Waldwachstumskunde
Systemanalyse

Silver fir in pure and mixed-species stands – growth trends, mixing effects and silvicultural potential

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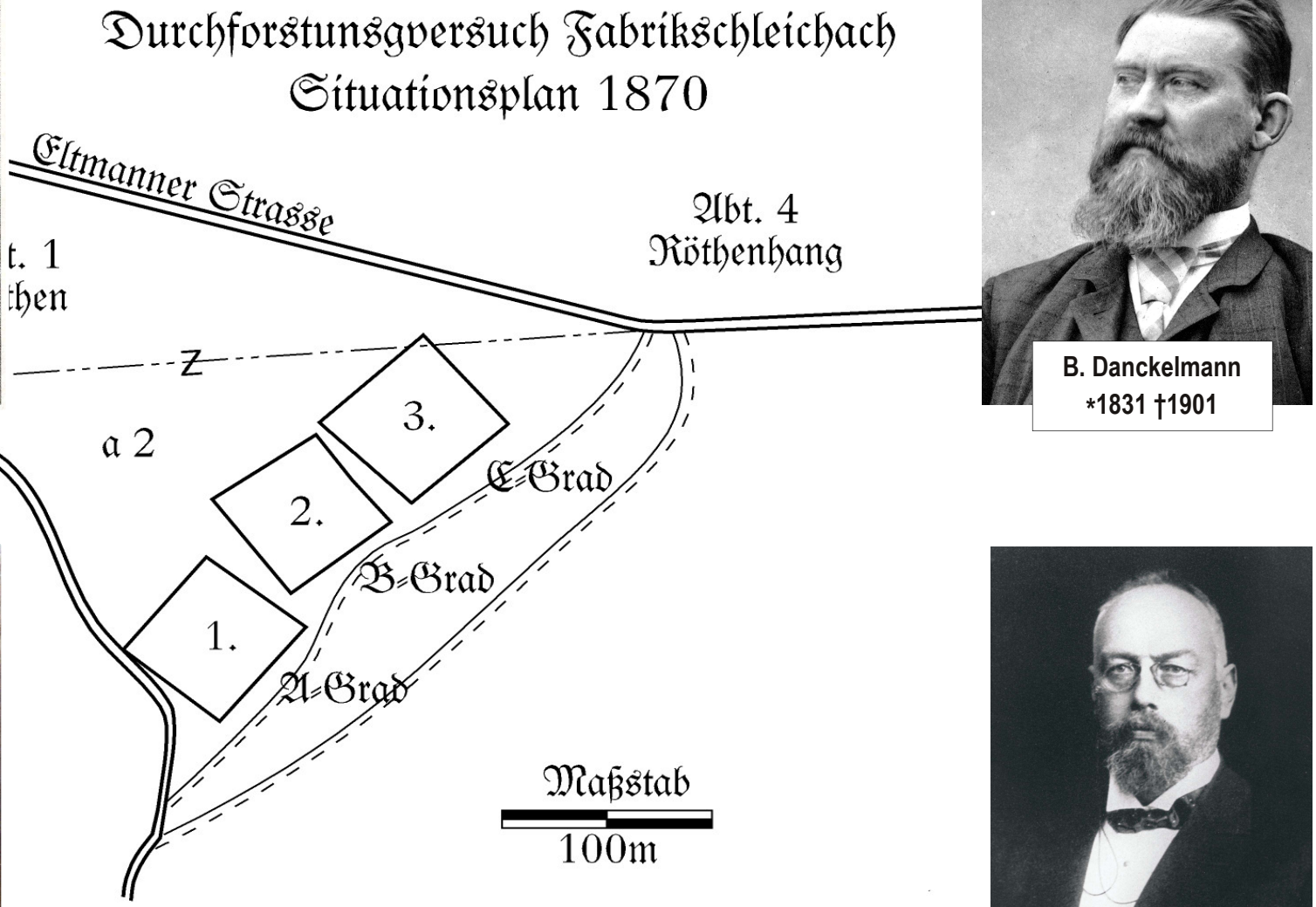
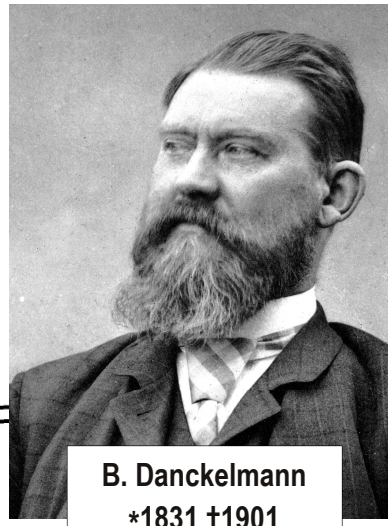
Technical University of Munich

Presentation available at: http://waldwachstum.wzw.tum.de/index.php?id=presentations

