Waldwachstum
Systemanalyse

TECHNISCHE UNIVERSITÄT MÜNCHEN

Forst growth and yield science at the Technische Universität München in Germany

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Technische Universität München

http://www.wwk.forst.wzw.tum.de/info/presentations/


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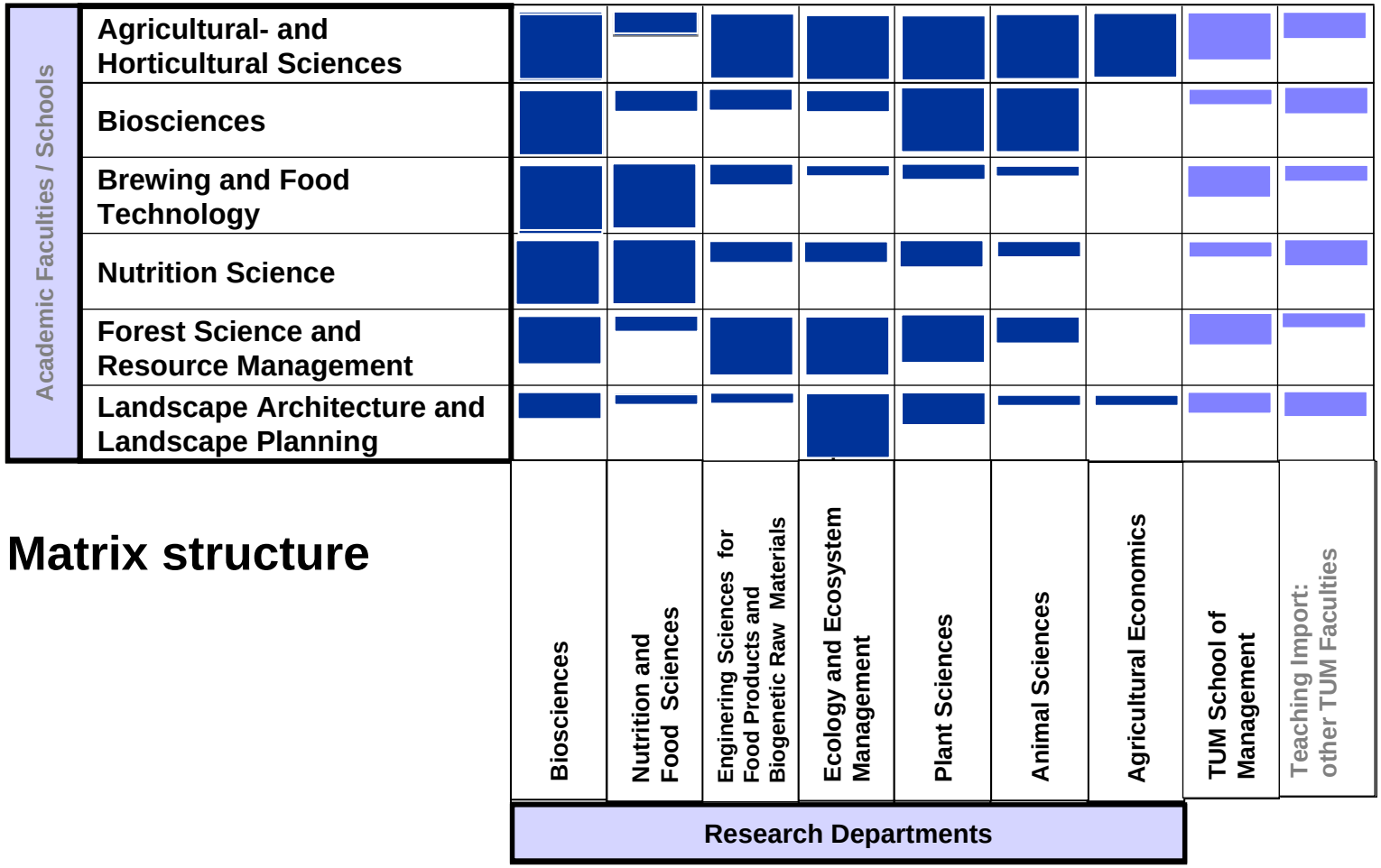
Center of Life and Food Science Weihenstephan



Matrix structure

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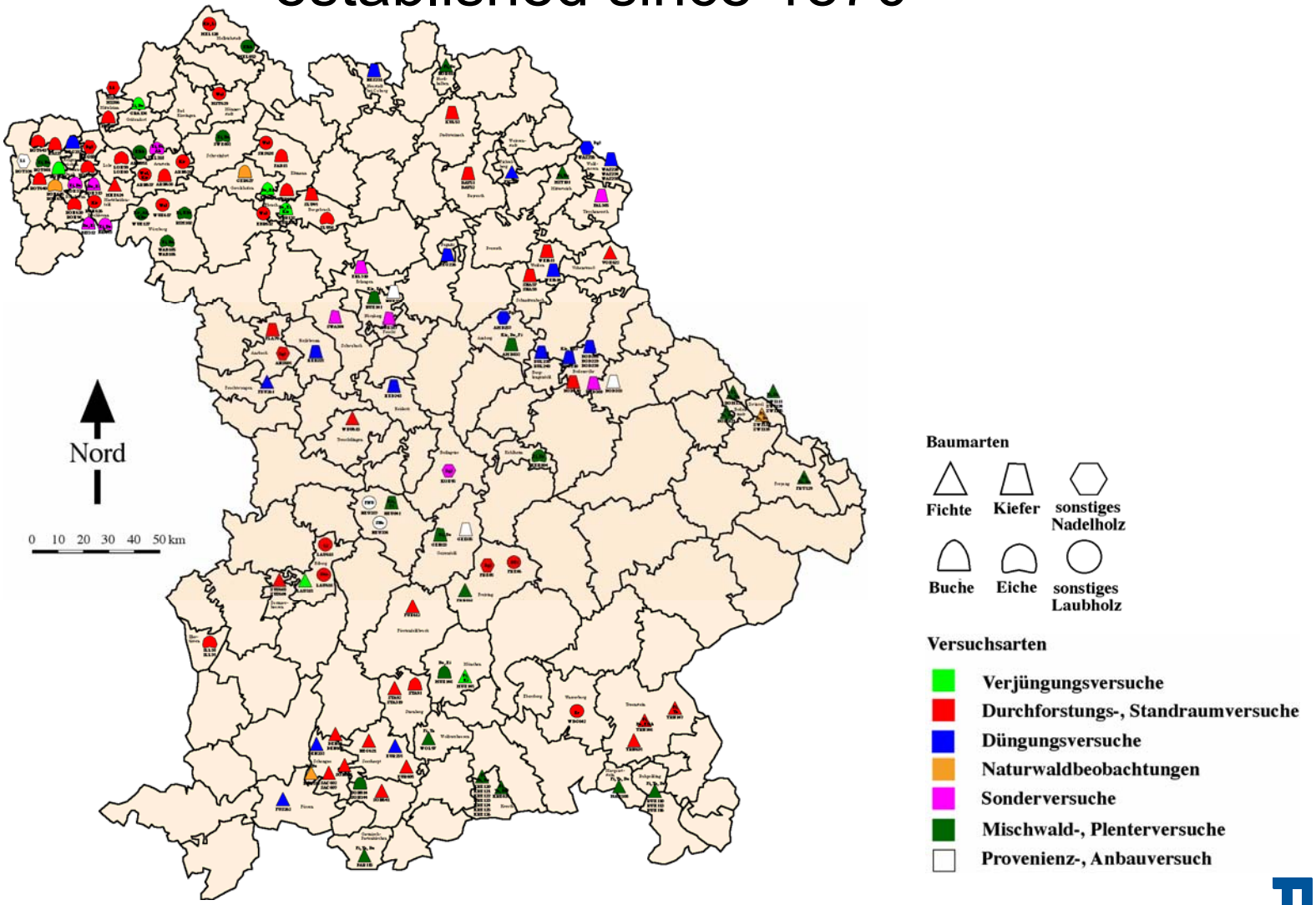
1 Growth trends caused by climate change

