# Individual-tree genetic modeling to assess adaptive responses to local environment conditions - implications for the European scale

Koen Kramer

Mart-Jan Schelhaas

Bert van der Werf

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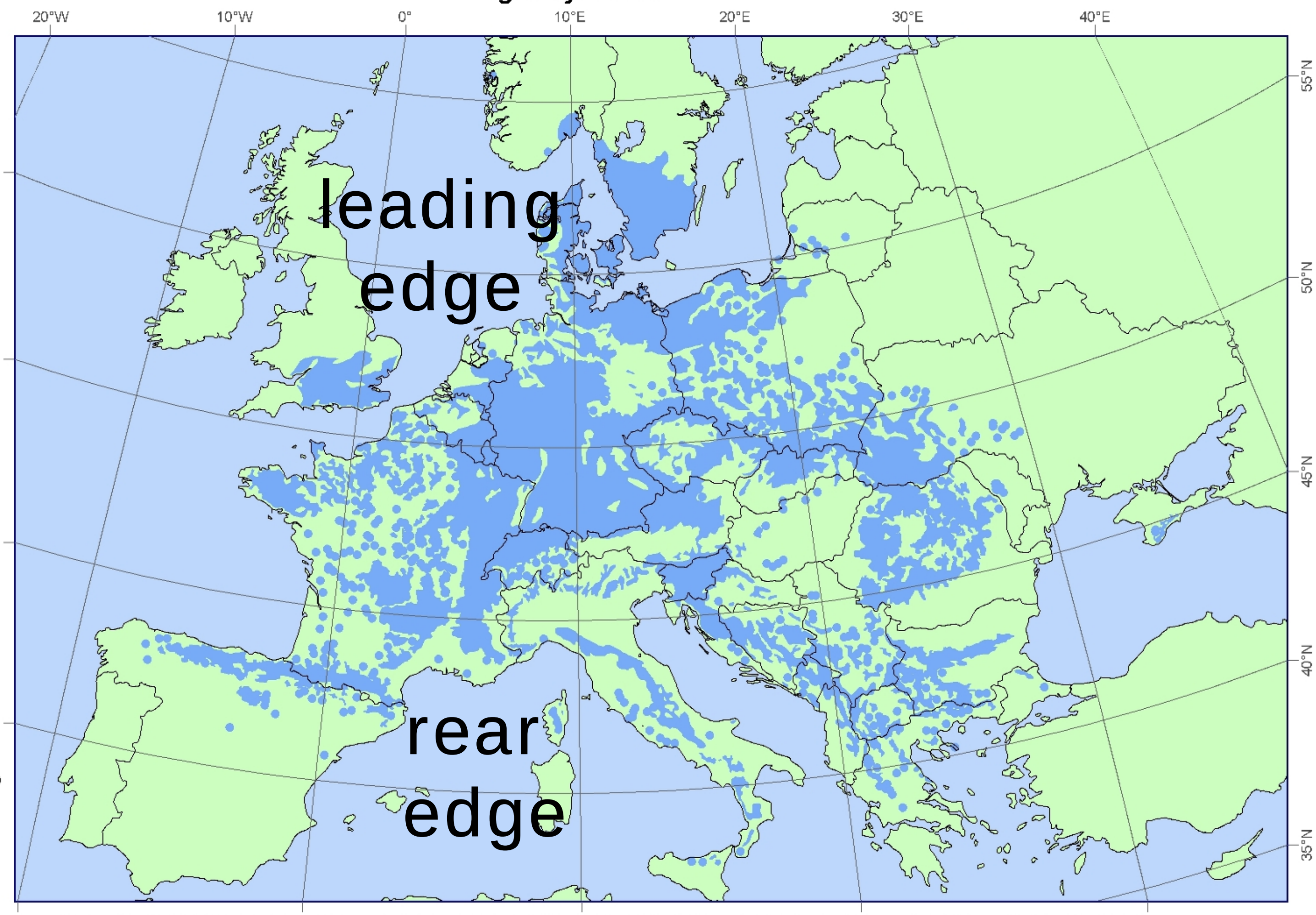
# Why genetic modelling?

*Fagus sylvatica*




EUFORGEN

EUFORGEN Secretariat
c/o Bioversity International
Via dei Tre Denari, 472/a
00057 Maccarese (Fiumicino)
Rome, Italy
Tel. (+39)066118251
Fax: (+39)0661979661
euf_secretariat@cgiar.org
More information, updates
and other maps at:
**www.euforgen.org**

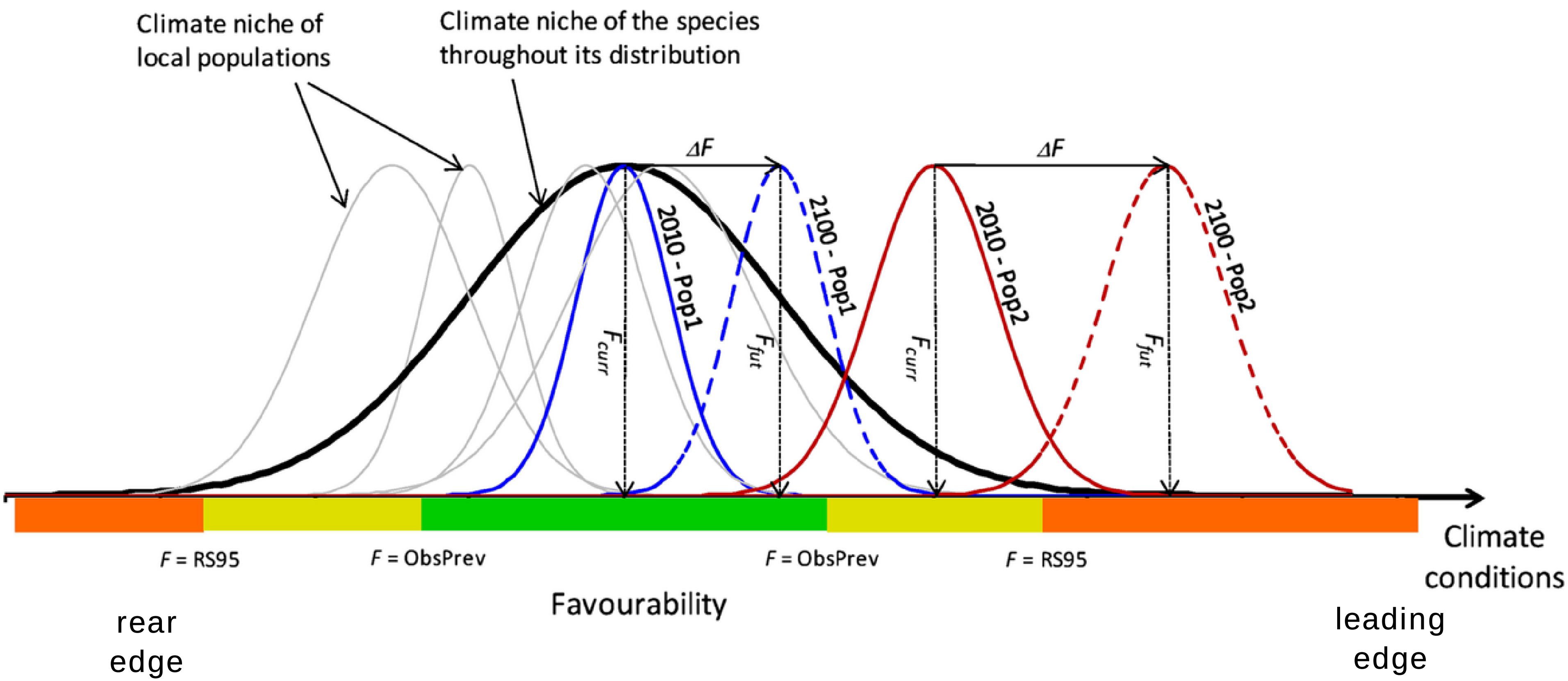
This distribution map, showing the natural distribution area of *Fagus sylvatica* was compiled by members of the EUFORGEN Networks based on an earlier map published in:
Pott R. (2000) Palaeoclimate and vegetation - long-term vegetation dynamics in central Europe with particular reference to beech. Phytocoenologia 30(3-4): 285-333

Citation: Distribution map of Beech (*Fagus sylvatica* ) EUFORGEN 2009, www.euforgen.org.