C. v. Carlowitz
*1645 †1714

W. L. Pfeil
*1783 †1859

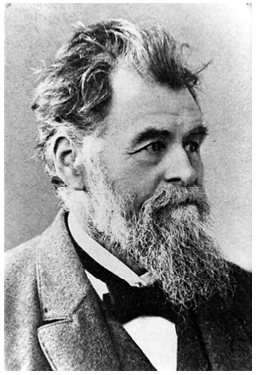




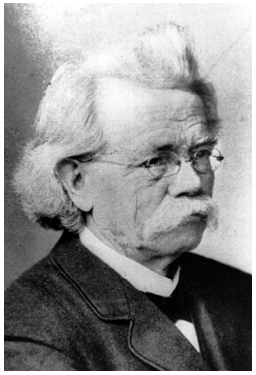
B. Danckelmann
*1831 †1901

A. Schwappach
*1851 †1932

Forest growth and yield research in Munich



A. v. Ganghofer
1827-1900



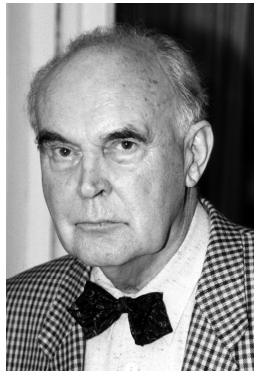
F. v. Baur
1878-1897

R. Weber
1897-1905

V. Schüpfer
1905-1937

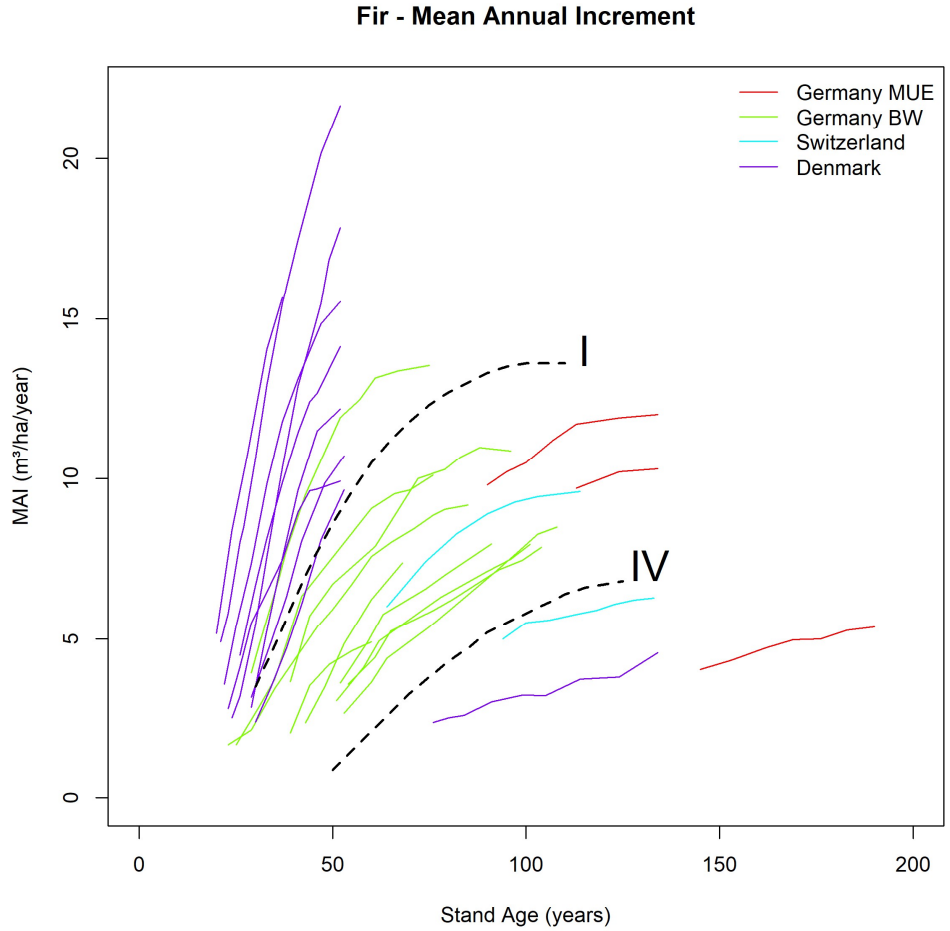
K. Vanselow
1937-1951

E. Assmann
1951-1972

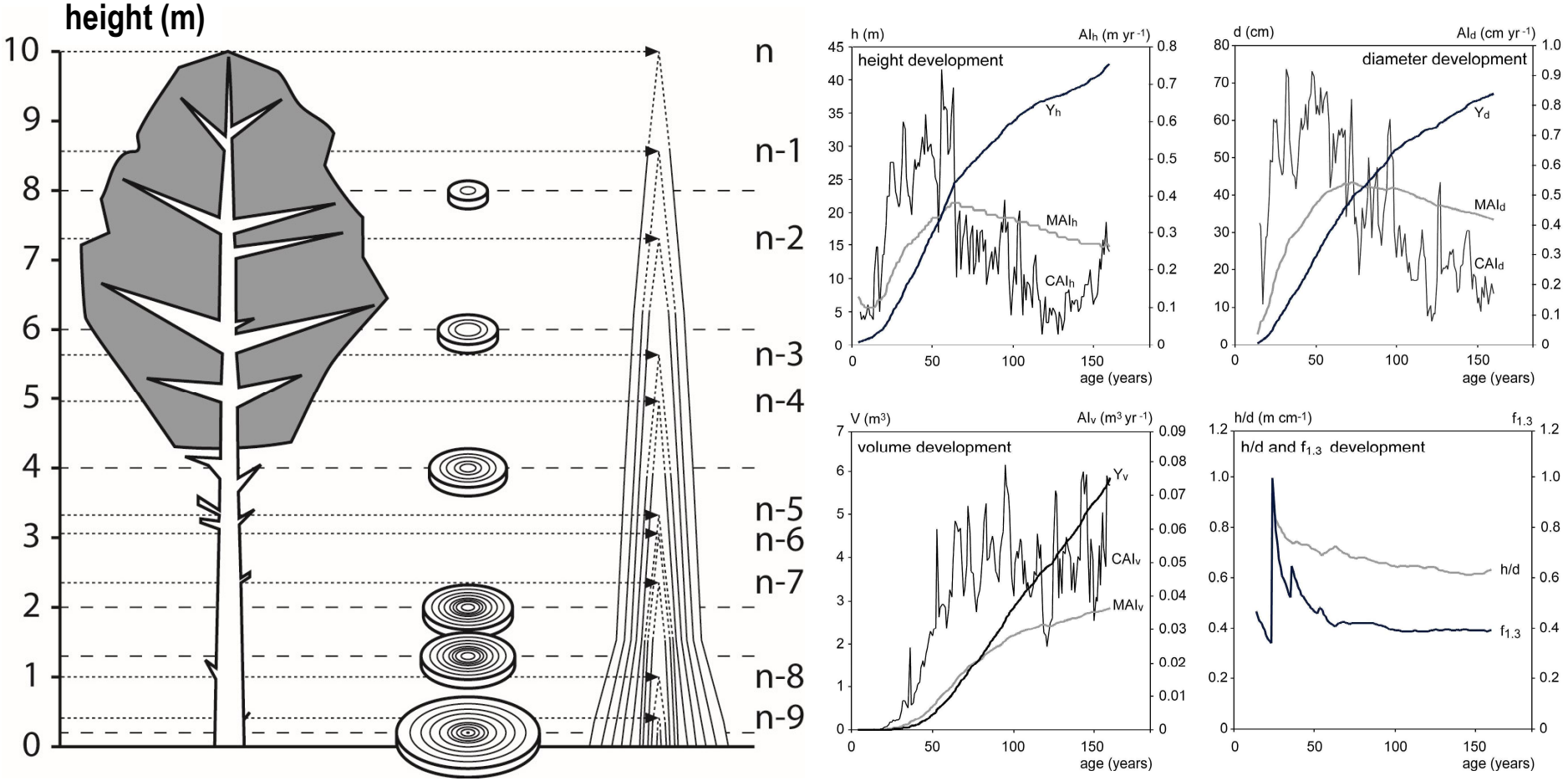


F. Franz
1972-1993

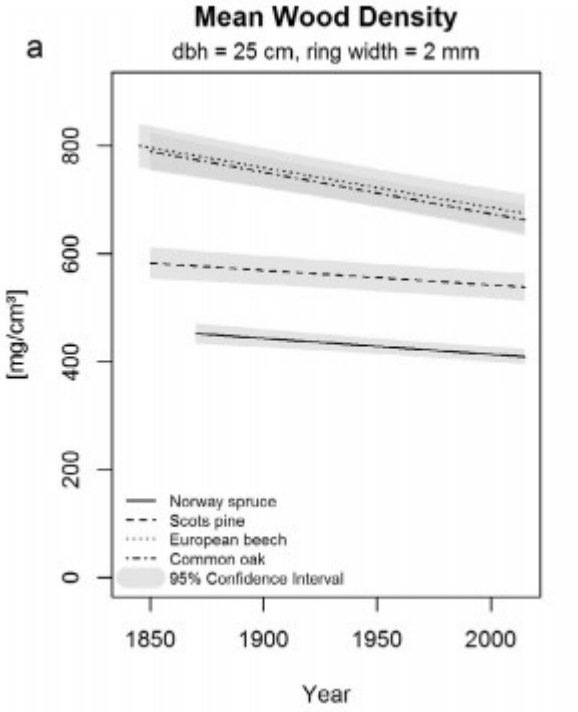
Courses of the MAI in m^3 ha^{-1} $year^{-1}$ on long-term experimental plots in Europe since 1860

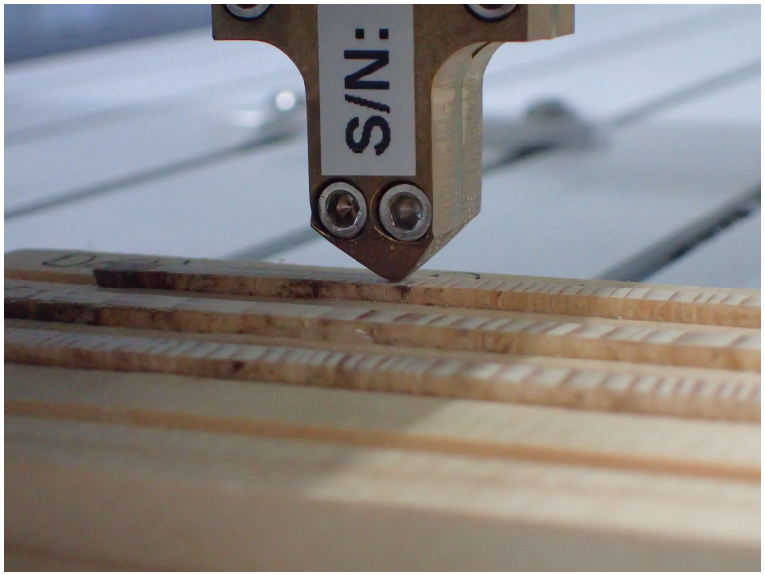


Growth reconstruction via stem analyses



Increment cores for analyses of growth and wood density





LIGNOSTATION, high frequency 10 MHZ wood densitometry

model: wood density = f (tree size, ring width, calender year…)

Pretzsch et al. (2018)

Silver fir in pure and mixed-species stands – growth trends, mixing effects and silvicultural potential