2 Productivity of mixed versus pure stands

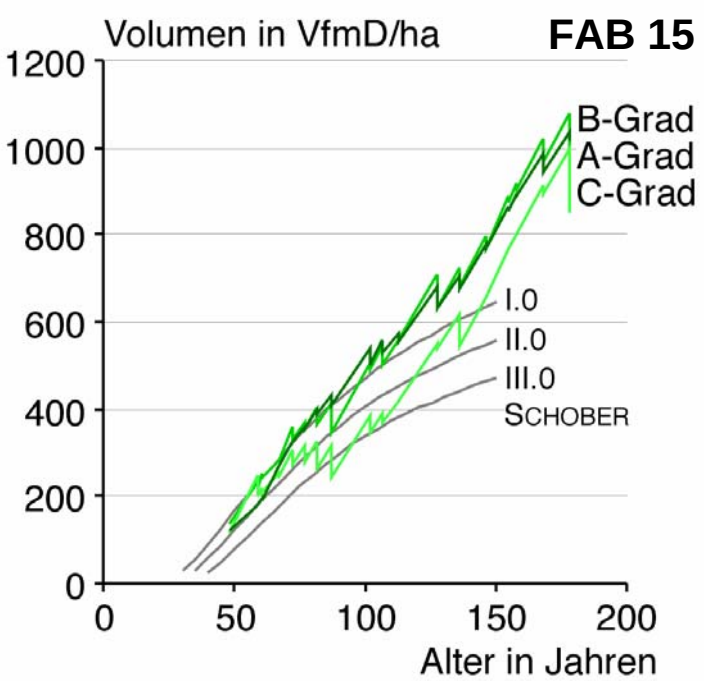
3 Modelling forest growth and yield

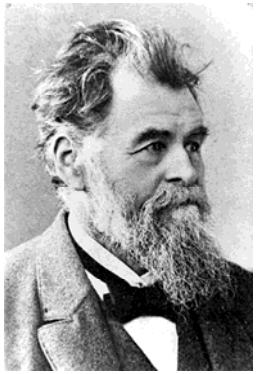
Perspectives

Long-term experimental plots in Bavaria established since 1870



Long-living organisms need long-term research





A. v. Ganghofer
*1827 †1900

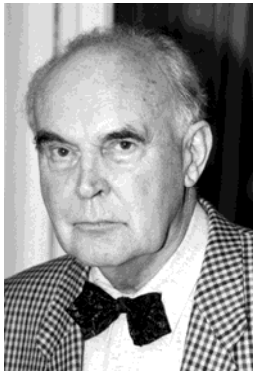
F. v. Baur
1878-1897

R. Weber
1897-1905

V. Schüpfer
1905-1937

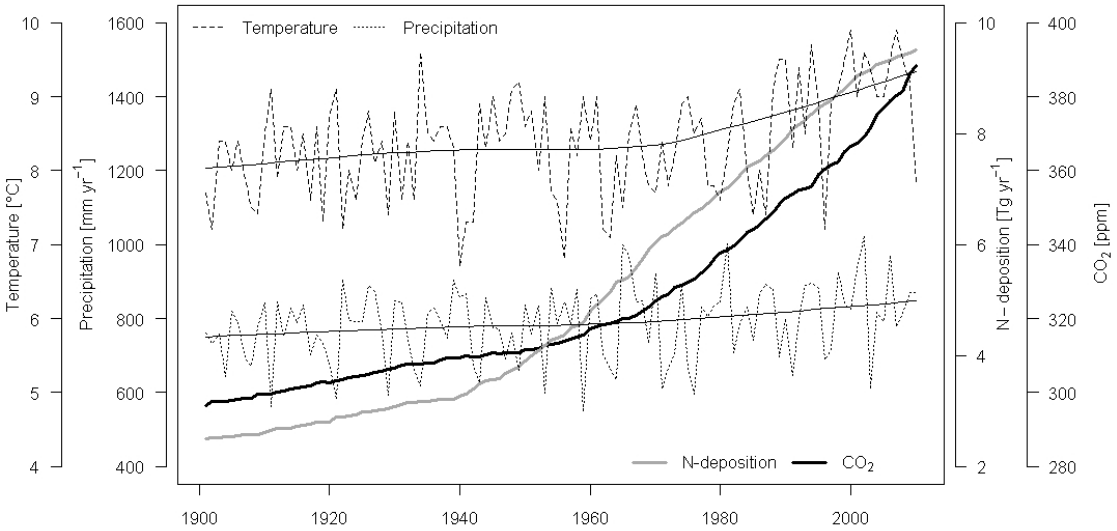
K. Vanselow
1937-1951

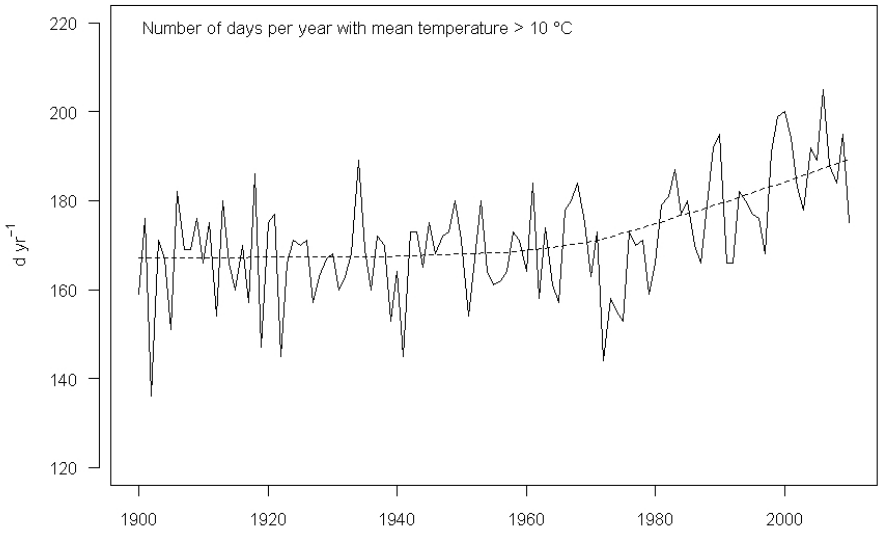
E. Assmann
1951-1972



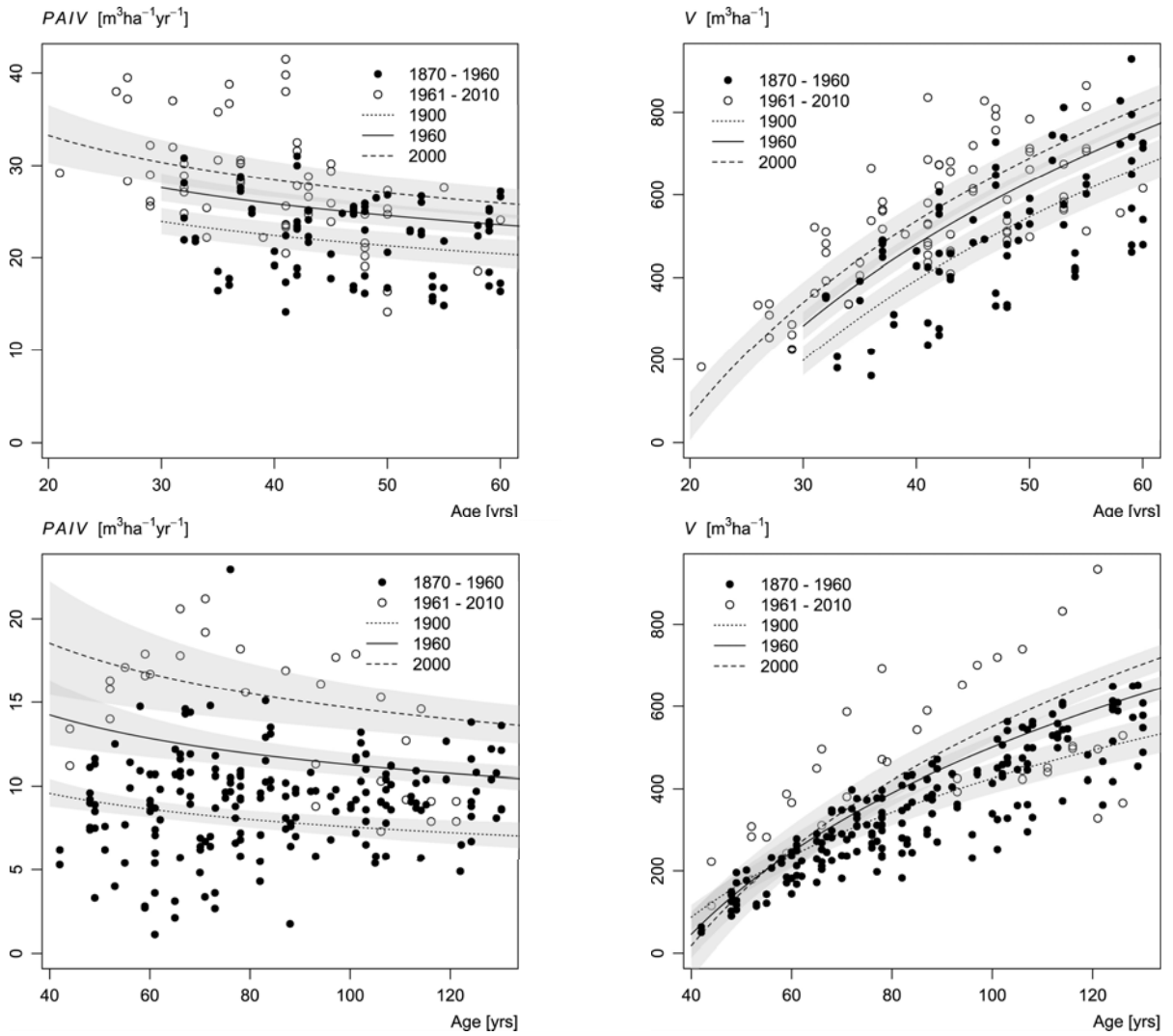
F. Franz
1972-1993

Recently published study: Main components of climate change in Europe



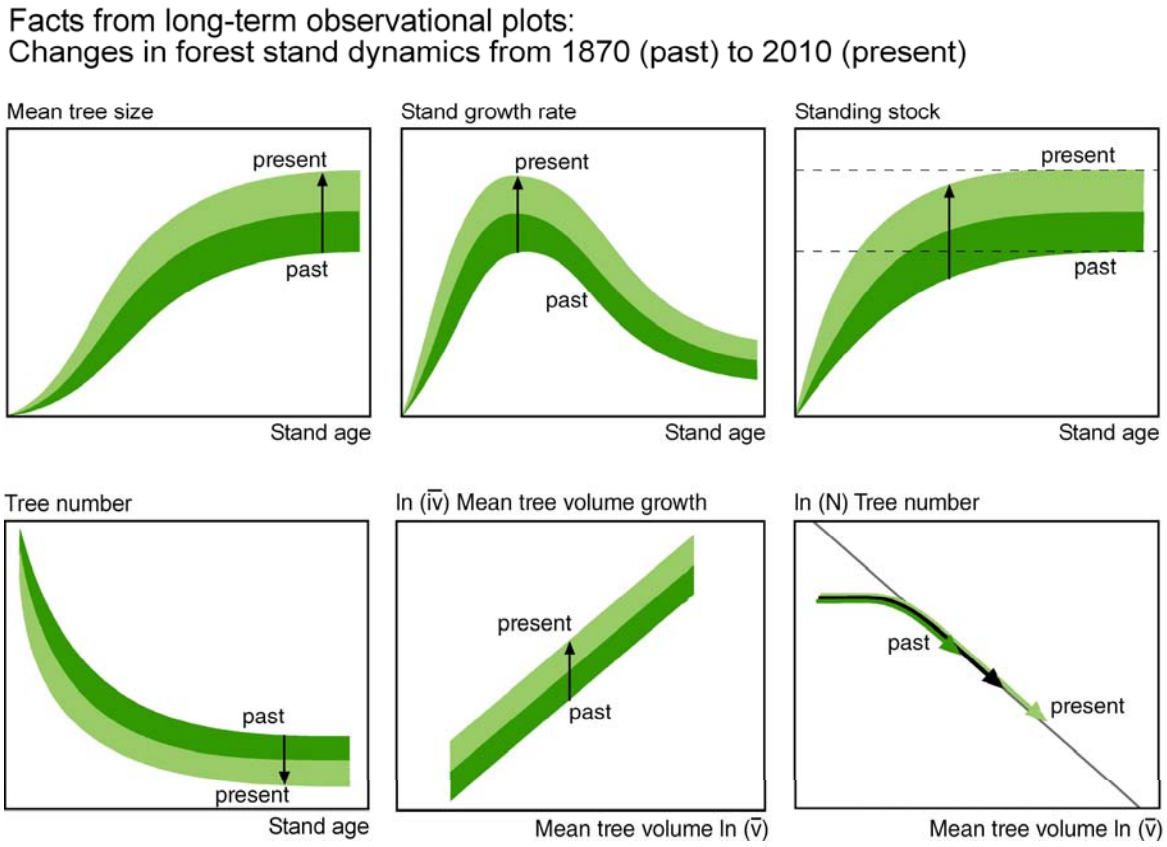


