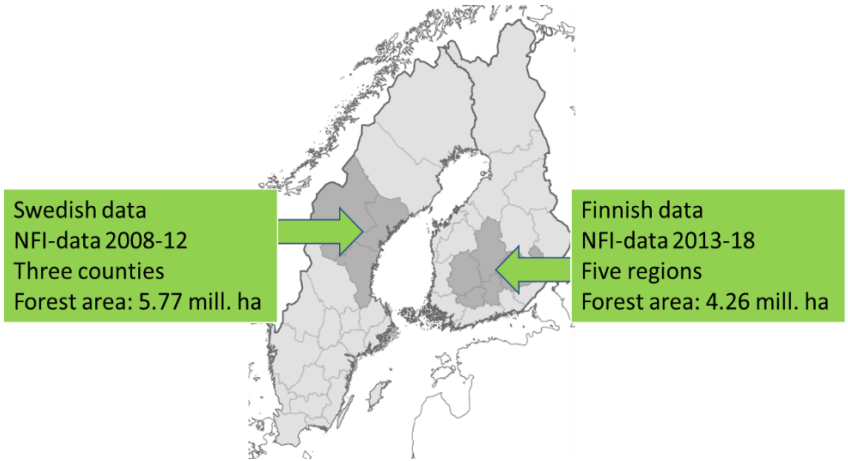
What have we promised to deliver ?

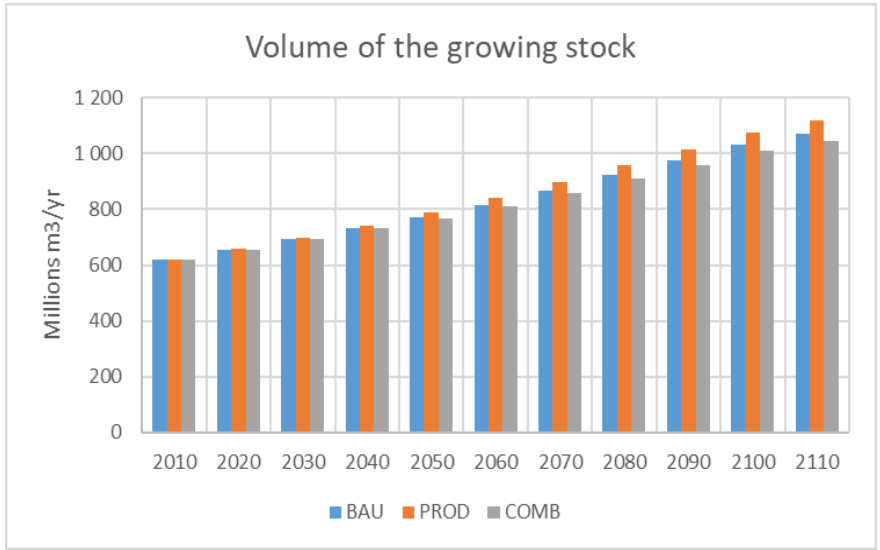
Alluvial regions

In alluvial regions of Southern Europe (Italy, France) where intensive production areas of poplar are located, benefits and risks of improved FRM and new associated management scenarios will be evaluated for different objectives (plywood production, biomass for bioenergy, phytoremediation on marginal lands).

How have we succeeded ?