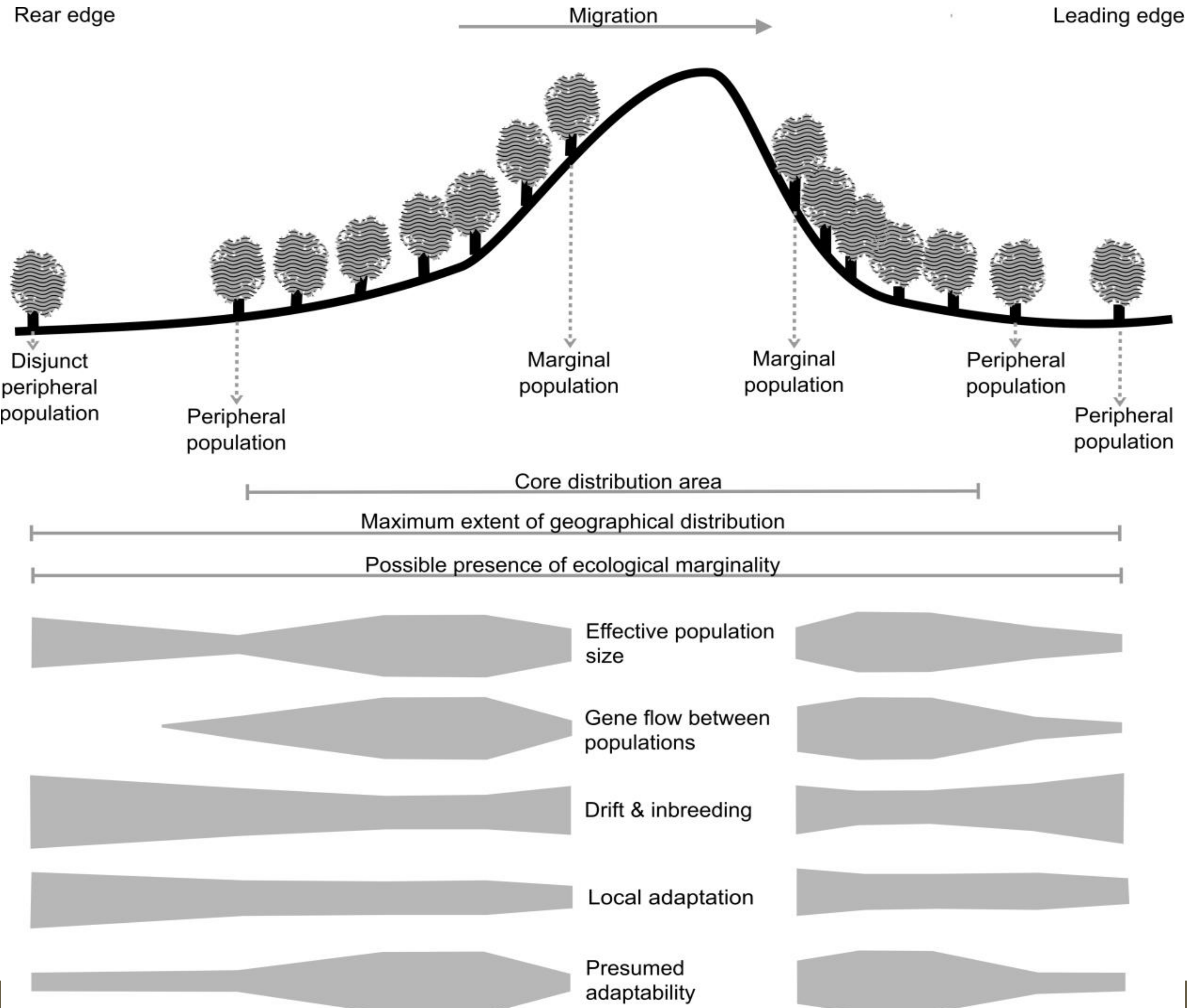
First published online on 30 August 2006 - Updated on 23 July 2008

Km
0 250 500 1,000

# climate niches - local vs whole distribution

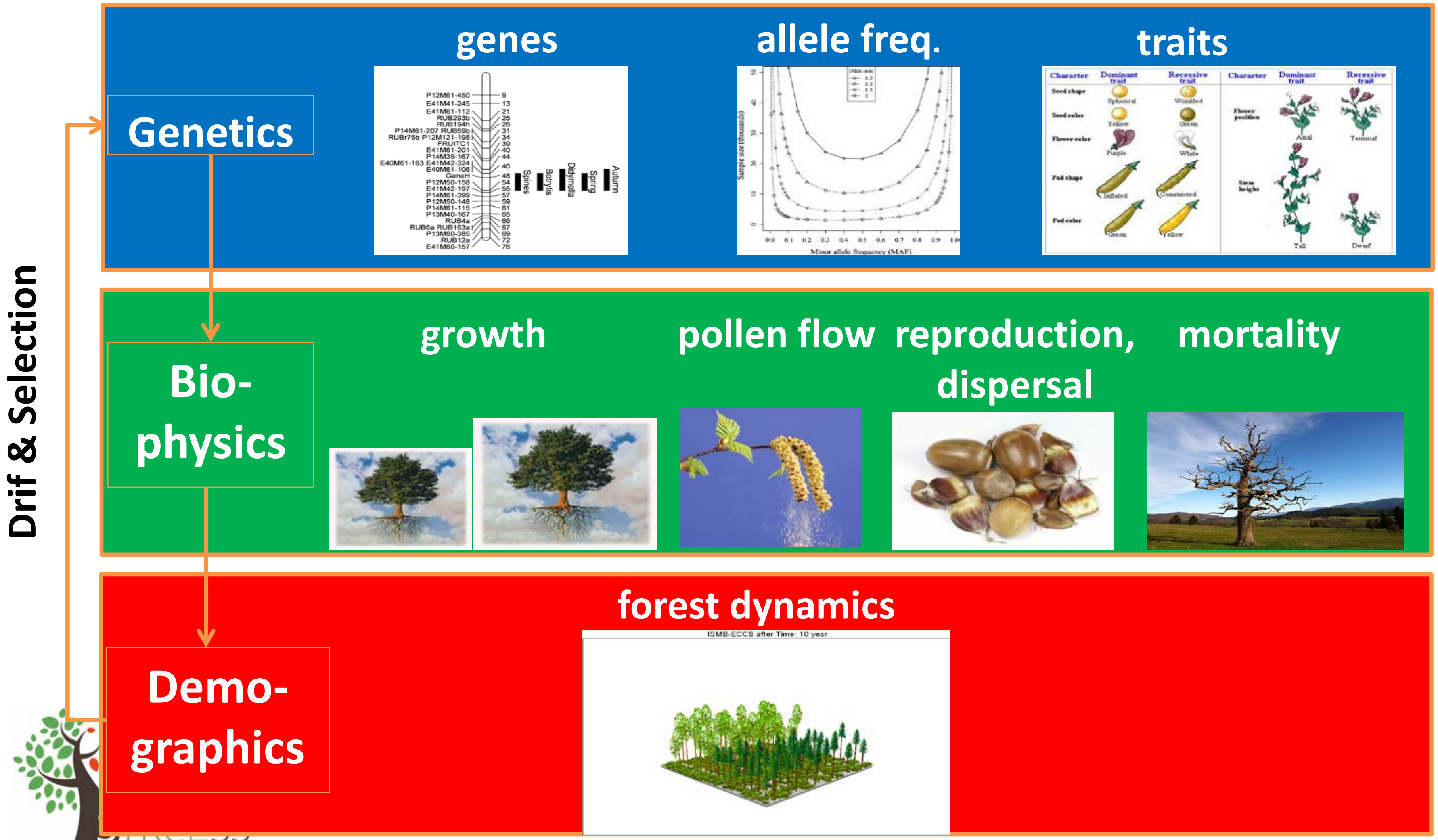



Schueler, et al. 2014, GCB




Fady , et al. in prep.