Growth trends of spruce (top) and beech (bottom)



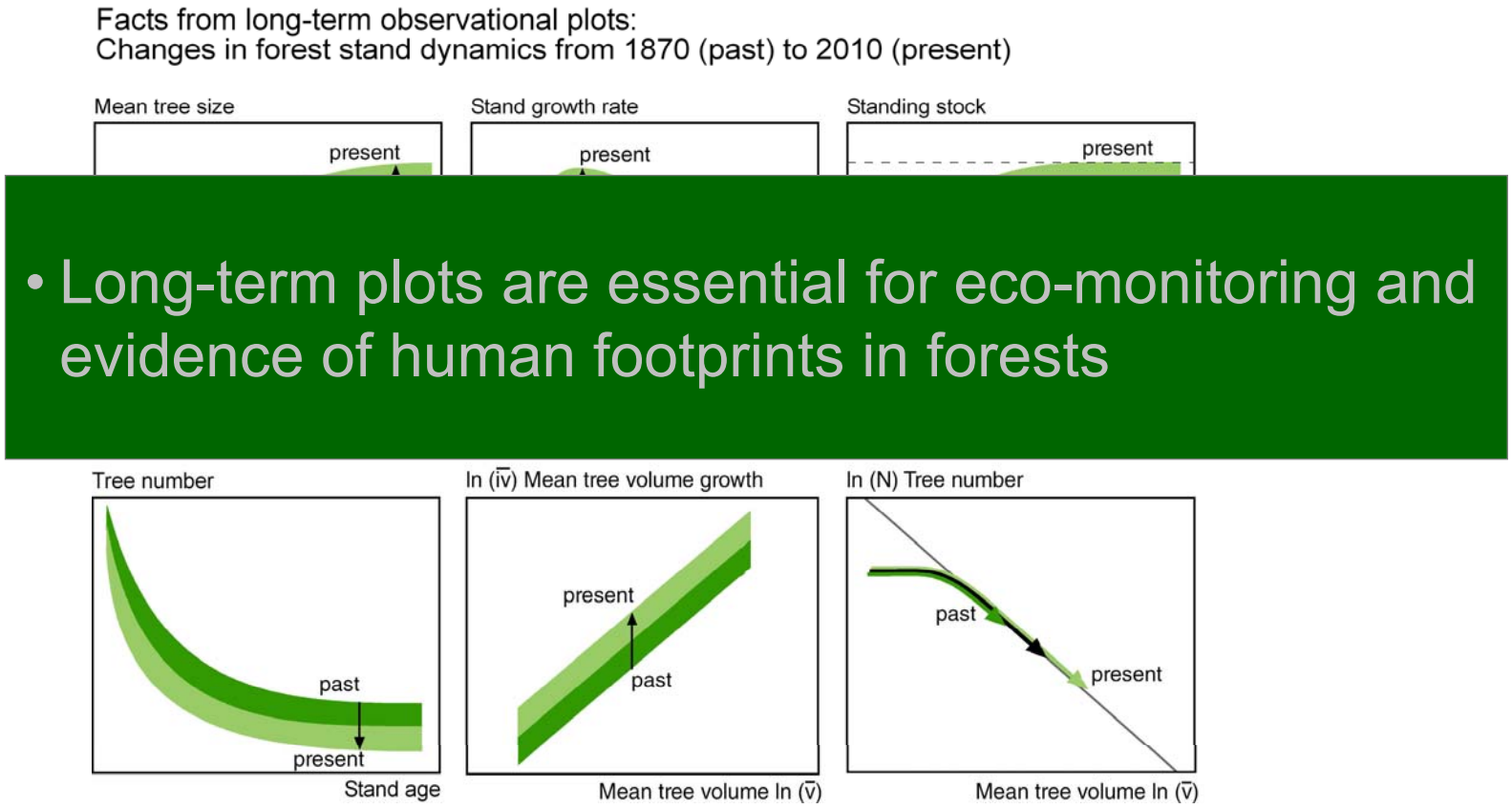
Pretzsch, H., Biber, P., Schütze, G., Uhl, E., Rötzer, Th., (2014) Forest stand growth dynamics in Central Europe have accelerated since 1870, Nat. Commun. 5:4967 doi:10.1038/ncomms5967

Effect of climate change on growth and yield at stand, tree, and organ level



Pretzsch, H., Biber, P., Schütze, G.,Bielak, K., 2014. Changes of forest stand dynamics in Europe. Forest Ecology and Management 316: 65-77

Effect of climate change on growth and yield at stand, tree, and organ level



Pretzsch, H., Biber, P., Schütze, G.,Bielak, K., 2014. Changes of forest stand dynamics in Europe. Forest Ecology and Management 316: 65-77