1 Growth trends of silver fir

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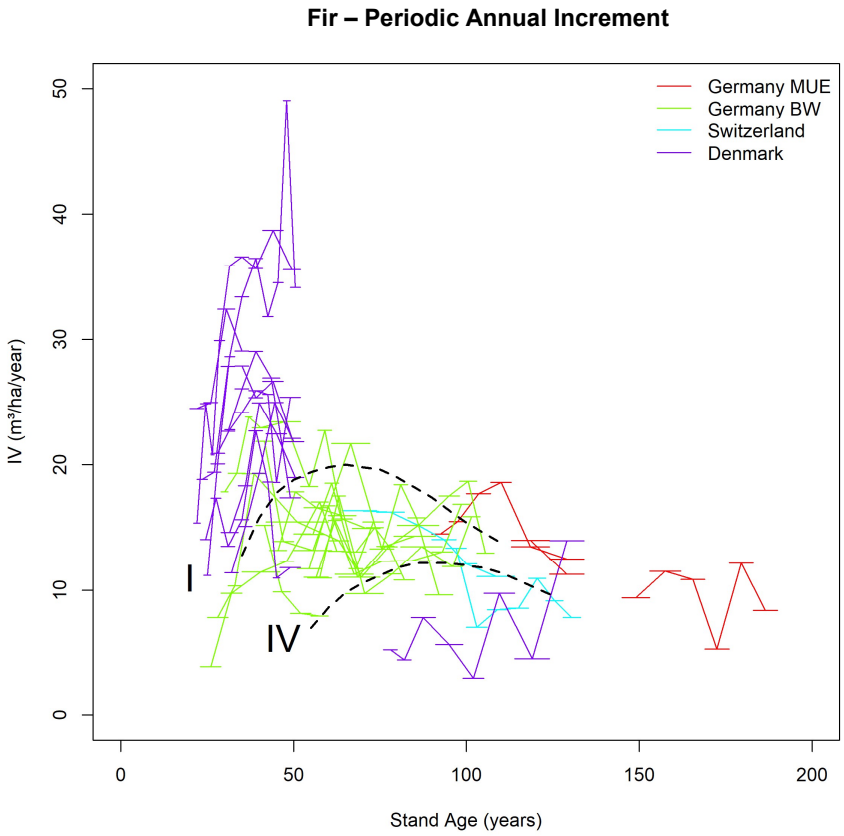
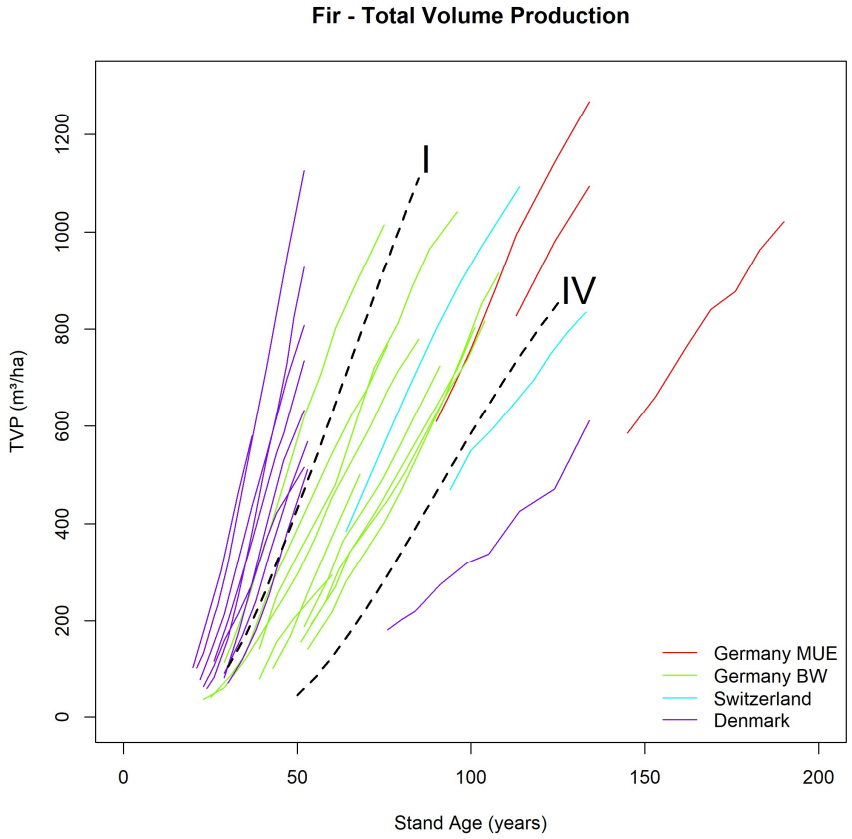
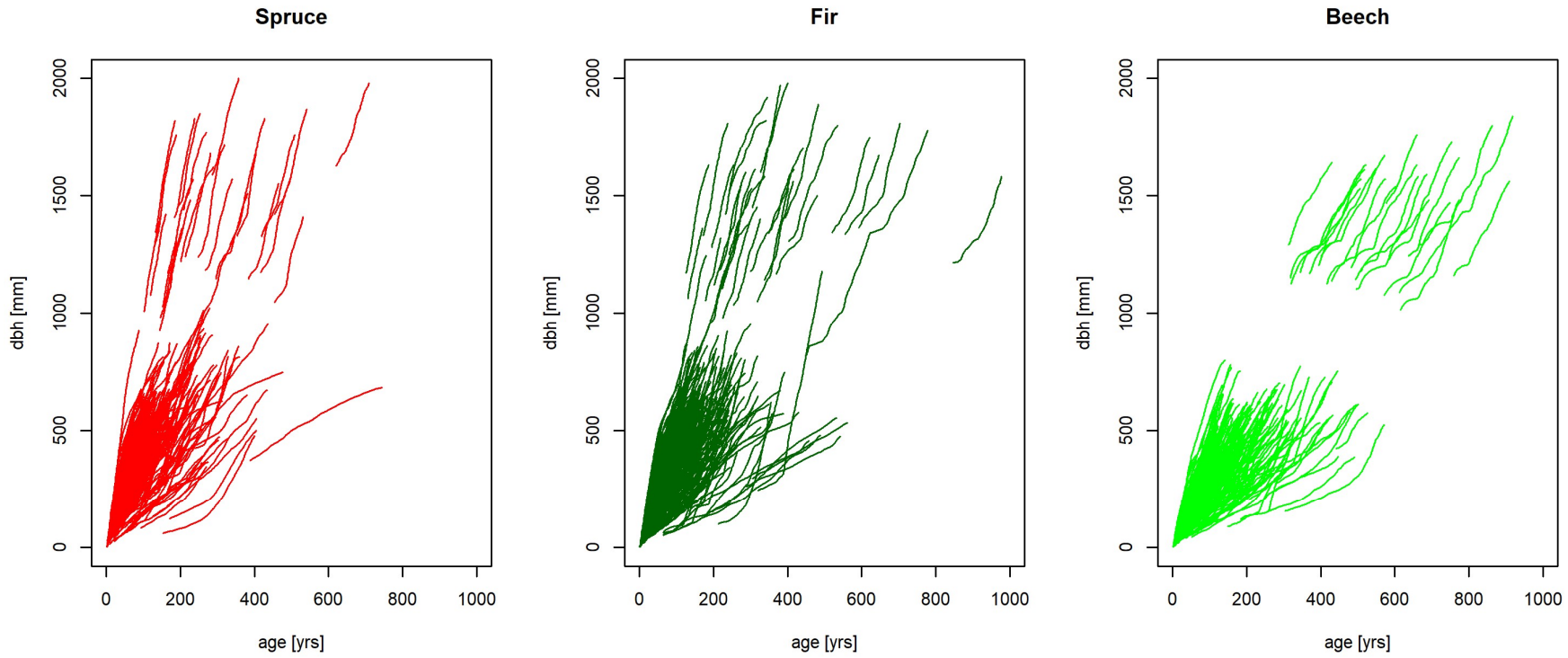
3 Role of silver fir in conversion of mono-specific to mixed stands – perspectives

Stand growth accelerated, persistent into higher stand ages and often exceeding yield tables

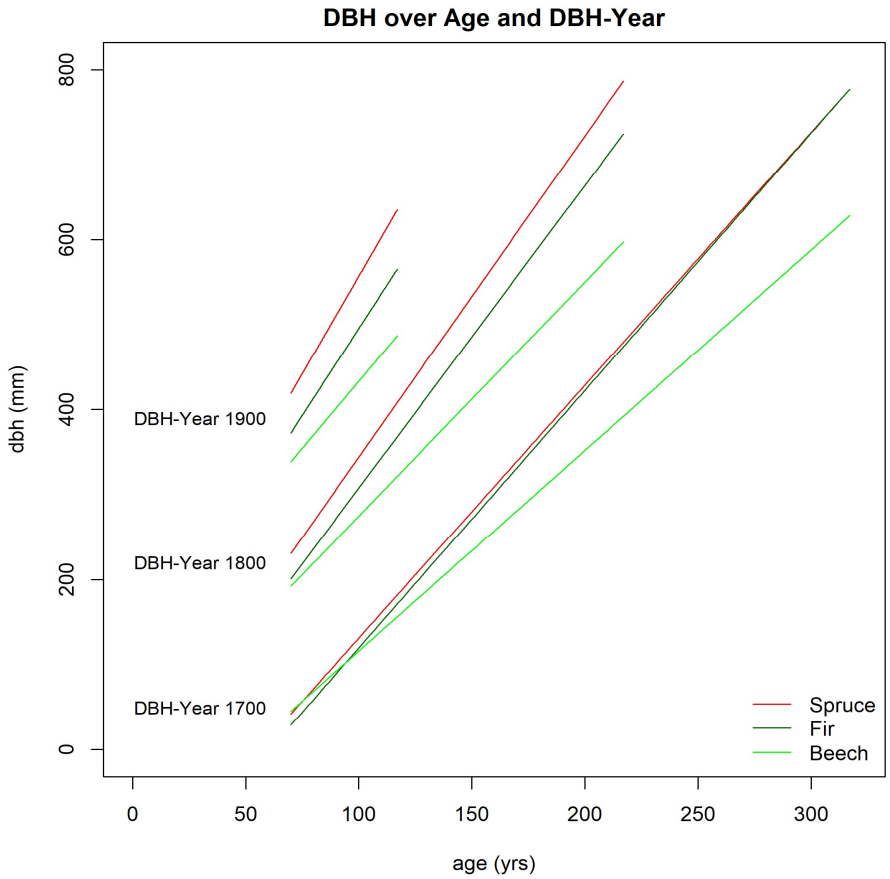




Over-proportional upwards trend of silver fir well into higher ages in European mountain forests