Nordic countries



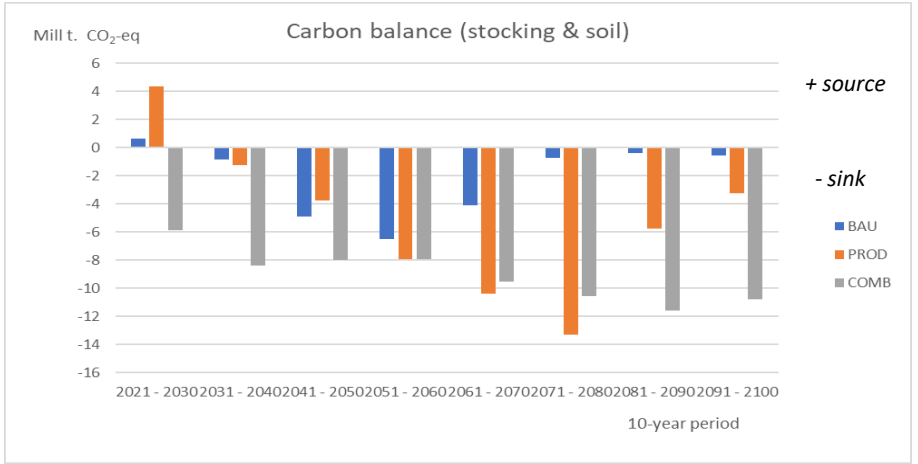


Sweden

1. business as usual: BAU
2. increased use of FRM: PROD
3. as PROD combined with increased proportion of broadleaves: COMB

How have we succeeded ?

Nordic countries



1. Business as Usual scenario (**BAU**) assumes that the deployment of improved FRM, as well as the intensity of silviculture and harvesting levels in production forests will remain similar to the present even for decades to come.

2. Scenario of Wood Production (**PROD**): to increase forest growth, wood production and profitability of forest management by intensifying silviculture through the use of artificial regeneration with improved FRM. The focus of PROD scenario is on the economic sustainability

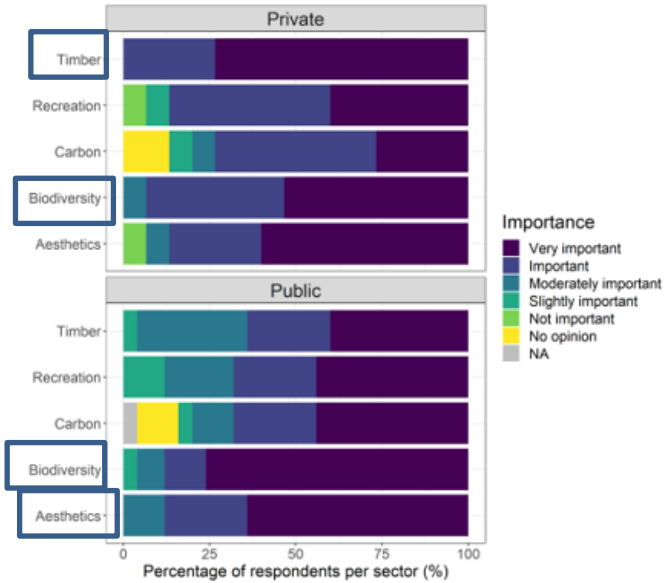
3. Adaptation and mitigation to climate change and biodiversity are emphasized in (**COMB**) with the help of adapted forest management and intensive use of improved FRM. Goal is to improve the resilience of forests and increase biodiversity. Carbon sequestration of forests is promoted by lengthening rotation periods and using improved FRM always when forest is regenerated by planting or sowing. The share of broadleaved tree species: at least 20 % share.

A benefit: improved FRM provides more space to handle the trade-offs related to forestry

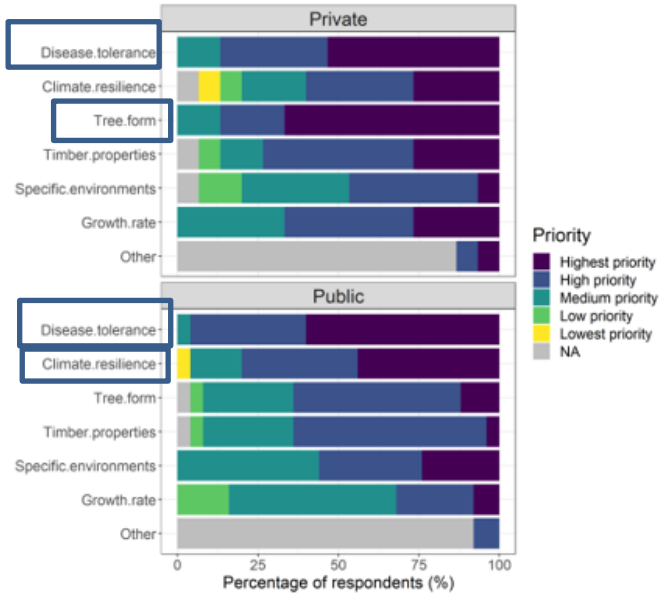
How have we succeeded ?