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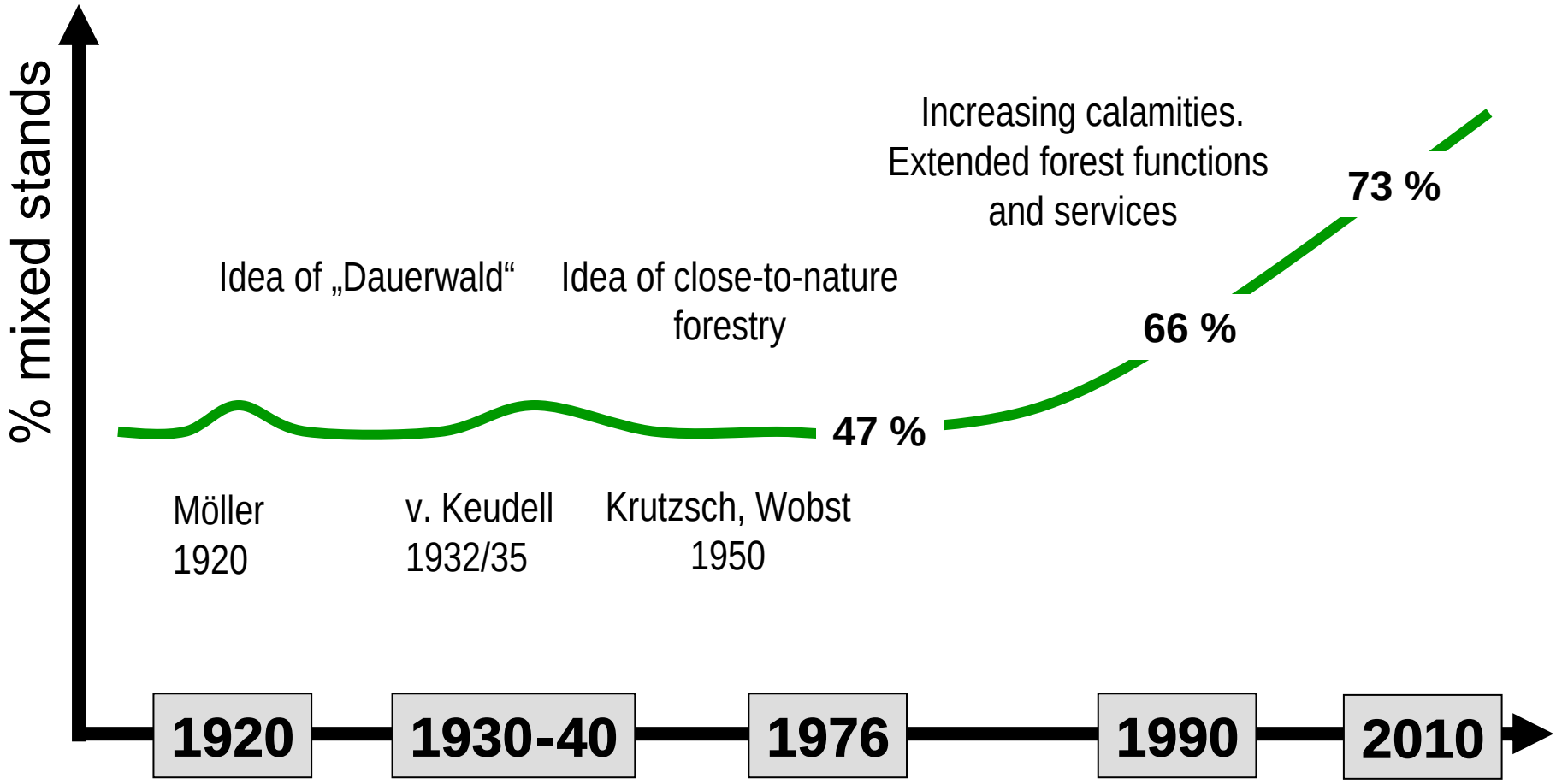
Perspectives

Back to complex mixed-species forests. From the idea to realization in Bavaria

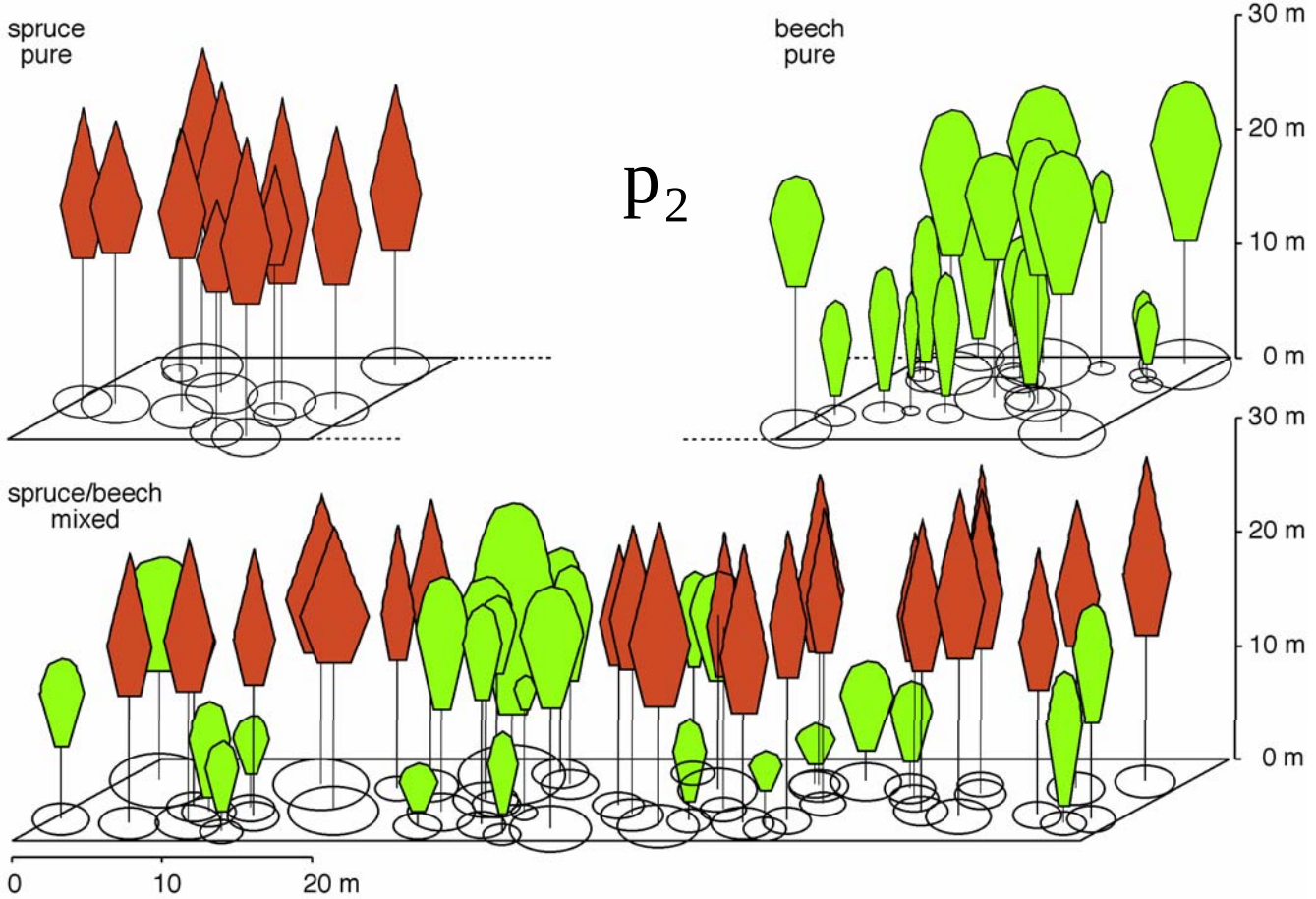


Mixing proportions (>10 % stand area) according to inventories GRI 1971, BWI I 1987, BWI 2 2002 in Bavaria

Experimental set-up and data base for analyzing crown allometry, tree efficiency, stand productivity