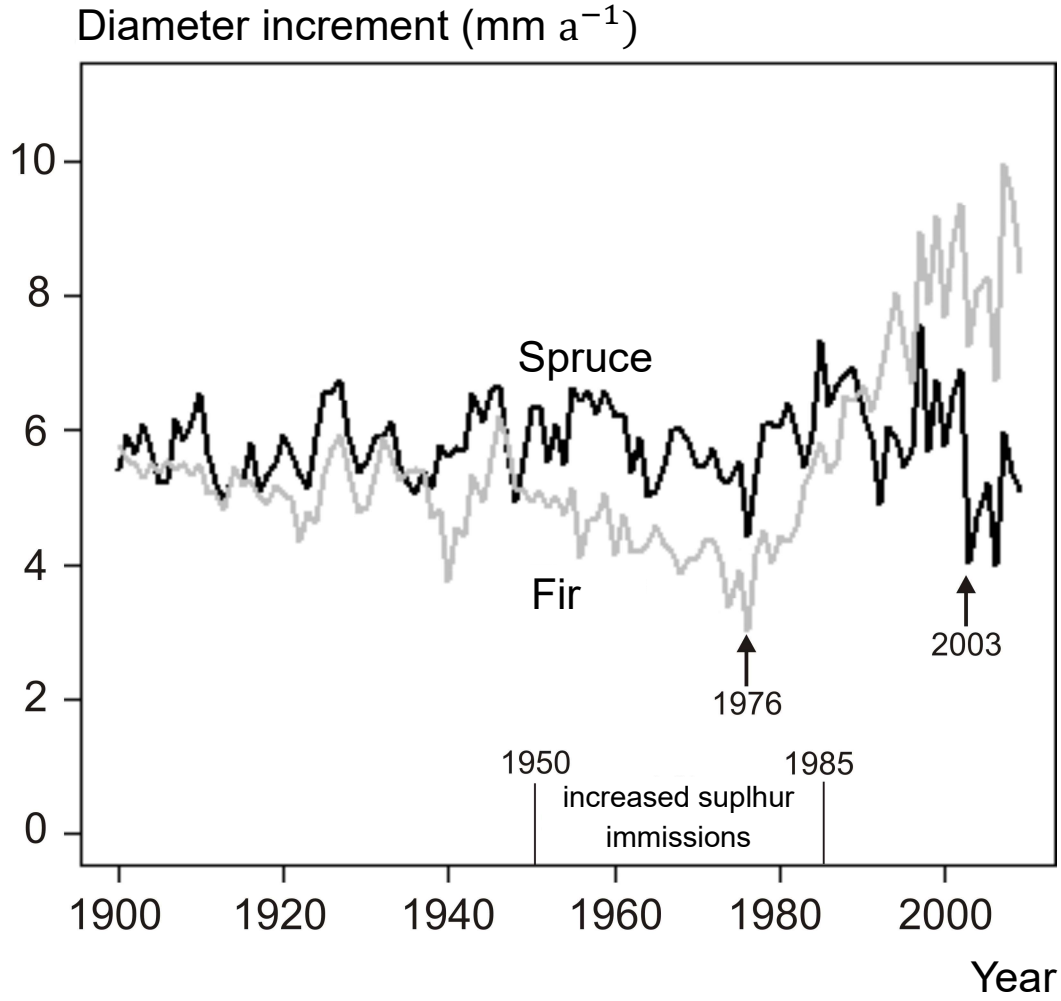


Tree growth in mountain forests in Europe – silver fir strongly increasing with calendar and age

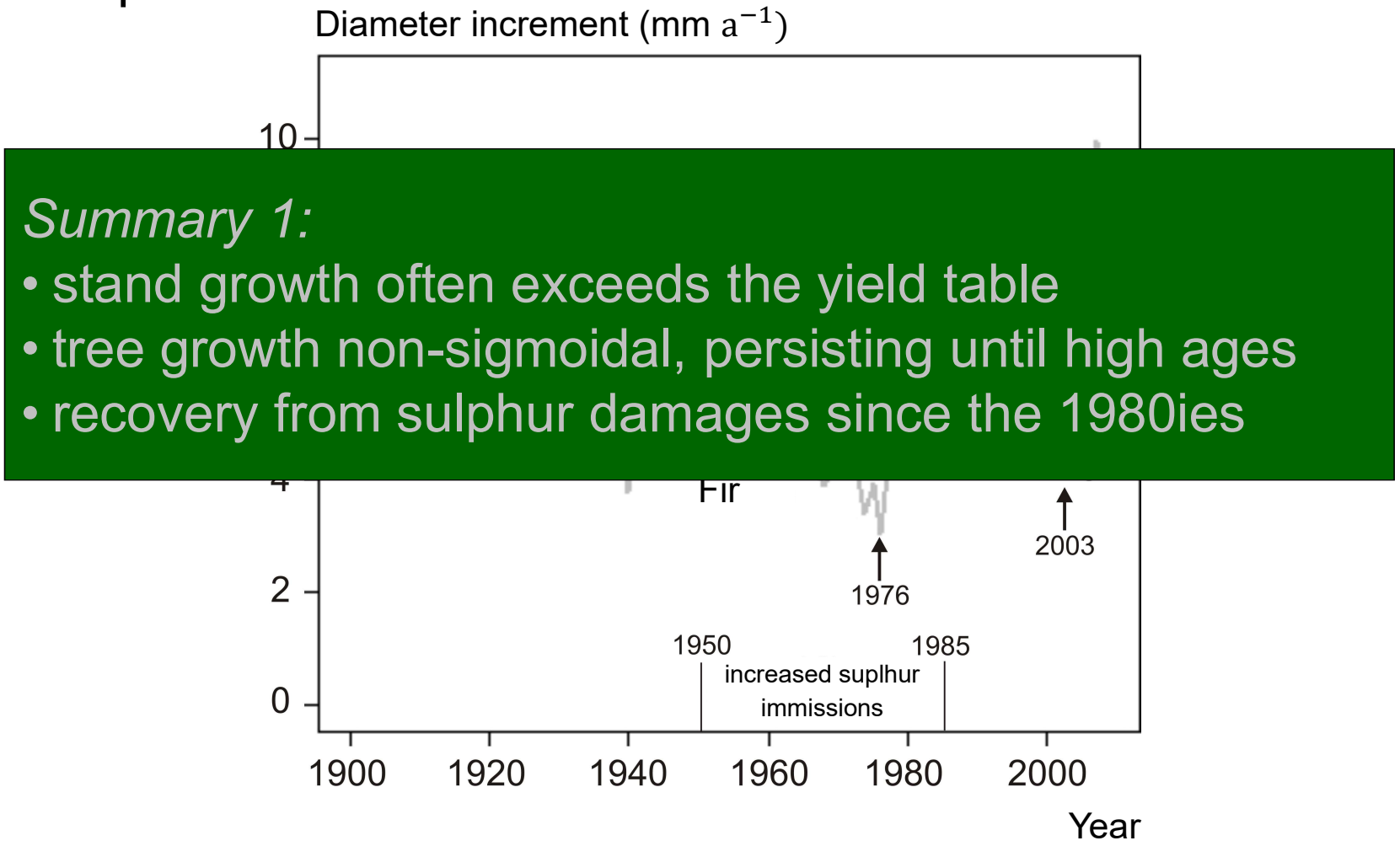


- Increasing rate over calender year
- Often over-proportional growth, even in ages > 200 years

Recovery of silver fir after 1980ies in the low mountain ranges in Europe



Recovery of silver fir after 1980ies in the low mountain ranges in Europe



Summary 1:

- stand growth often exceeds the yield table
- tree growth non-sigmoidal, persisting until high ages
- recovery from sulphur damages since the 1980ies