Scottish woodlands

Benefits, importance



Priority traits



Stakeholder opinions (total of > 40 respondents)

B4est (Scottish woodlands)

North-East Scotland

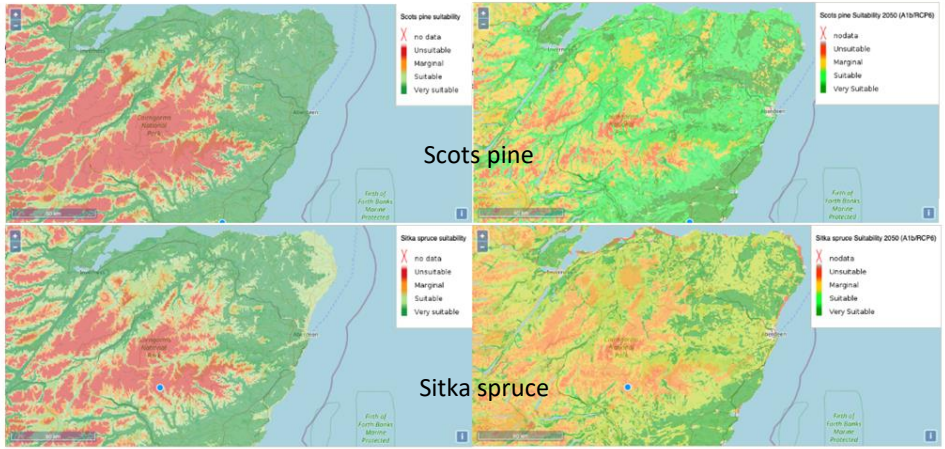
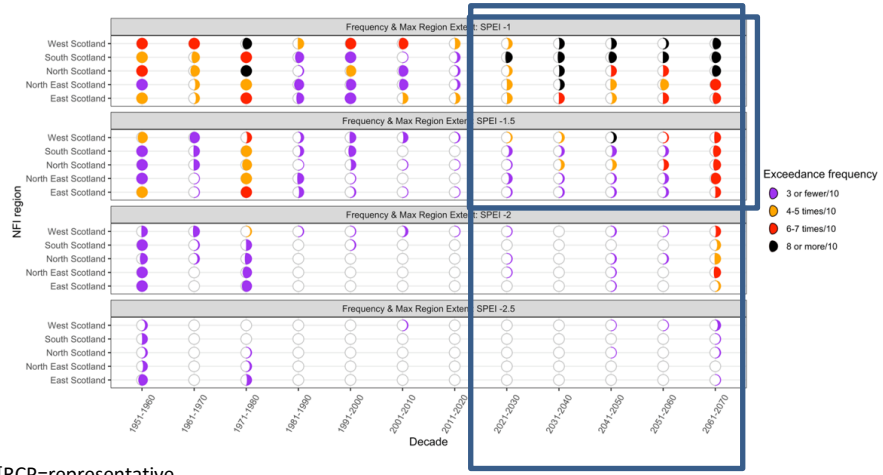


Figure 11. Changing climatic suitability of Scots pine and Sitka spruce predicted using a RCP6 green-house gas forcing scenario using the model Ecological Site Classification

Extreme drought vulnerability, Sitka spruce



[RCP=representative concentration pathway according to IPCC]

→ Scots pine becomes marginal for timber production and Sitka spruce loses areas suitable for good-quality timber (higher elevations) [a risk]

→ North Scotland: severe droughts are more frequent in the future (causing e.g. defoliation damage to spruce crops) [a risk]

How have we succeeded ?