p_1

p_2



$p_{1,2}$

m_1

m_2

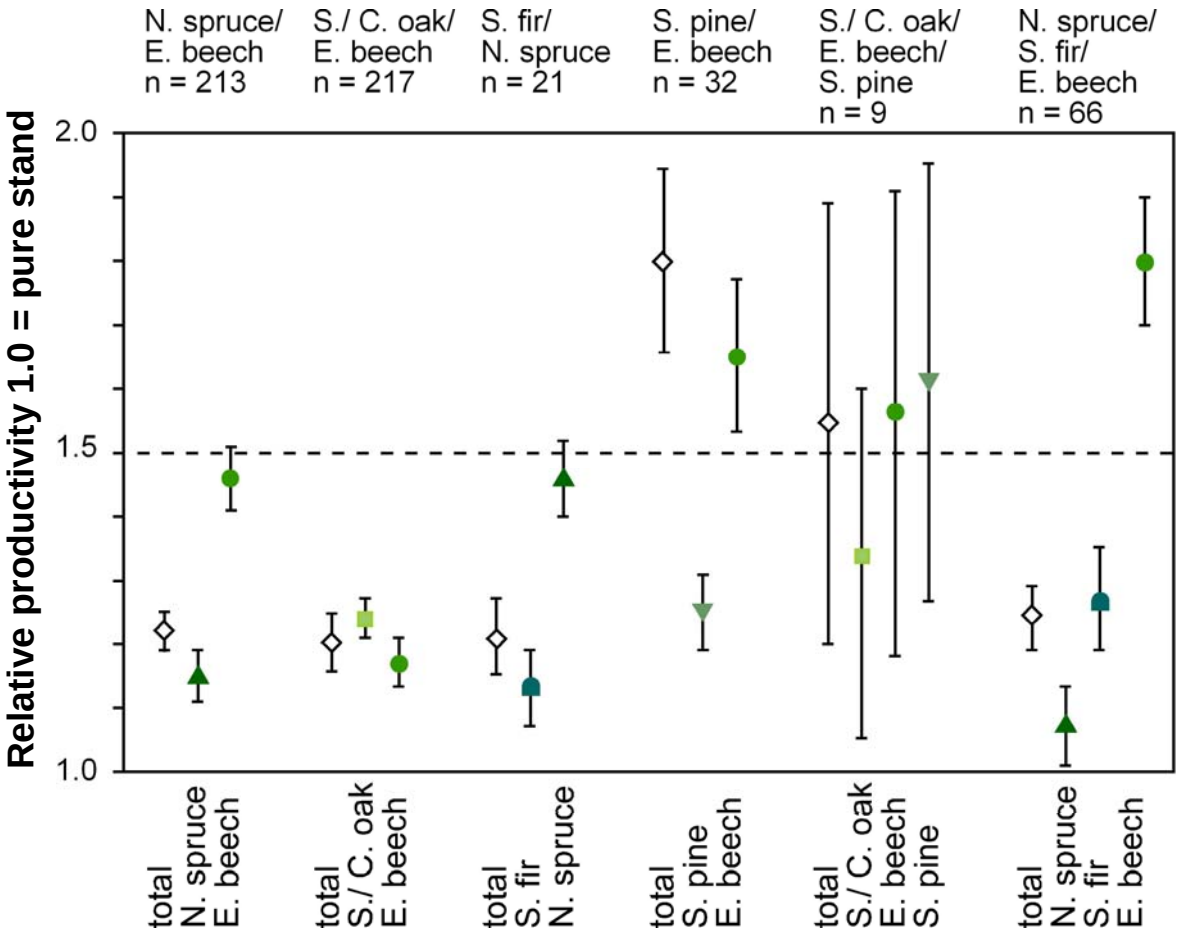
$pp_{1,(2)}$

$pp_{(1),2}$

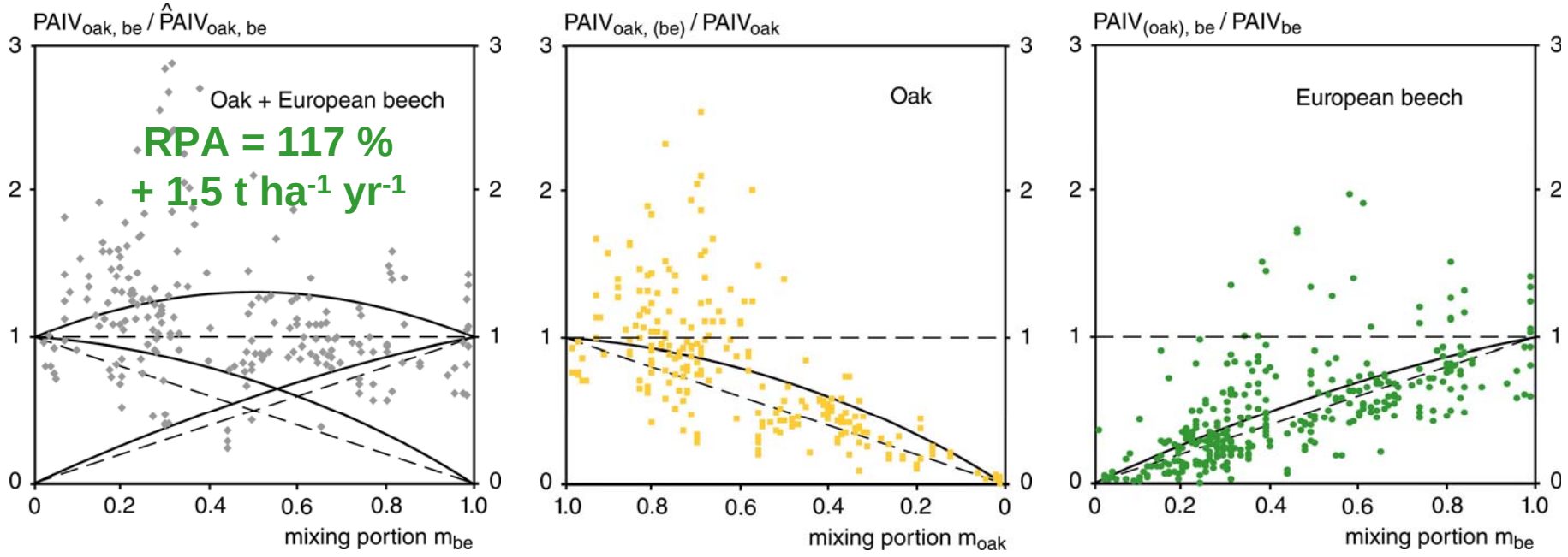
$$p_{1,2} = pp_{1,(2)} + pp_{(1),2}$$

see Kennel, 1965; Vandermeer, 1989; Forrester, 2013

Overyielding of mixed stands compared with pure stands of spruce, pine, fir beech, and, oak

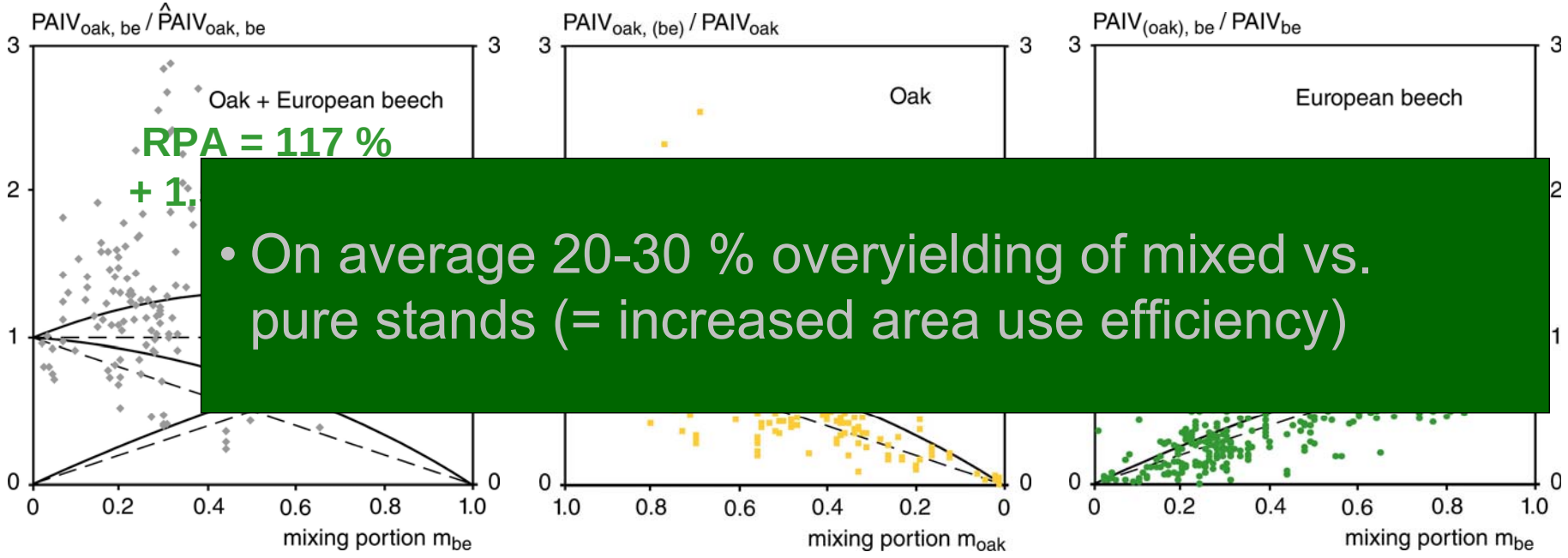


Relative productivity of mixed oak/ beech versus pure stands



Pretzsch et al. (2013) Productivity of mixed versus pure stands of oak and European beech
Eur J Forest Res, 132:263-280

Relative productivity of mixed oak/ beech versus pure stands



- On average 20-30 % overyielding of mixed vs. pure stands (= increased area use efficiency)

Pretzsch et al. (2013) Productivity of mixed versus pure stands of oak and European beech
Eur J Forest Res, 132:263-280