# ForGEM model



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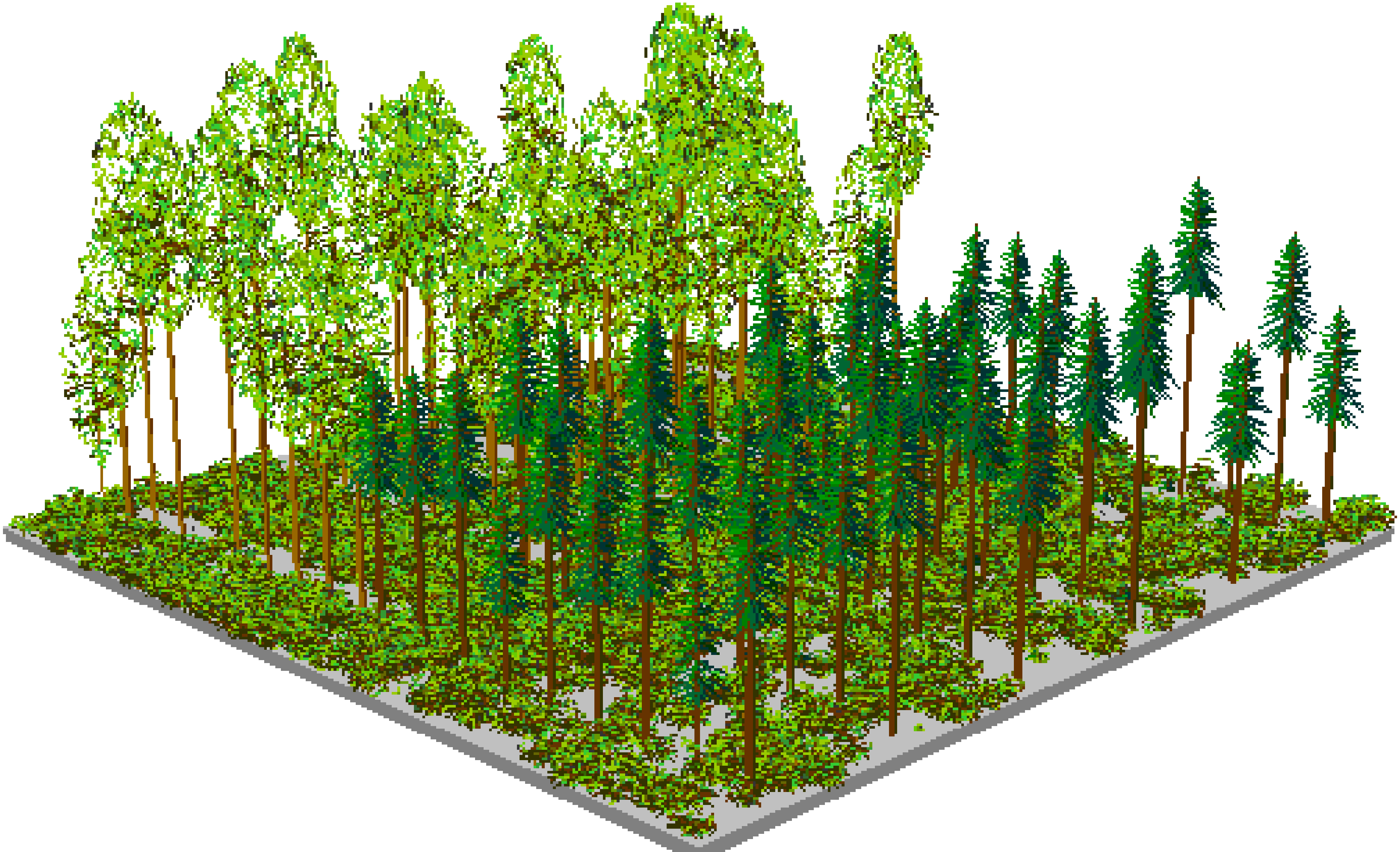
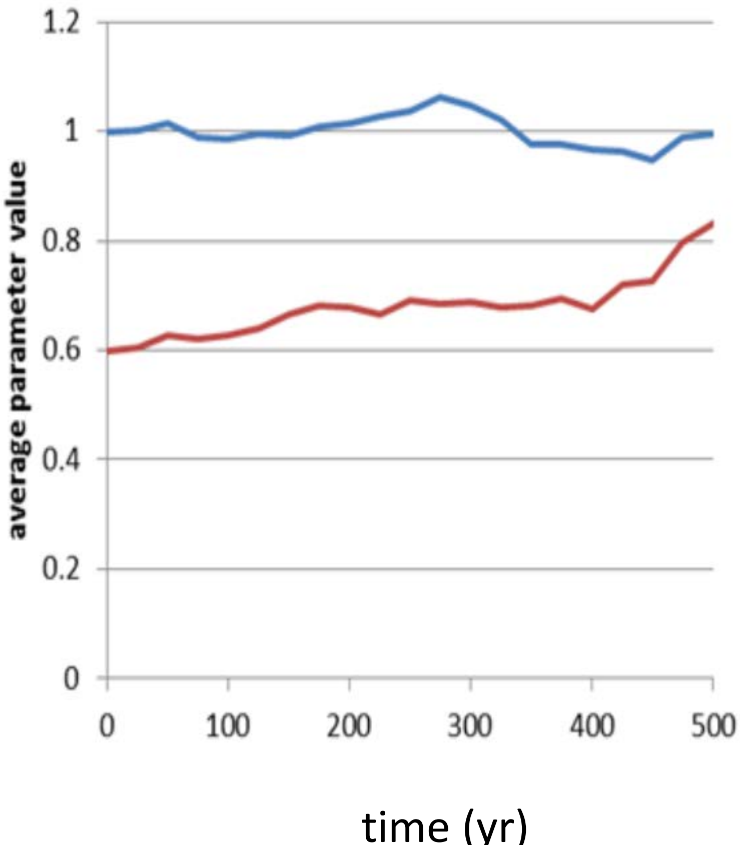
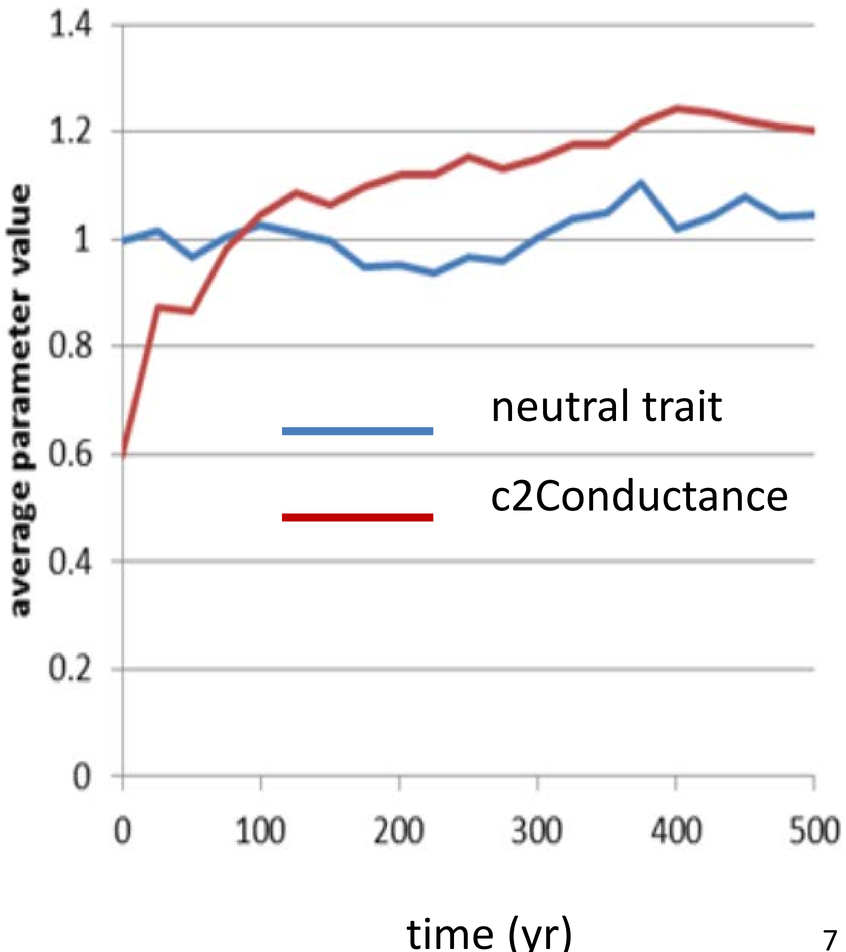