Atlantic range

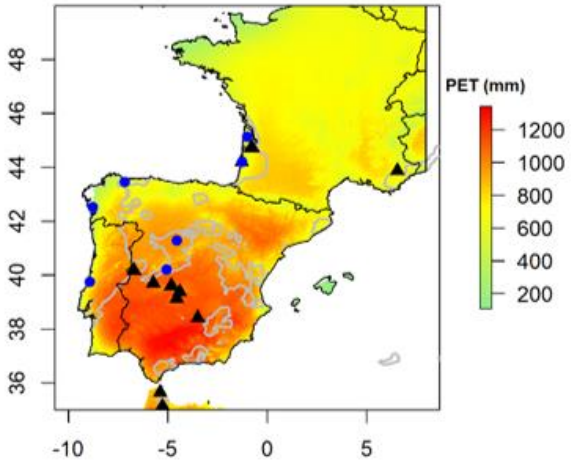
Provenance-based models for maritime and stone pine and assisted migration under alternative future climate scenarios – the risks and benefits of improved FRM

For maritime pine: nine provenances along the European Atlantic coastline

For stone pine: 10 provenances scattered in southern and inner Spain, in Portugal and in French Côte d'Azur

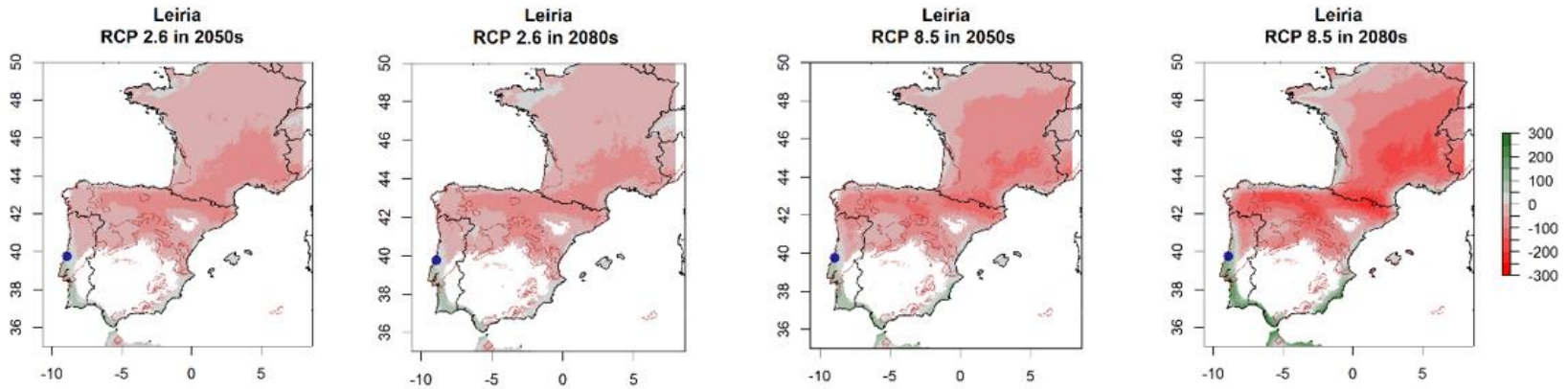
Mean tree height at age of 15 yrs (linear mixed-effects model)

Maritime pine



PET= potential evapotranspiration, black triangles: common garden sites, blue dots: provenances

B4est (Atlantic range)