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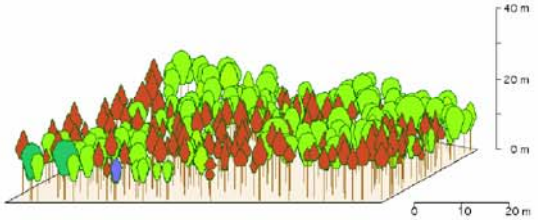
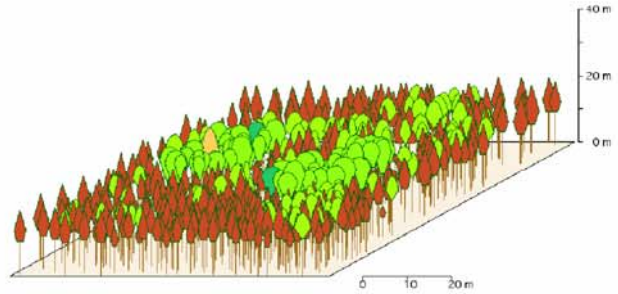
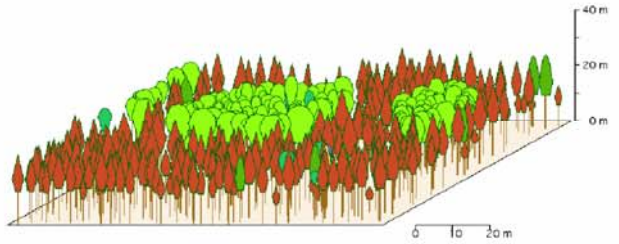
Age series Freising 813 in mixed stands of spruce and beech



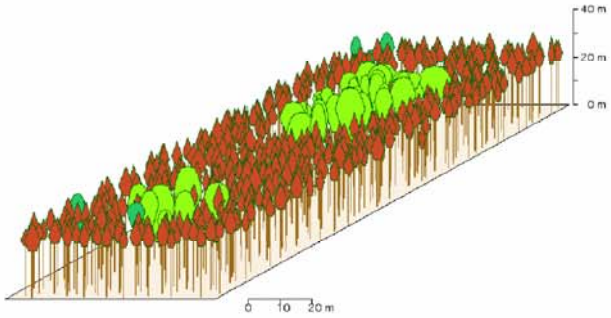
plot 6
spruce 37 a., beech 50 a.



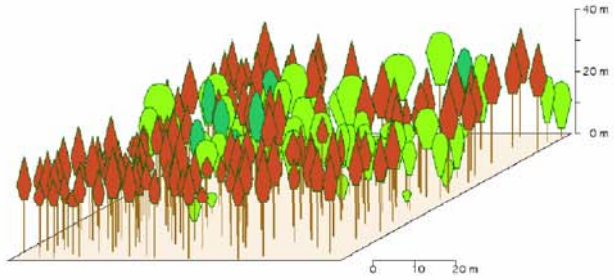
plot 5
spruce 47 a., beech 59 a.



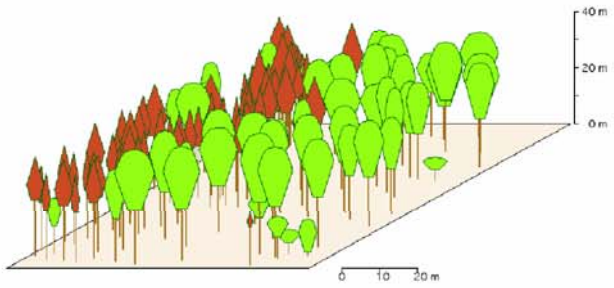
plot 1
spruce 49 a., beech 56 a.



plot 2
spruce 82 a., beech 102 a.

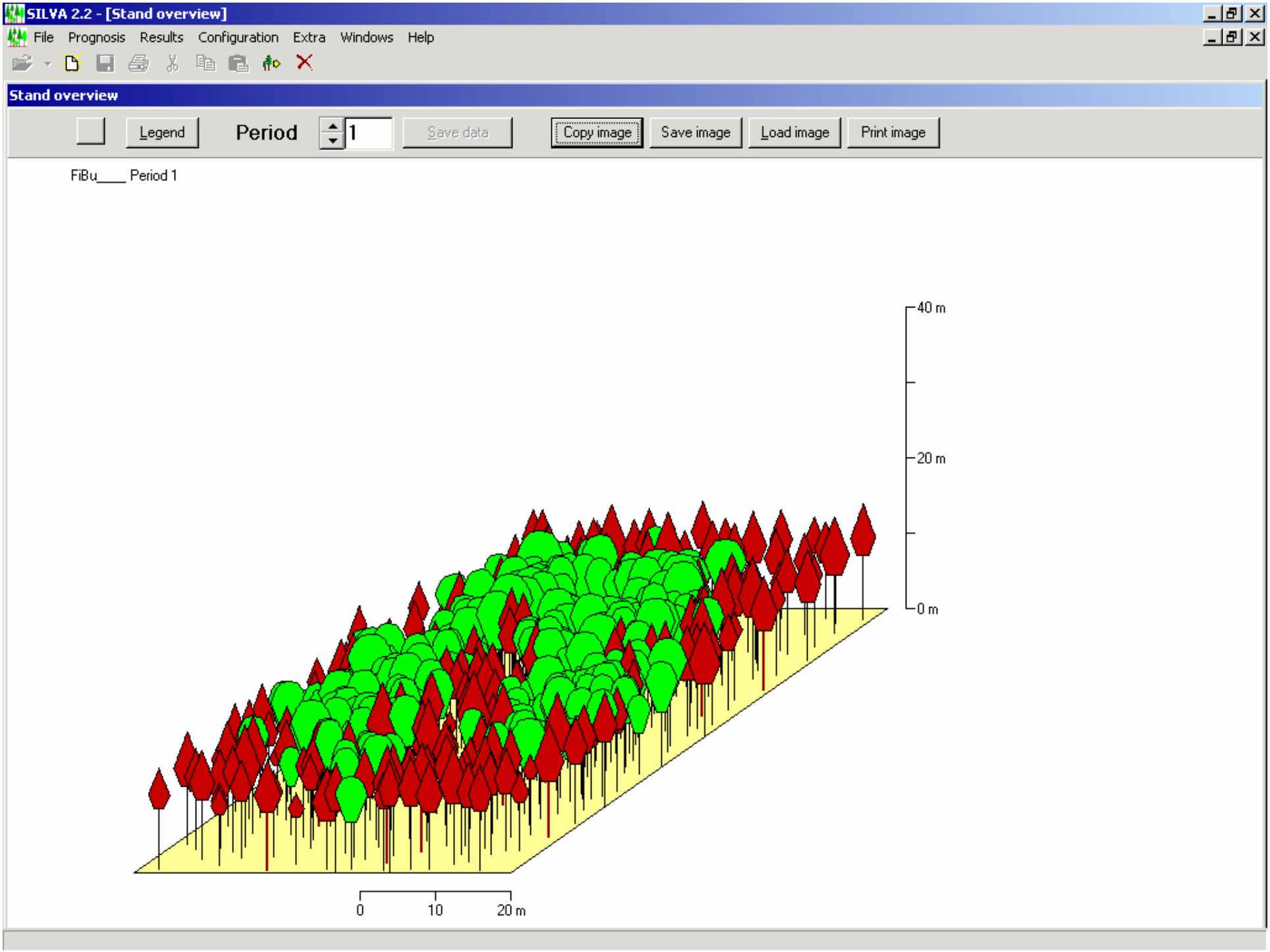


plot 4
spruce 93 a., beech 108 a.



plot 3
spruce 125 a., beech 155 a.