# Example 1. Genetic adaptation of a model parameter related to stomatal conductance

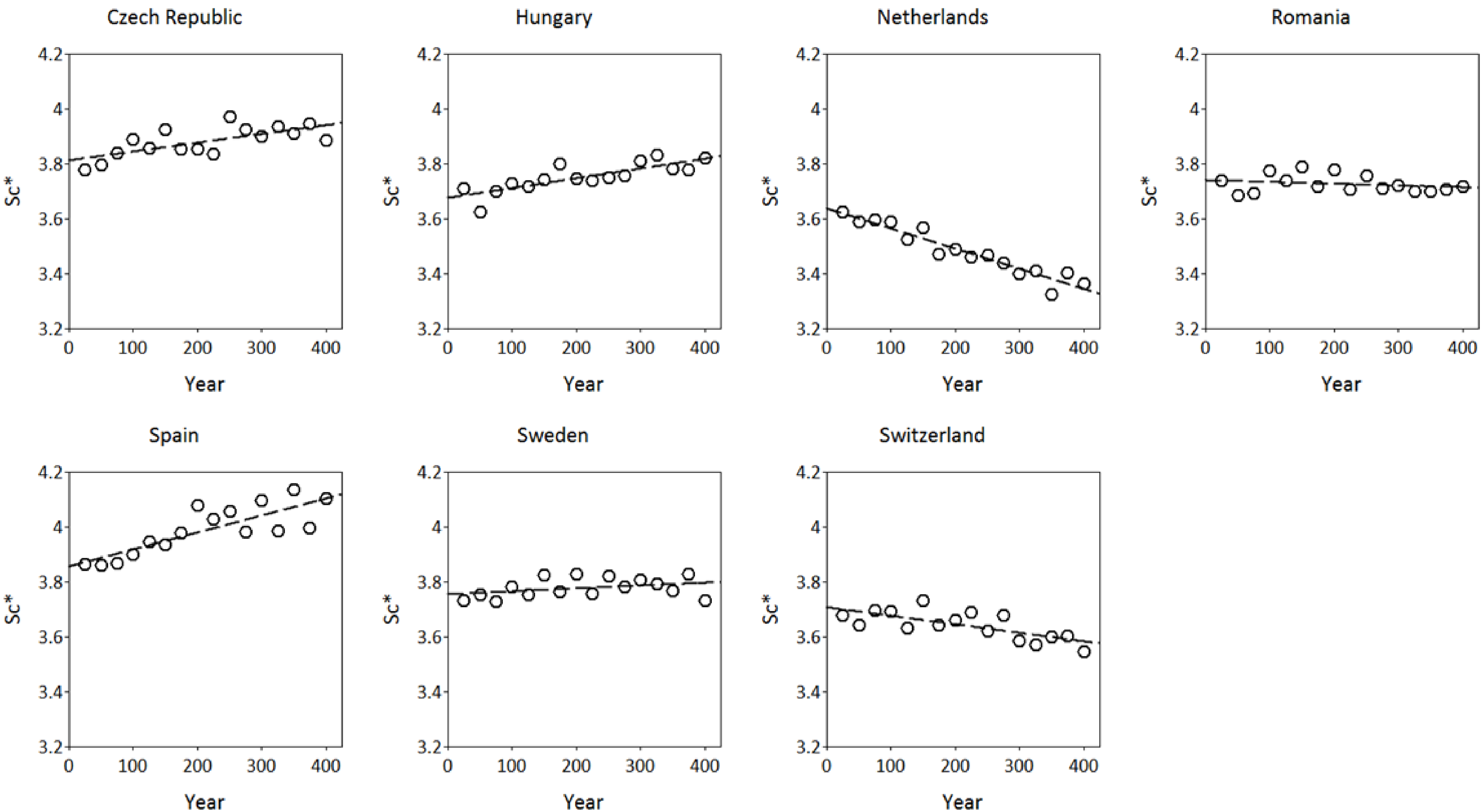
## Cool and wet




## Warm and dry

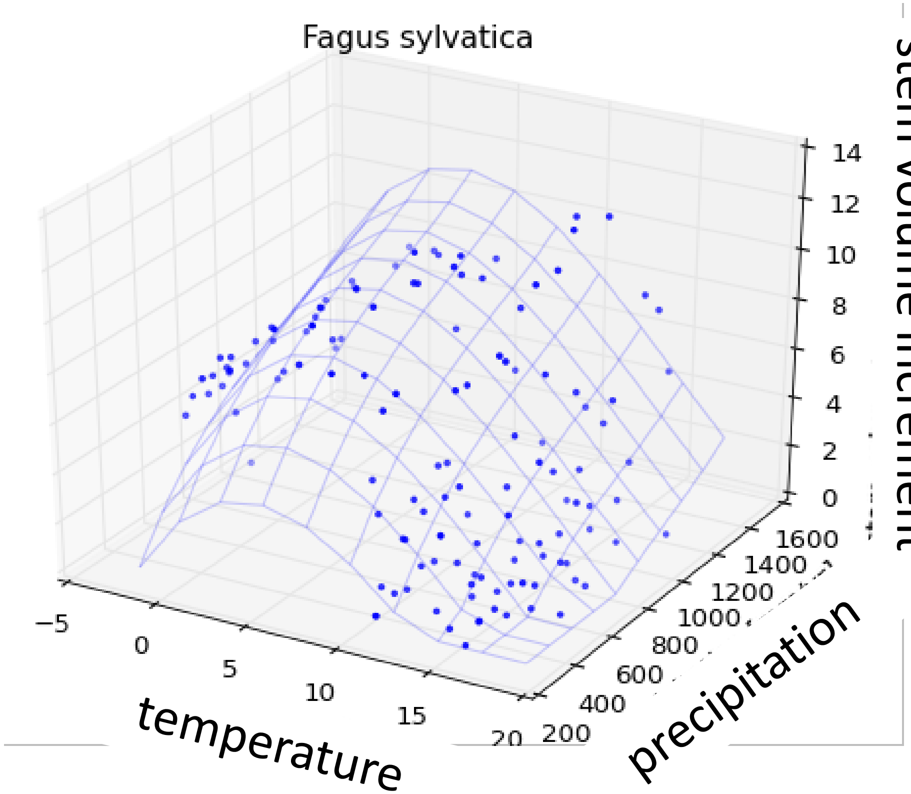


# Example 2. Adaptive response of critical state of chilling

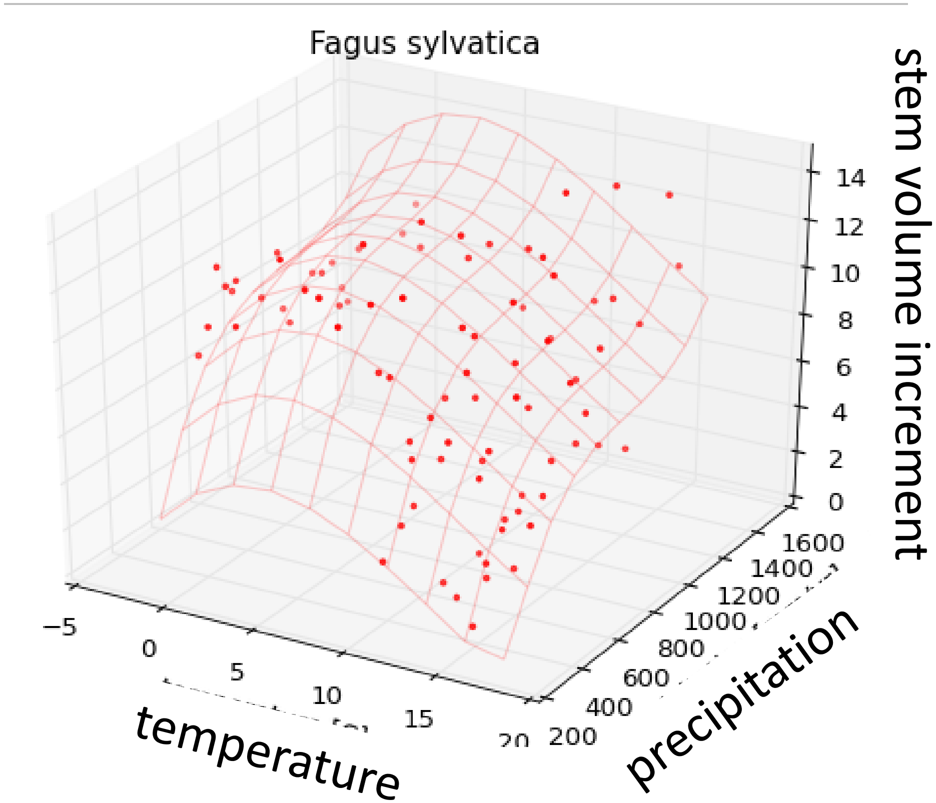