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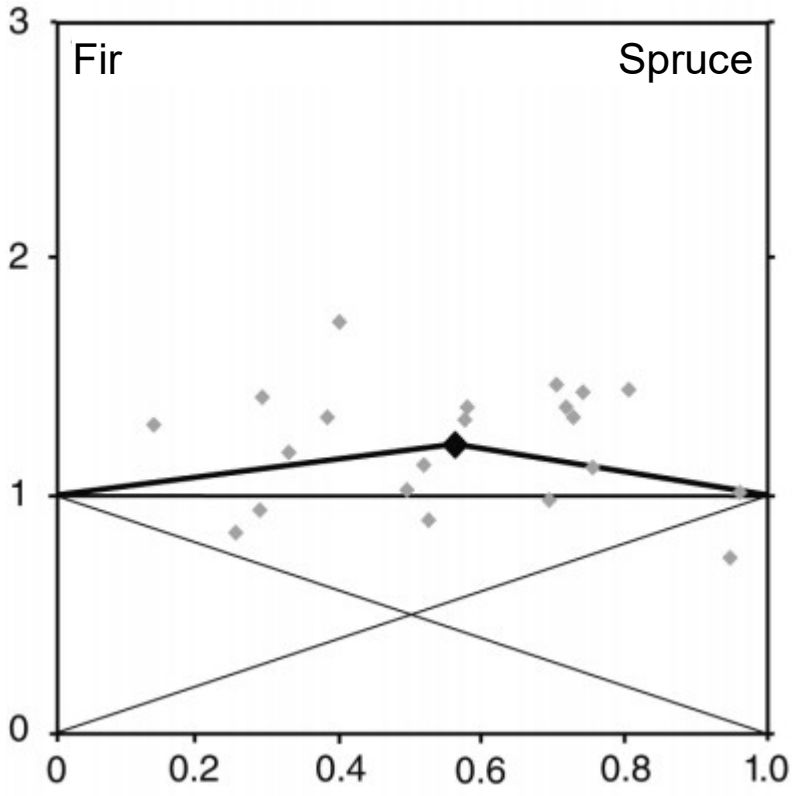
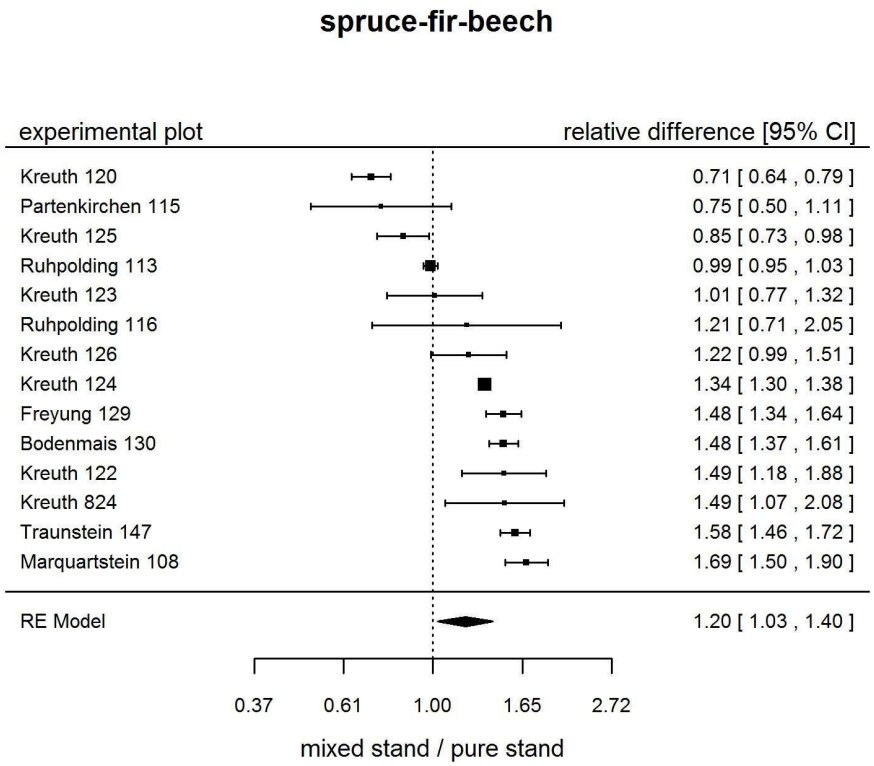
Mean overyielding in mixtures of silver fir and Norway spruce of 16 (±6) %



Pretzsch et al. (2013)

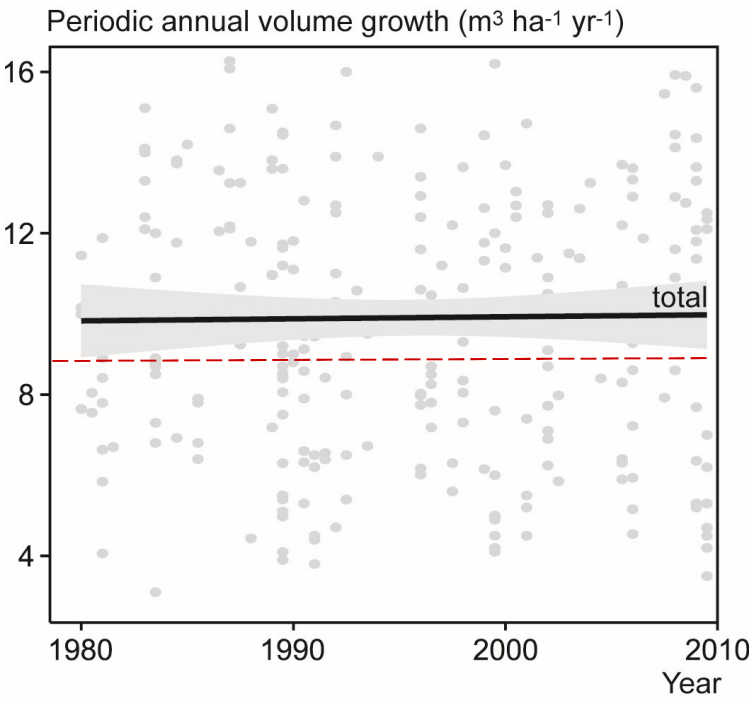
Jensen (1983)

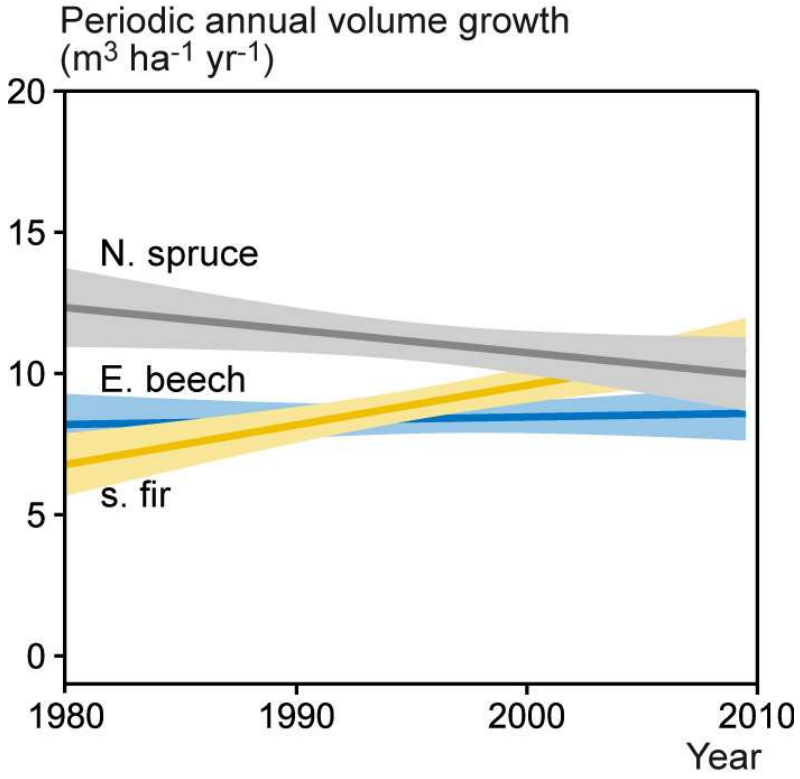
Meta-analysis on overyielding of mixed stands of Norway spruce, European beech, silver fir in Europe (long-term exp.)