Pretzsch H, Biber P, Ďurský J (2002) The single tree based stand simulator SILVA, Construction, application and evaluation. Forest Eco Mngt 162: 3-21


SILVA 2.2 - [Stand overview]
File Prognosis Results Configuration Extra Windows Help
Stand overview
Legend
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FiBu____ Period 1
40 m
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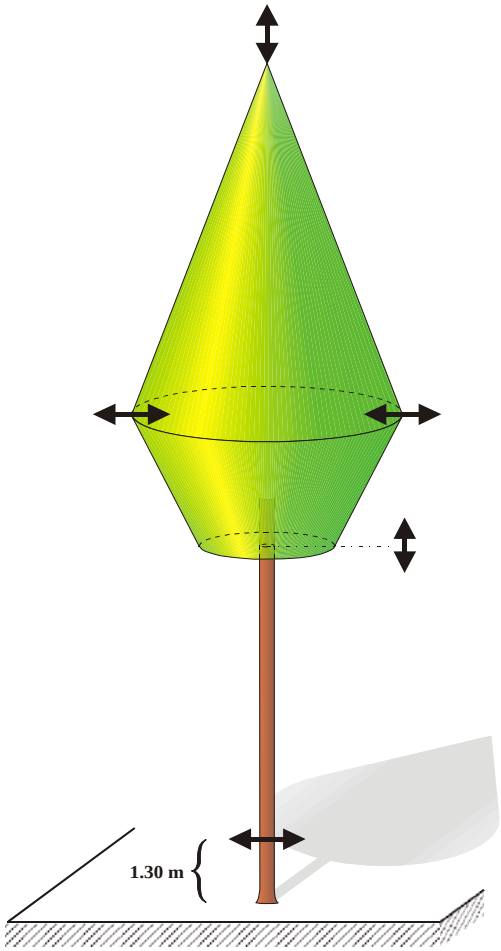
0 m
0
10
20 m

Functions for regulation of the individual tree growth in the SILVA 3.0 simulator

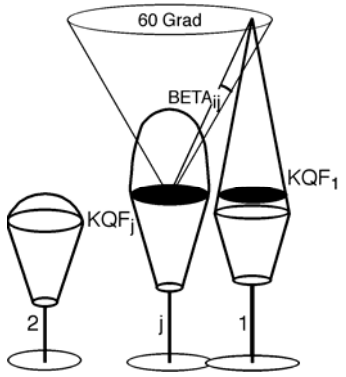


$$\frac{\Delta \text{height}}{\Delta t} = f_1(\text{height, crown, competition, site conditions})$$

$$\text{crown - diameter} = f_2(\text{height, diameter})$$

$$\text{crownbase} = f_3(\text{height, diameter})$$

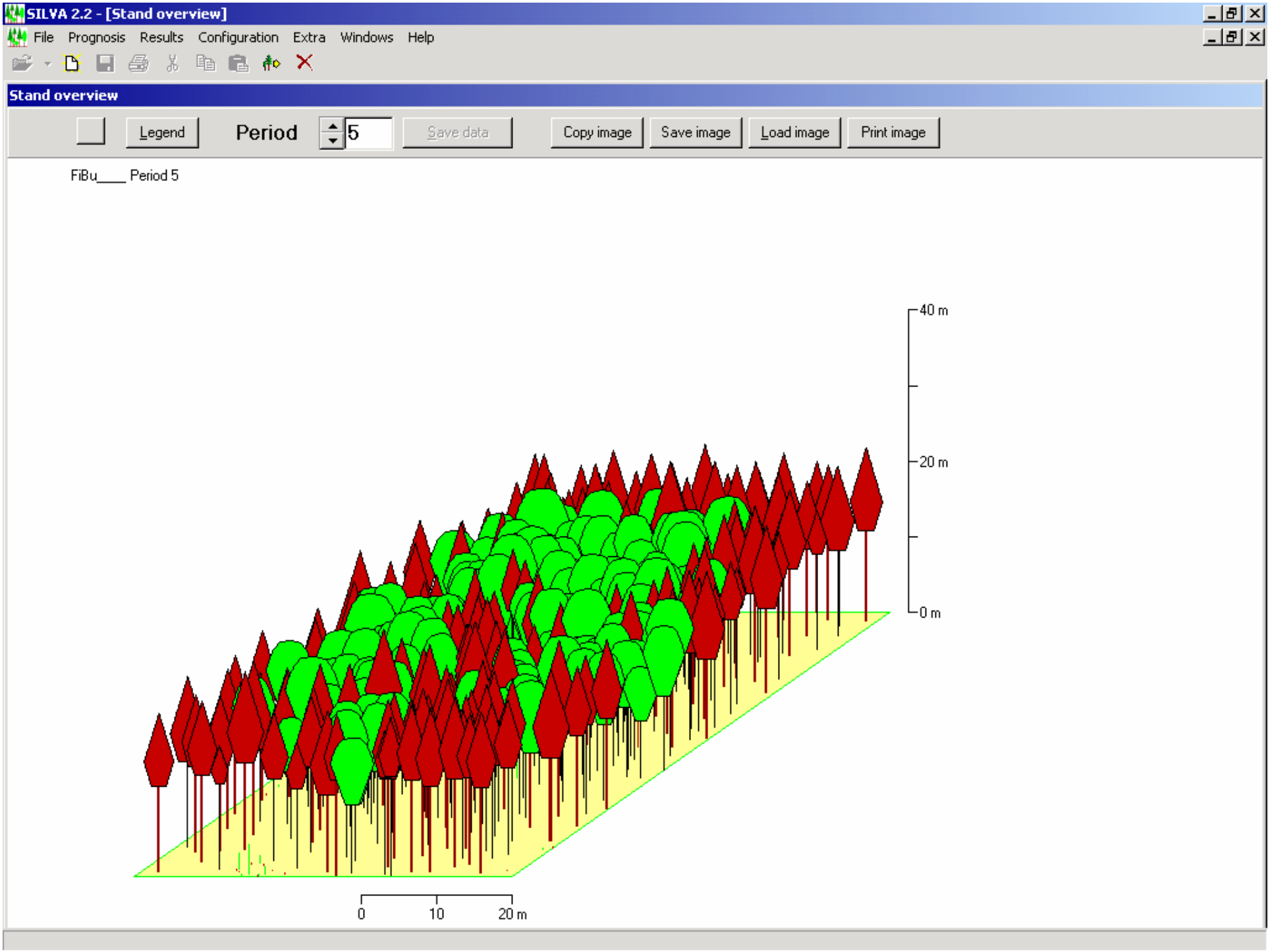
Quantification of competition



$$KKL_j = \sum_{\substack{i=1 \\ i \neq j}}^{n} BETA_{ij} \cdot \frac{KQF_i}{KQF_j} \cdot TM_i$$

$$\frac{\Delta \text{diameter}}{\Delta t} = f_4(\text{diameter, crown, competition, site conditions})$$

$$\text{mortality}_{\Delta t} = f_5\left(\text{height, diameter, } \frac{\Delta \text{diameter}}{\Delta t}, \text{competition, site conditions}\right)$$