# Consequences of adaptive response on stem volume increment - beech

## No adaptation

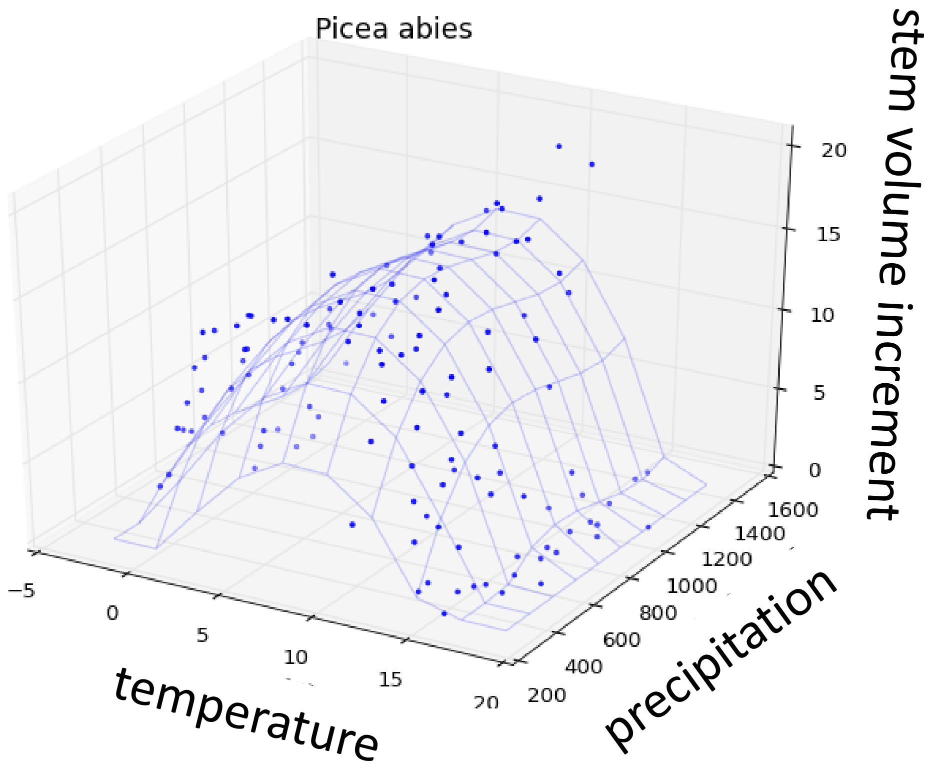



## With adaptation

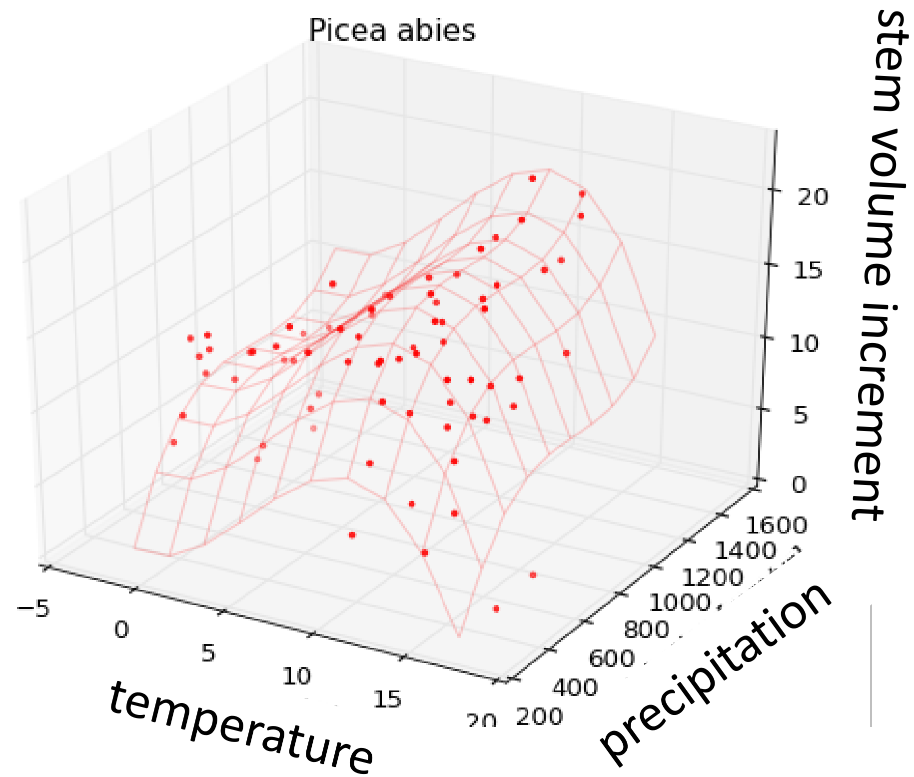


# Consequences of adaptive response on stem volume increment – N.spruce

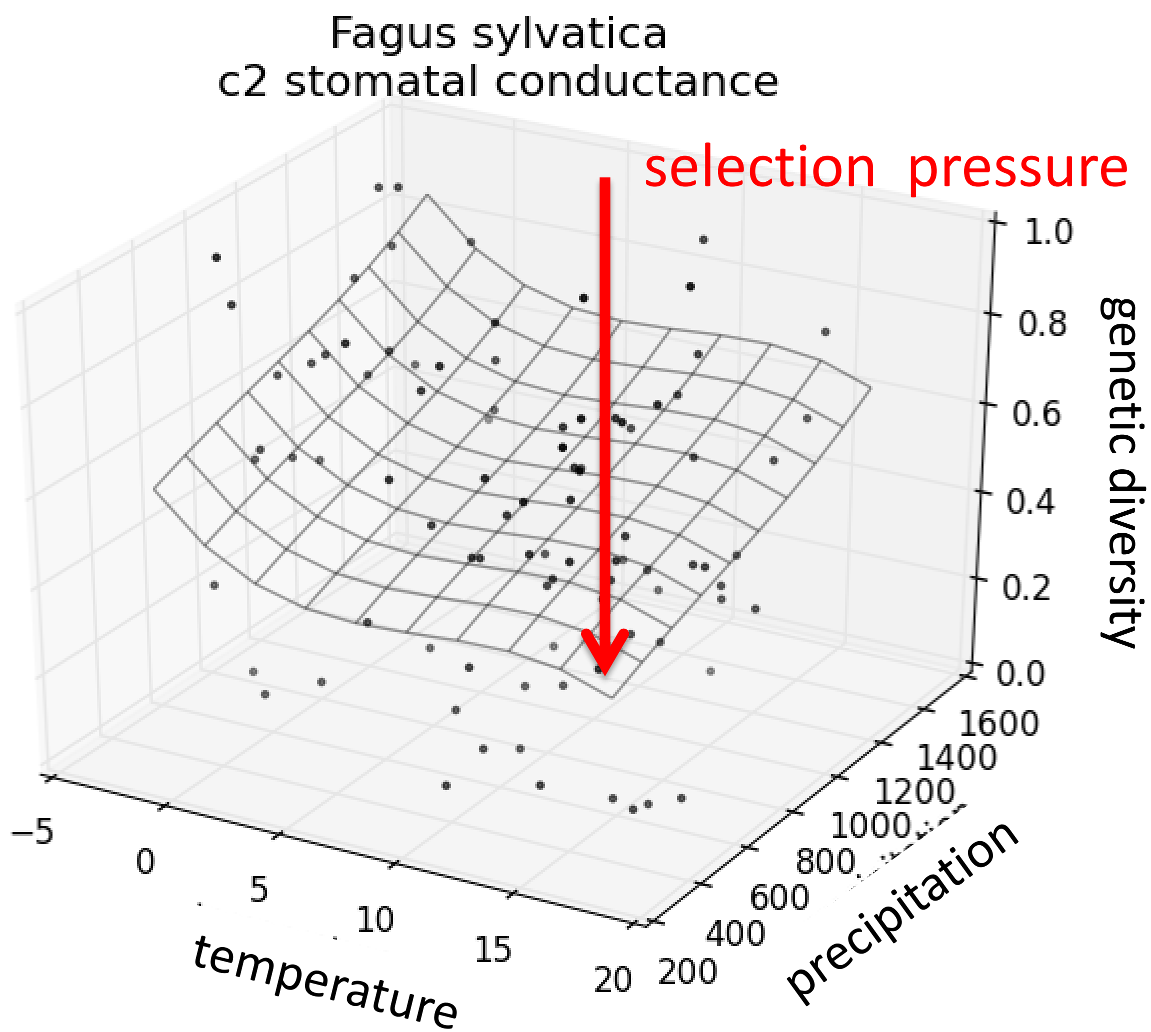