Pretzsch et al. (2017)

Growth stability of the n=105 CLIMO study 1 spruce-fir-beech stands



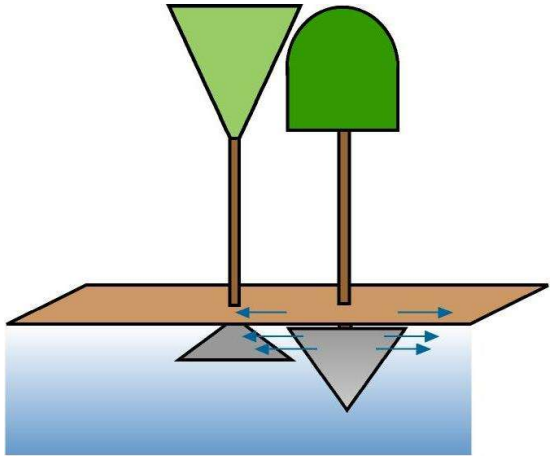


yield table + 20 %

Hilmers et al. (in press)

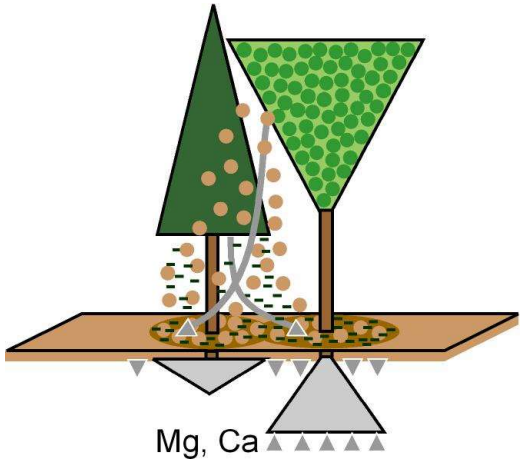
Explanations for positive mixing effects in mixed Norway spruce - silver fir stands

hydraulic redistribution



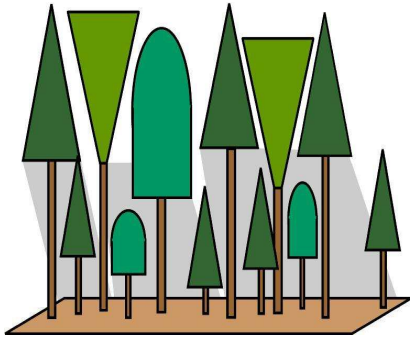
e.g. Prieto et al. (2012)

nutrients upward transport



e.g. Rothe and Binkley (2001)

complementary light ecology



e.g. Forrester et al. 2007a,b

Explanations for positive mixing effects in mixed Norway spruce - silver fir stands

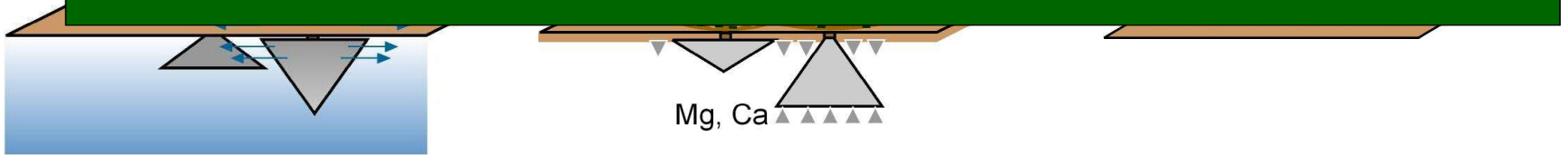
hydraulic redistribution

nutrients upward transport

complementary light ecology

Summary 2:

- overyielding by 10-20 % in mixed species stands
- higher stability of growth in mixture, risk distribution
- complementary light ecology and rooting depth



e.g. Prieto et al. (2012)

e.g. Rothe and Binkley (2001)

e.g. Forrester et al. 2007a,b

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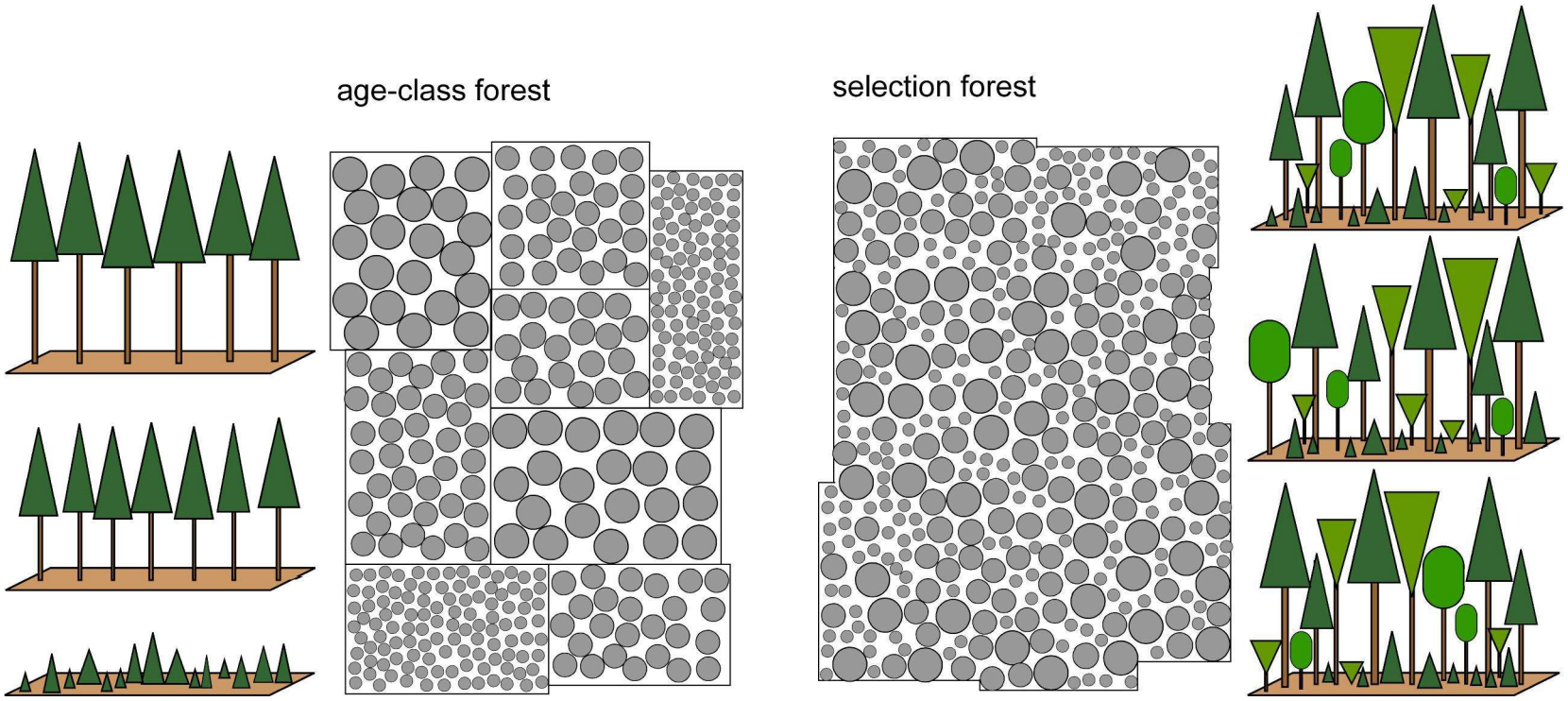
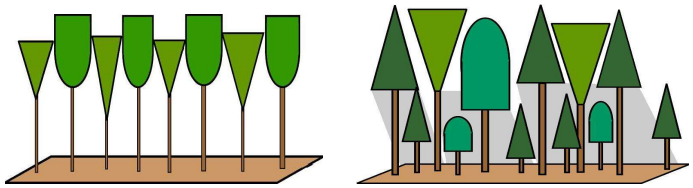
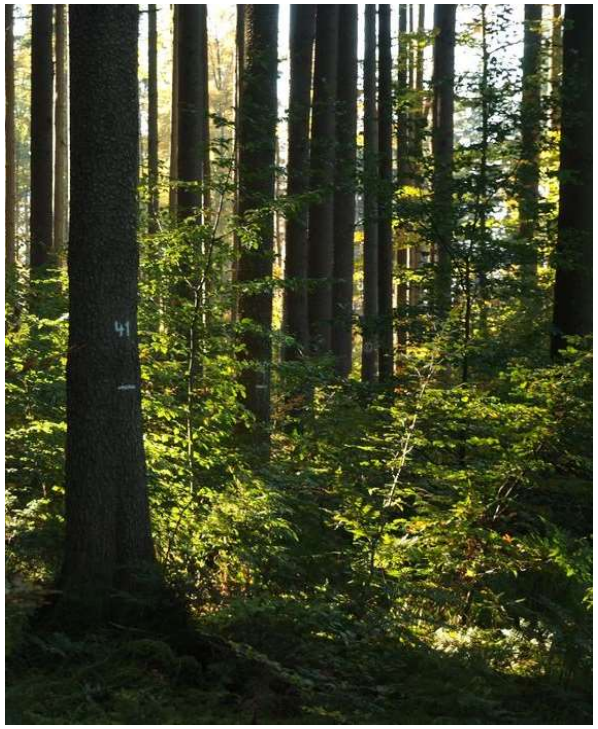
The objective: From even-aged mono-cultures to uneven-aged mixed-species stands, e.g. selection forest