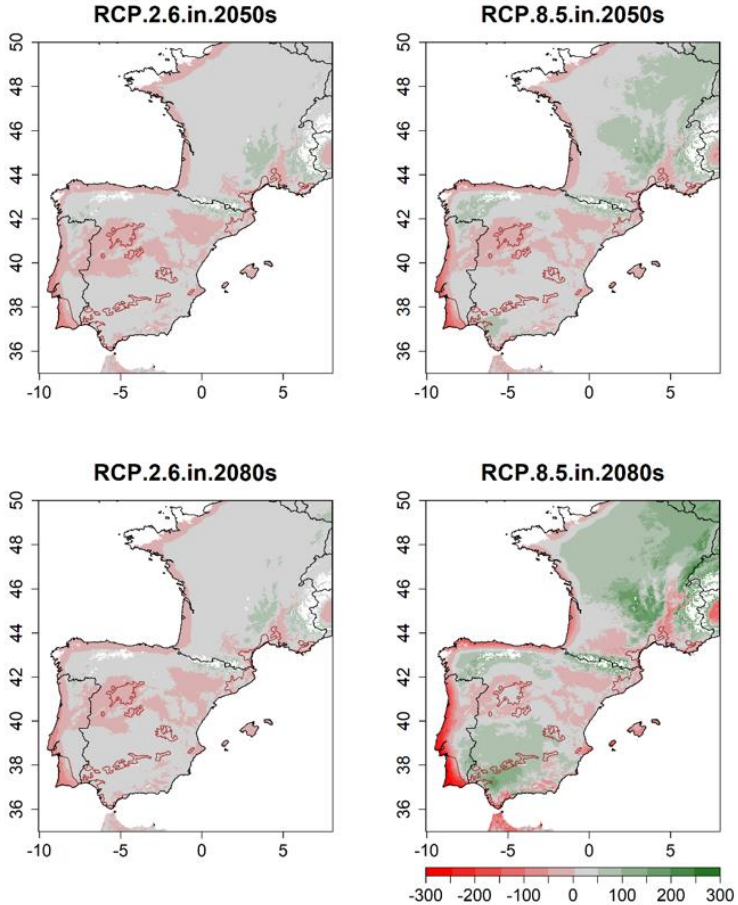


Average shifts in *maritime pine* tree height (cm), red color declined, green color improved - compared to the tree height under current climate. Blue dot illustrates the geographic origin of the provenance tested

[The increase of global mean surface temperature by the end of the 21st century (2081–2100) relative to 1986–2005 is likely to be **0.3-1.7°C** under **RCP 2.6**, and **2.6°-4.8°C** under **RCP 8.5**]

→ the performance of maritime pine is predicted to improve along the southern Portuguese coast (tree height increases on average, ca. 50 cm) and to decline along the northern Spanish coast, in Bretagne and Normandy, and in northern half of Spain [a benefit]

(Atlantic range)



Tree height under climate scenarios compared to tree height under current climate, *stone pine*

→ The performance of stone pine along the European Atlantic coast is expected to worsen under both climate scenarios, RCP 2.6 and RCP 8.5 and with both time spans (2050, 2080). This surely is a risk !

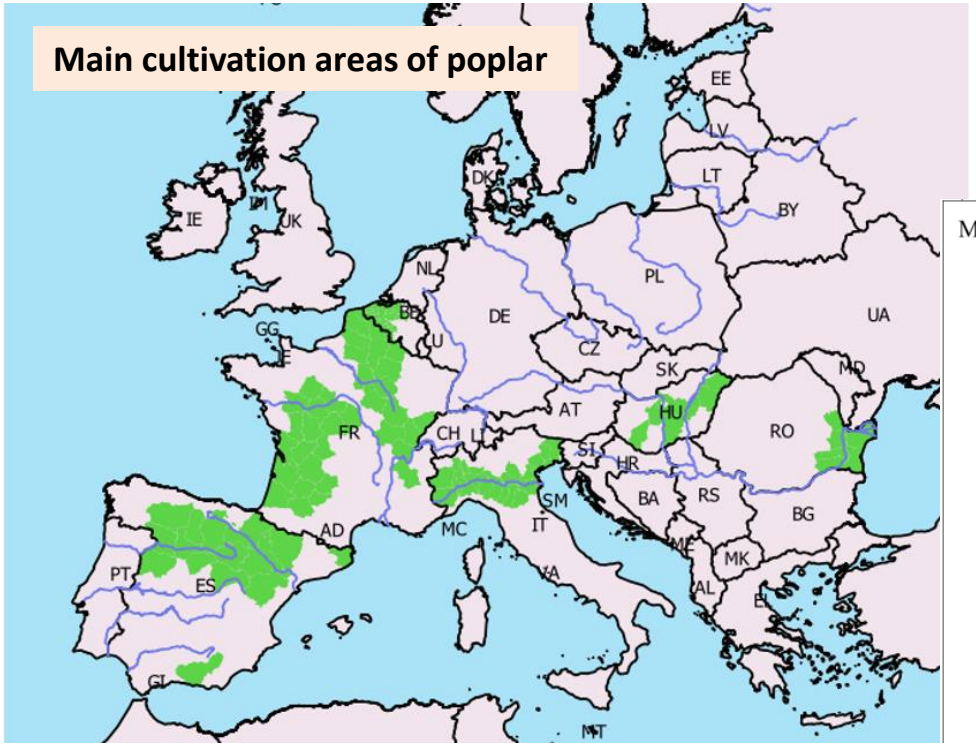
→ However, performance in certain spots is expected to slightly improve under both RCPs and both future time periods, for instance in SW Spain