## No adaptation




## With adaptation

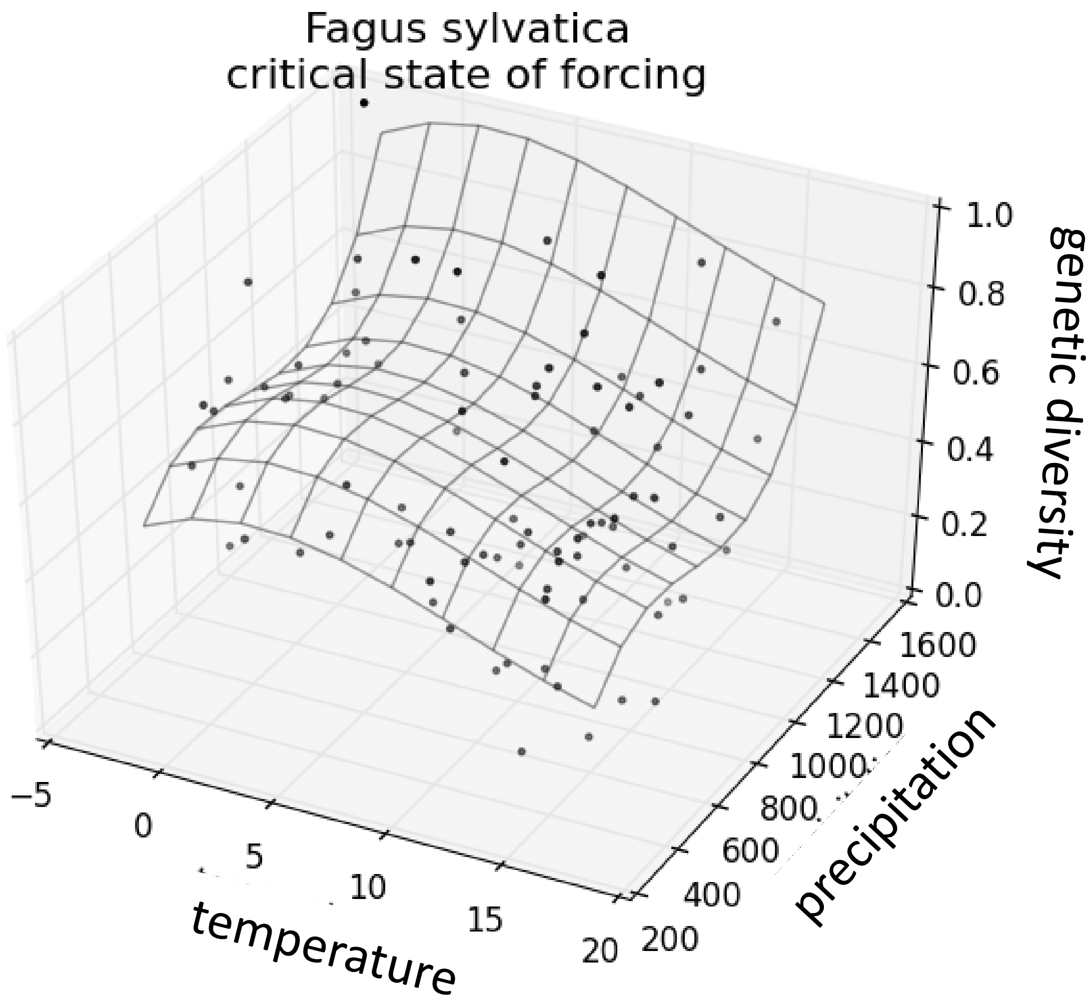


# Consequences of adaptive response on genetic diversity - conductance



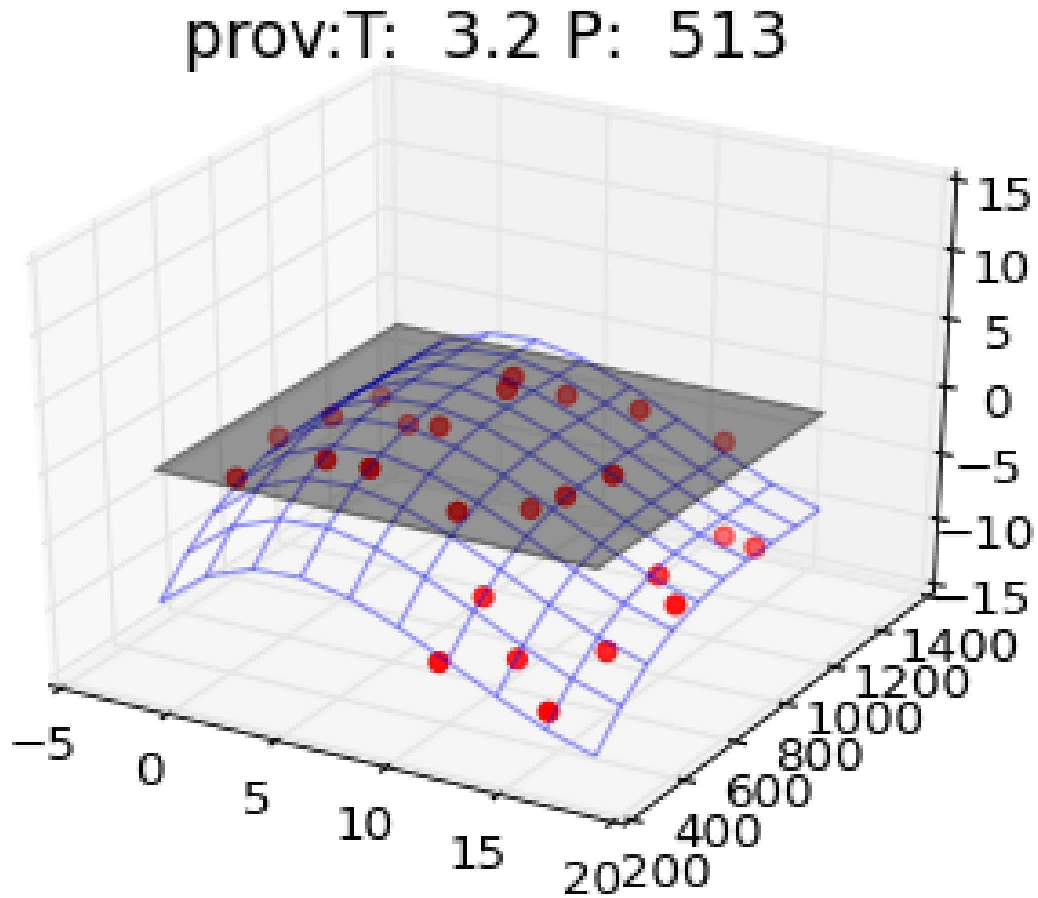

www.s

# Consequences of adaptive response on genetic diversity - phenology



# *in silico* provenance trial – Ex.1

## difference in stem volume increment with local provenance

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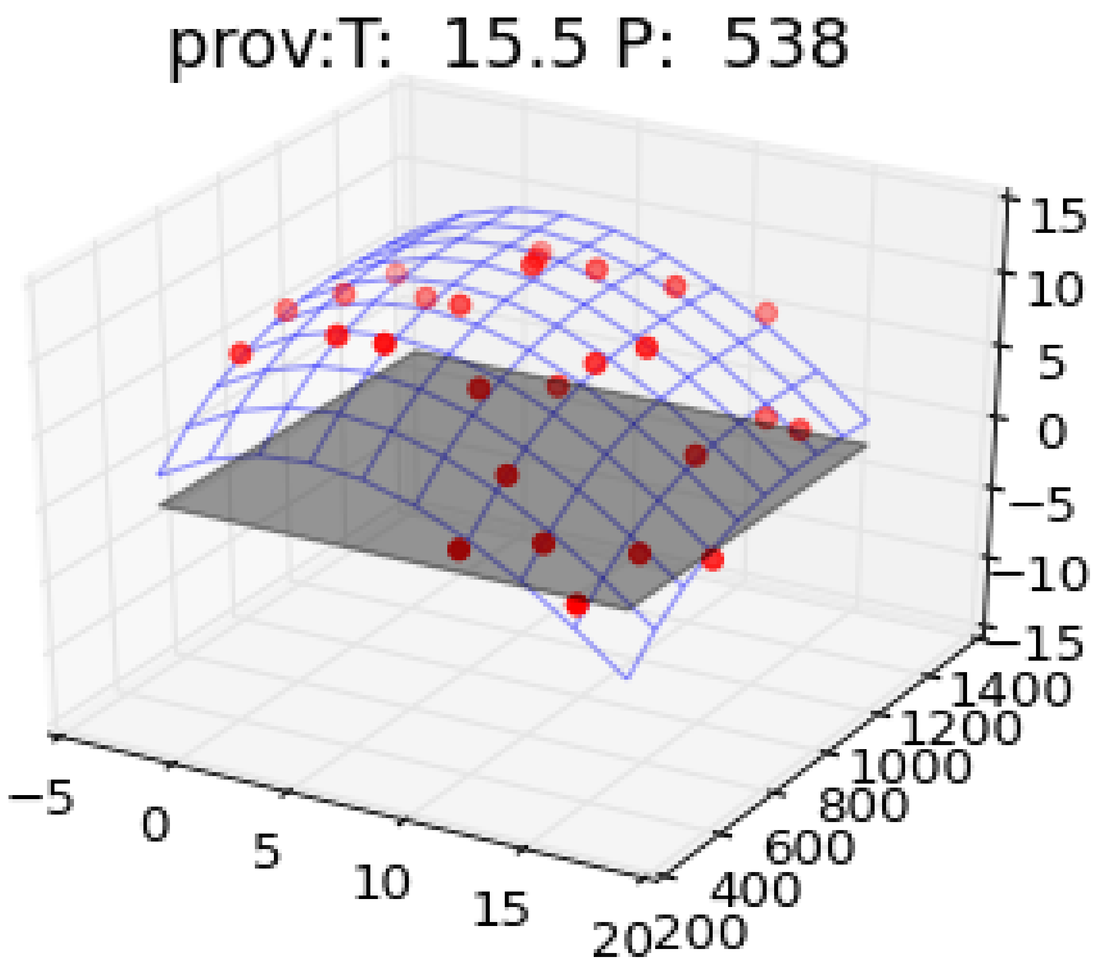
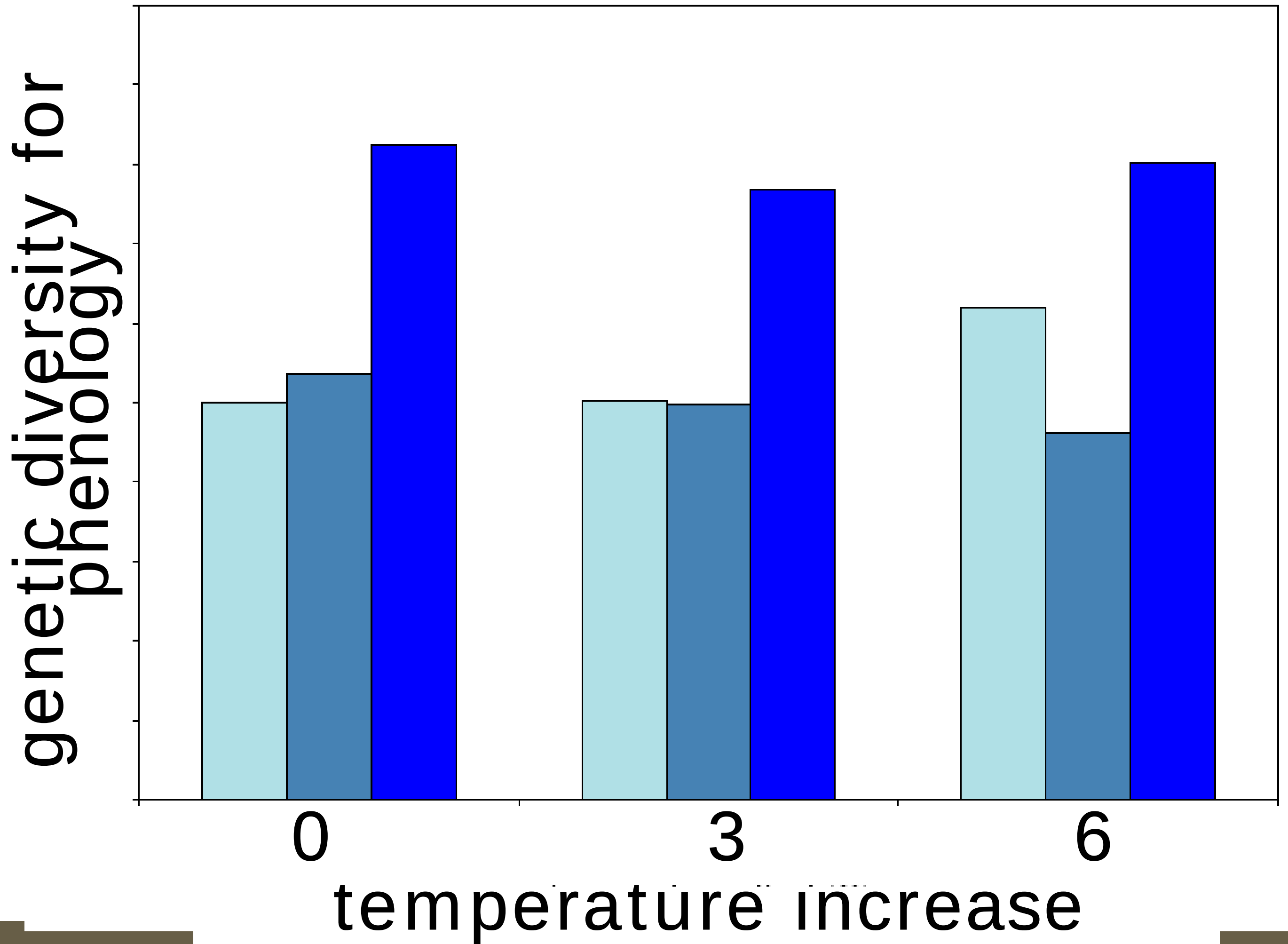
# *in silico* provenance trial – Ex.2