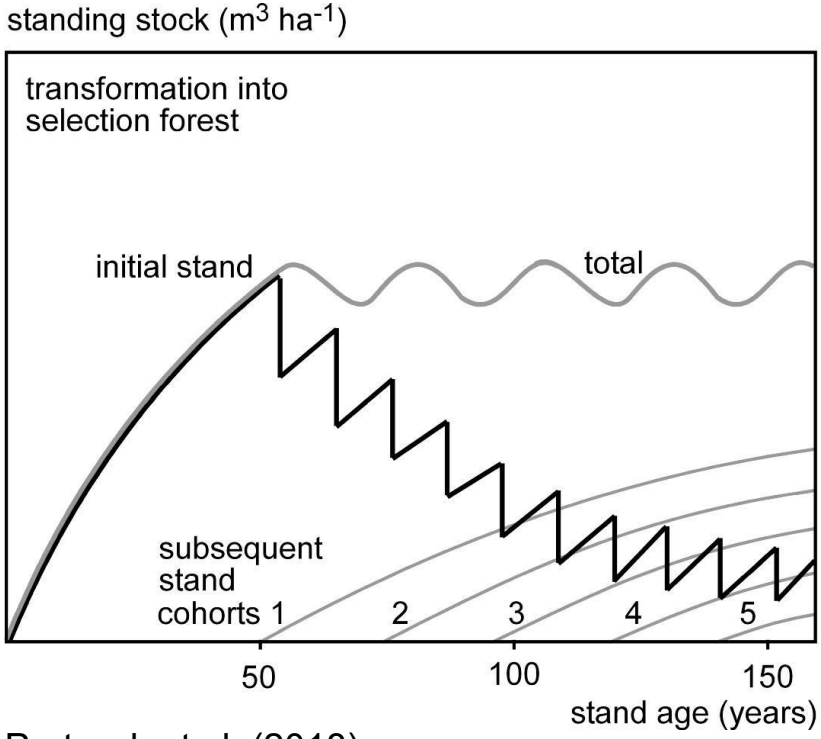


Shade tolerance, advanced planting, under-planting



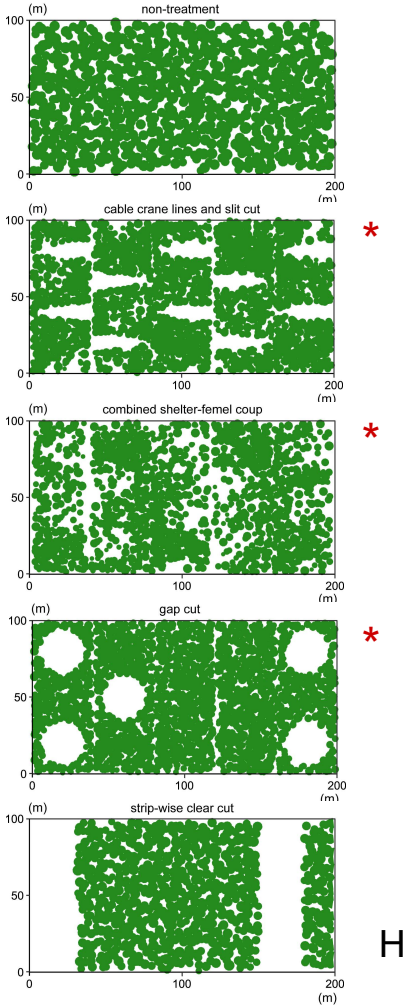
shade tolerance: E. beech > fir > N. spruce > oak > pine





Pretzsch et al. (2018)

Scenario analyses and guidelines for transformation of mountain monocultures to close-to-nature stands



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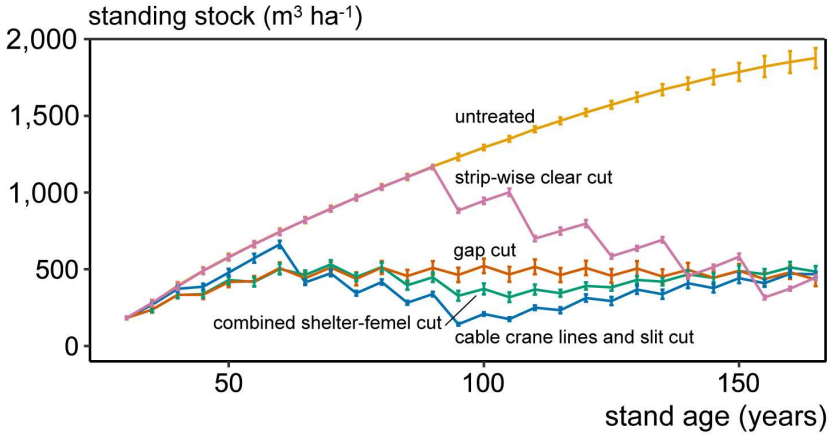

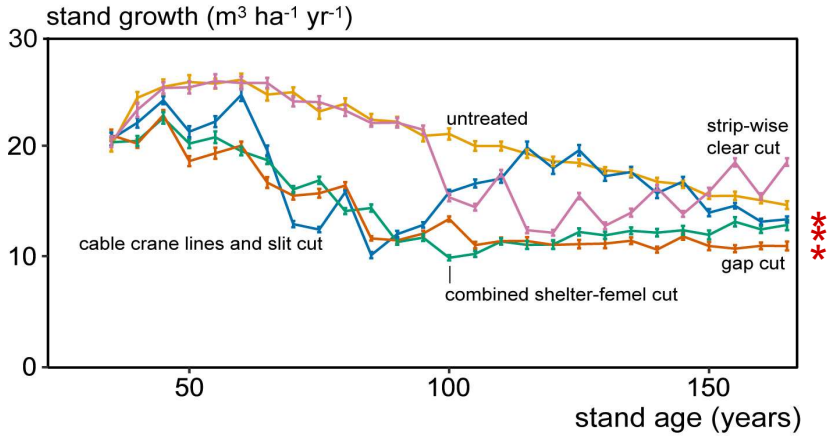

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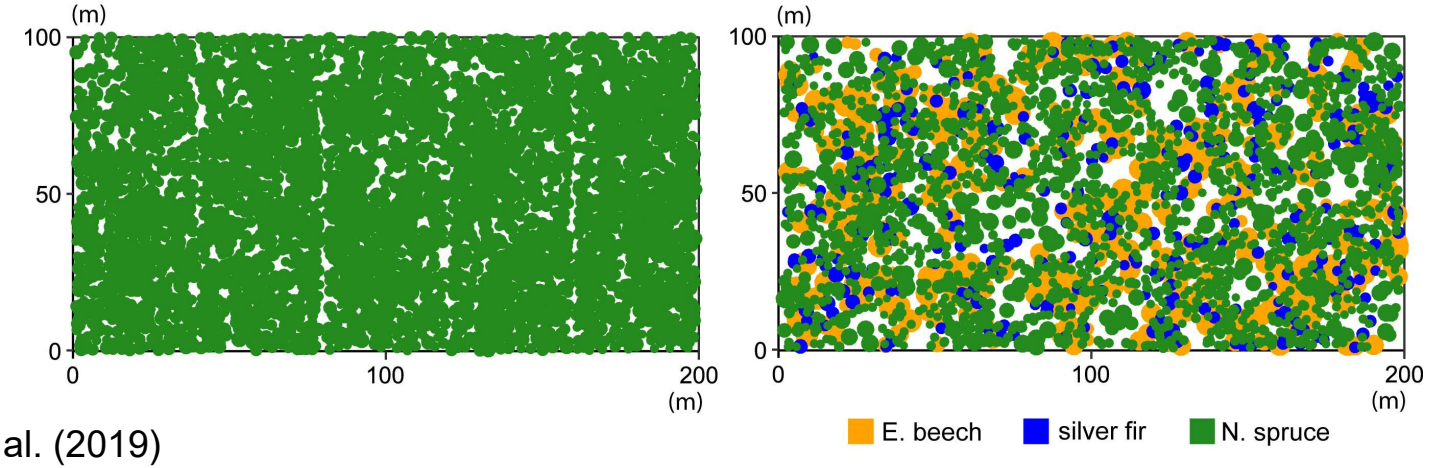
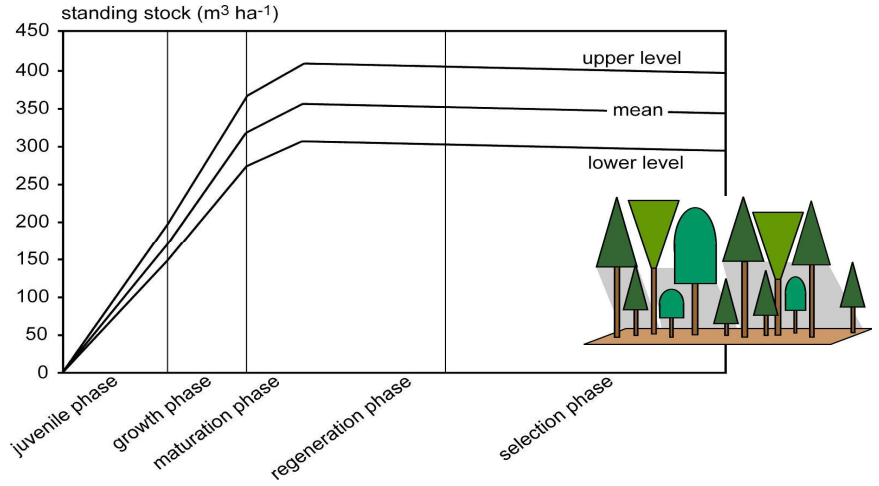
Hilmers et al. (2019)