→ If the findings regarding maritime pine are confirmed by further analyses that would be an excellent outcome, since then there would be enough drought-resistance in the region – and assisted migration would not be needed [a benefit]

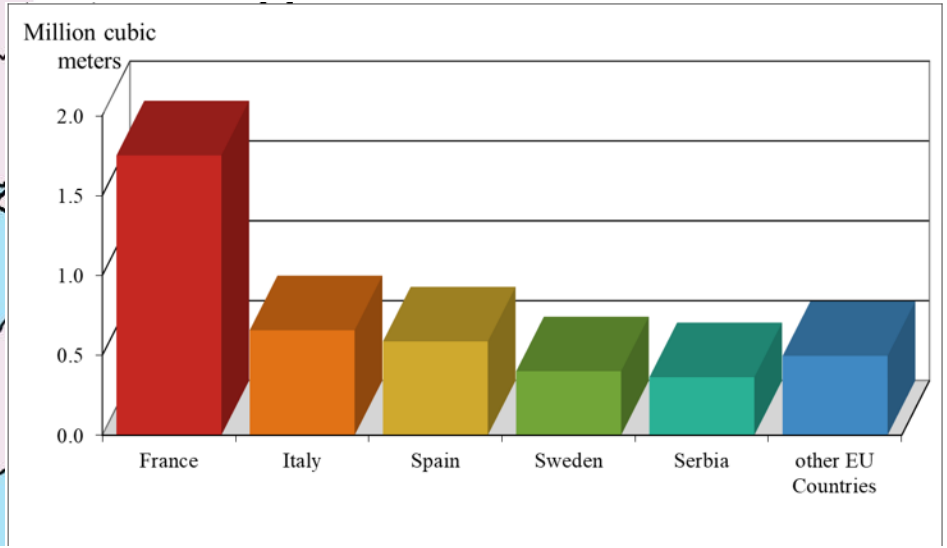
→ One might argue that both biotic and abiotic risks play a crucial role, particularly with maritime pine (e.g. pine pitch canker and drought) and specific traits (e.g. nematode, fusarium and drought resistance) should be included into regional breeding programmes

How have we succeeded ?

Alluvial regions



Production of poplar (round wood)



How have we succeeded ?

Alluvial regions

The new FRM

1. Poplar clones resistant to main leaf diseases and woolly aphid
2. Improved FRM clones grow faster than unimproved

→ Benefits:

Lower production costs (up to 27% decrease), better environmental sustainability and new opportunities for different end-uses

B4est (Alluvial regions)

Achievements related to new FRM programme

- Reducing the N load (manyfold less compared to e.g. corn cultivation)
- Lesser toxicity of phytosanitary treatments (compared to traditional approach: impact index ca. ¼ of the original)
- Good potential for decontamination of polluted soils (mainly due to fast growth of new poplar clones)
- Superb efficiency in absorbing carbon dioxide (up to 25 tons of CO_2 ha^{-1} $year^{-1}$)
- One considerable risk is the fact that land owners are reluctant to apply improved FRM due to experienced difficulties in selling wood to plywood market (meetings among the stakeholders are under way)

Wrap up table

Region	Original emphasis (objective) of the case study	Has the case study tackled with and delivered ?
Nordic countries	Performance of improved FRM in multifunctional and sustainable forest management	👍
Scotland	forest resilience, carbon sequestration, and biodiversity	👍
Atlantic range	management scenarios with risk assessment (biotic and abiotic)	👍
Alluvial regions	new associated management scenarios will be evaluated for different objectives	👍

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