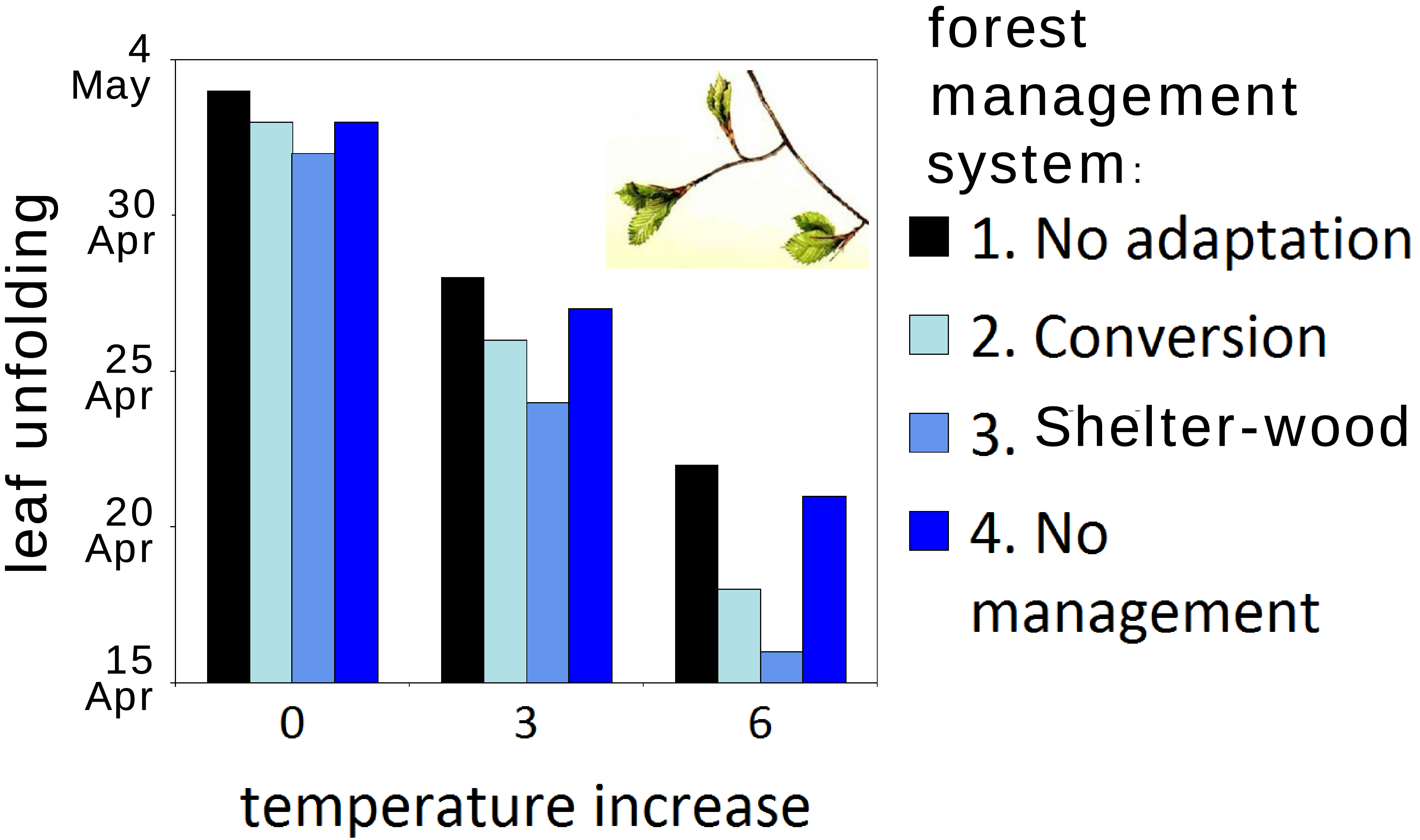
## difference in stem volume increment with local provenance



# Genetic information for management: simulated impact management on adaptive capacity




# simulated impact of management on rate of adaptation



# Conclusions (1/2)

Genetic processes are important to take into account in climate change impact assessment:

- adaptive differences across distribution of tree species, local responses may differ from global responses
- selection intensity differs along environmental gradients, and differs between parameters / eco-physiological processes



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# Conclusions (2/2)

Research needs:

- rates of adaptation vs environmental change
- genetic base of: adaptation – plasticity - acclimation
- assess functional – adaptive- diversity