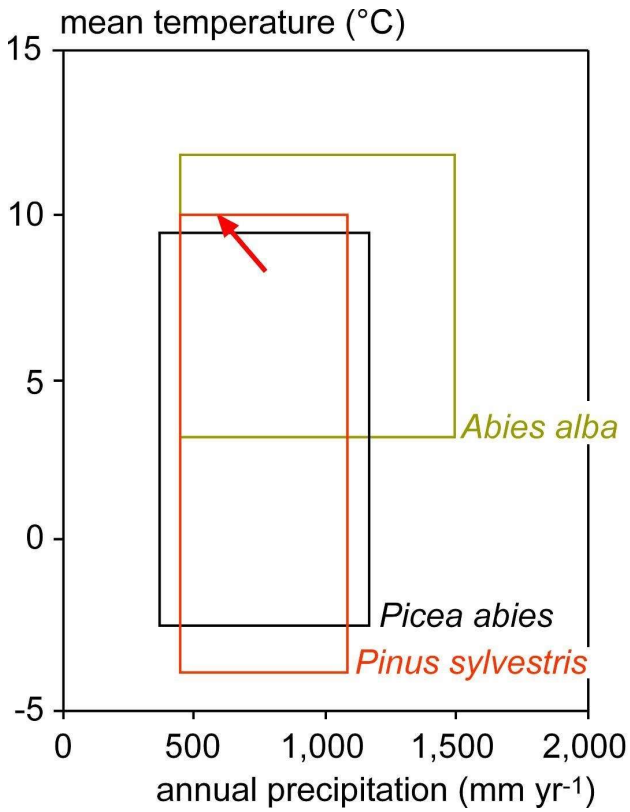
Scenario analyses and guidelines for transformation of mountain monocultures to close-to-nature stands

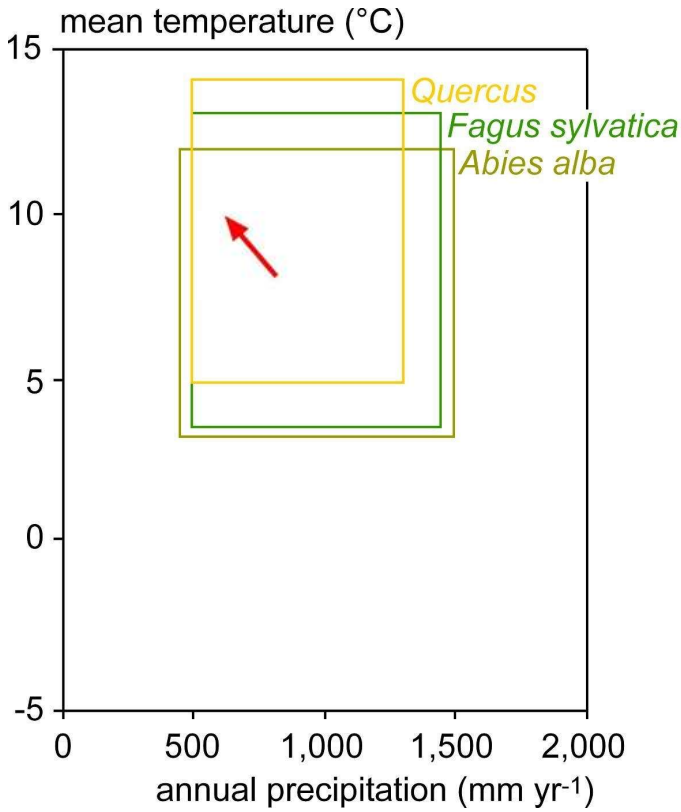


Hilmers et al. (2019)



Perspectives - climate envelope of silver fir compared with other conifers and broad-leaved trees





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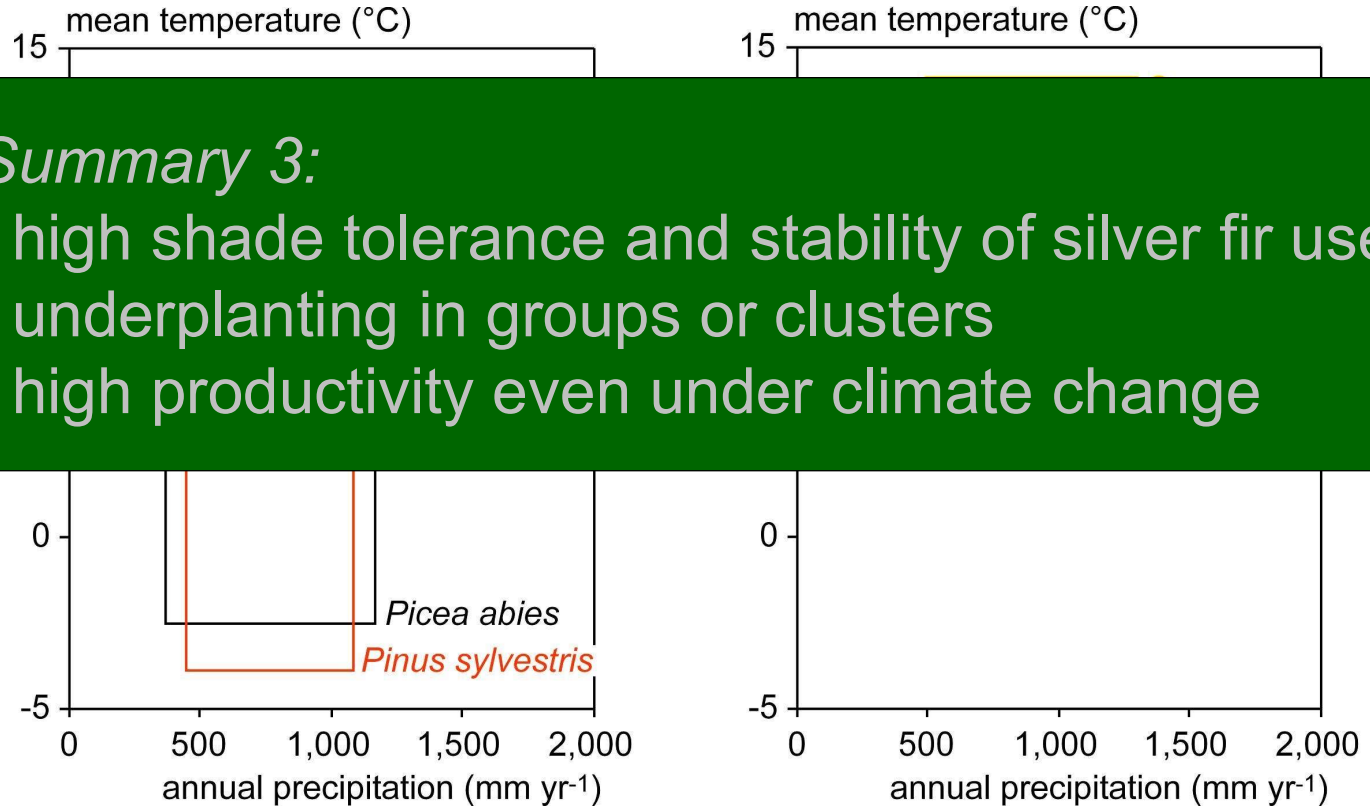

Summary 3:

- high shade tolerance and stability of silver fir useful
- underplanting in groups or clusters
- high productivity even under climate change


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DFG
EU
StMELF, StMUV, BaySF
Thanks to the CLIMO partner institutions for providing data
http://waldwachstum.wzw.tum.de/index.php?id=presentations

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