SILVA 2.2 - [Stand overview]
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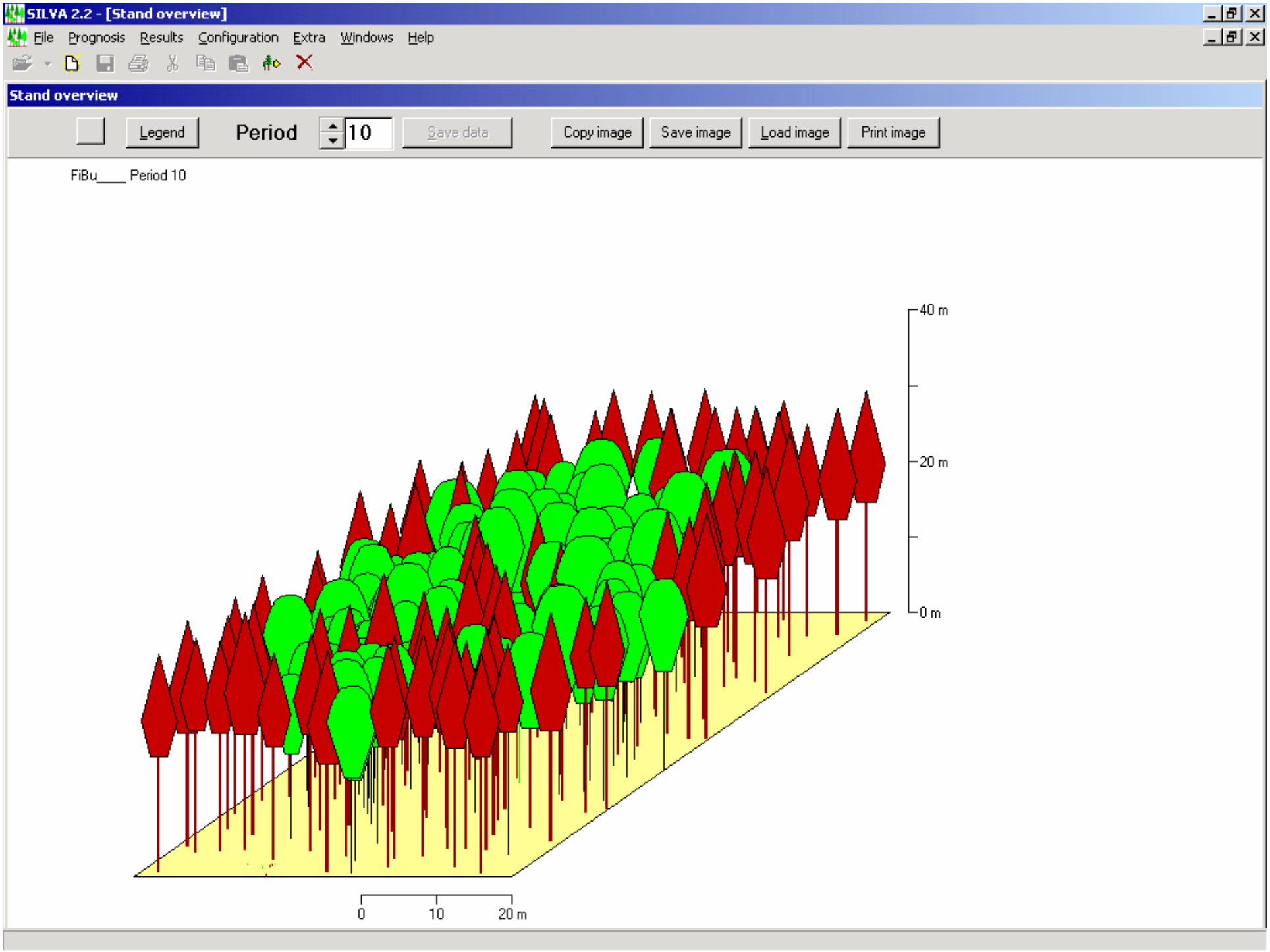
SILVA 2.2 - [Stand overview]
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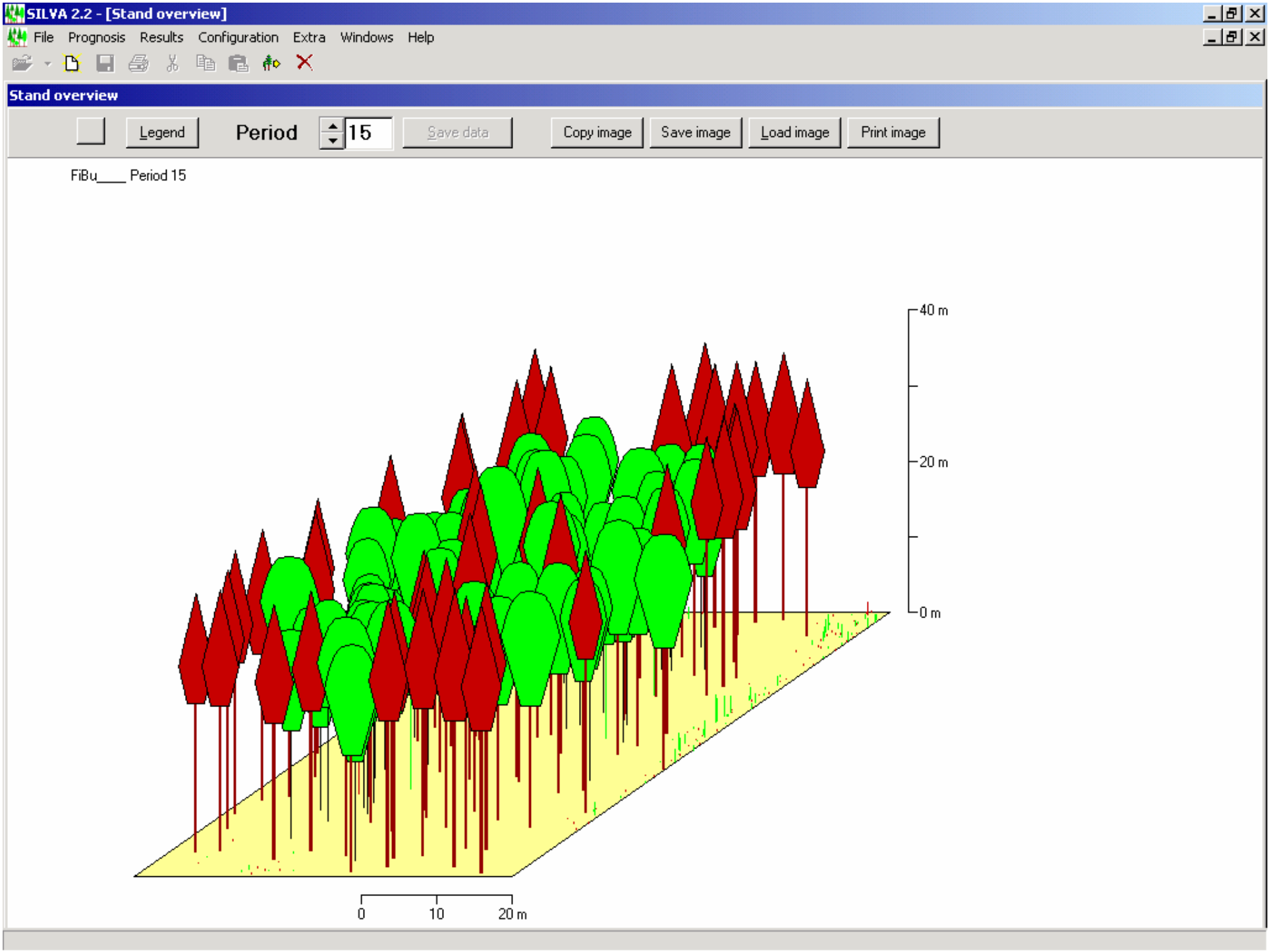
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SILVA 2.2 - [Stand overview]

File Prognosis Results Configuration Extra Windows Help

Stand overview

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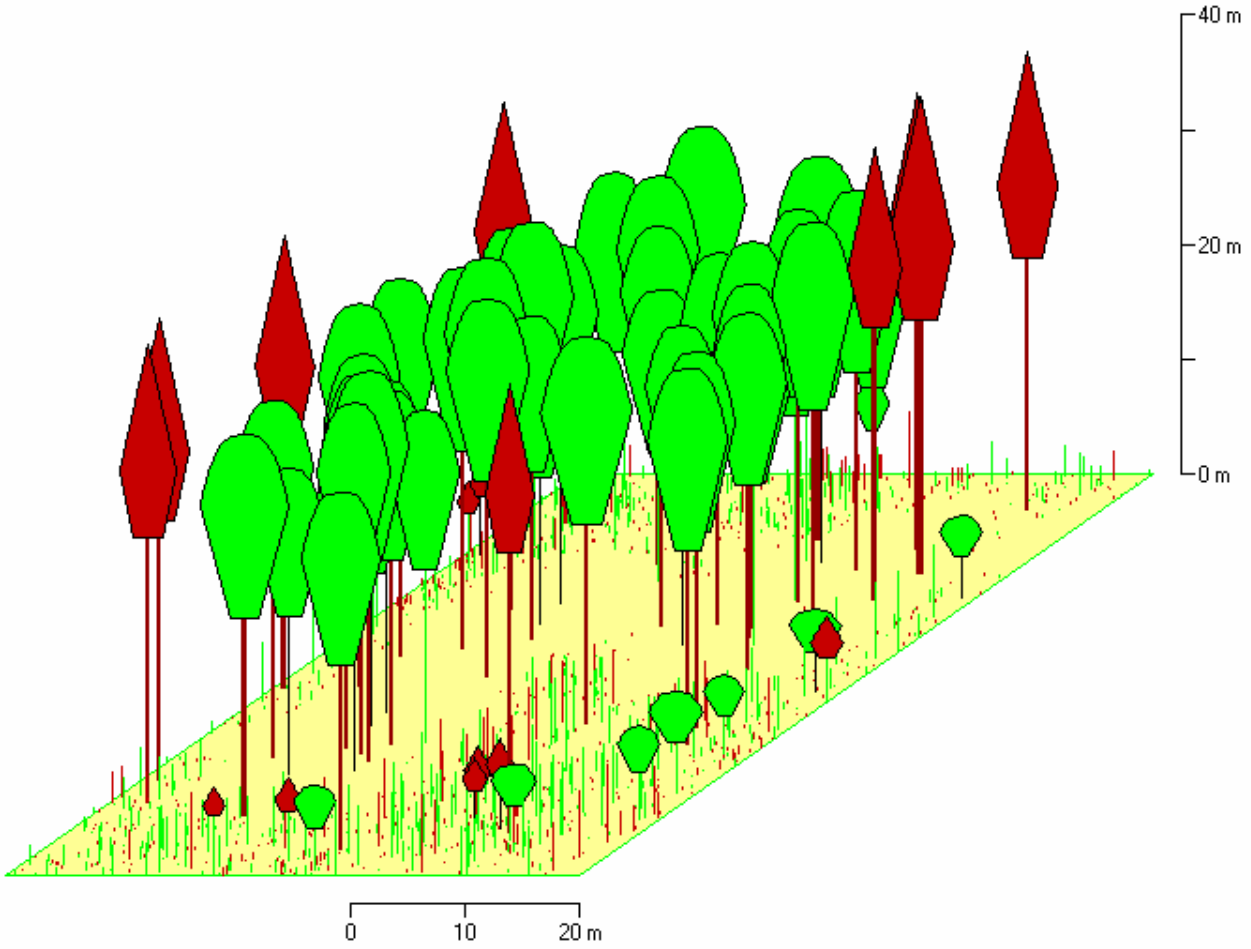

SILVA 2.2 - [Stand overview]

File Prognosis Results Configuration Extra Windows Help

Stand overview

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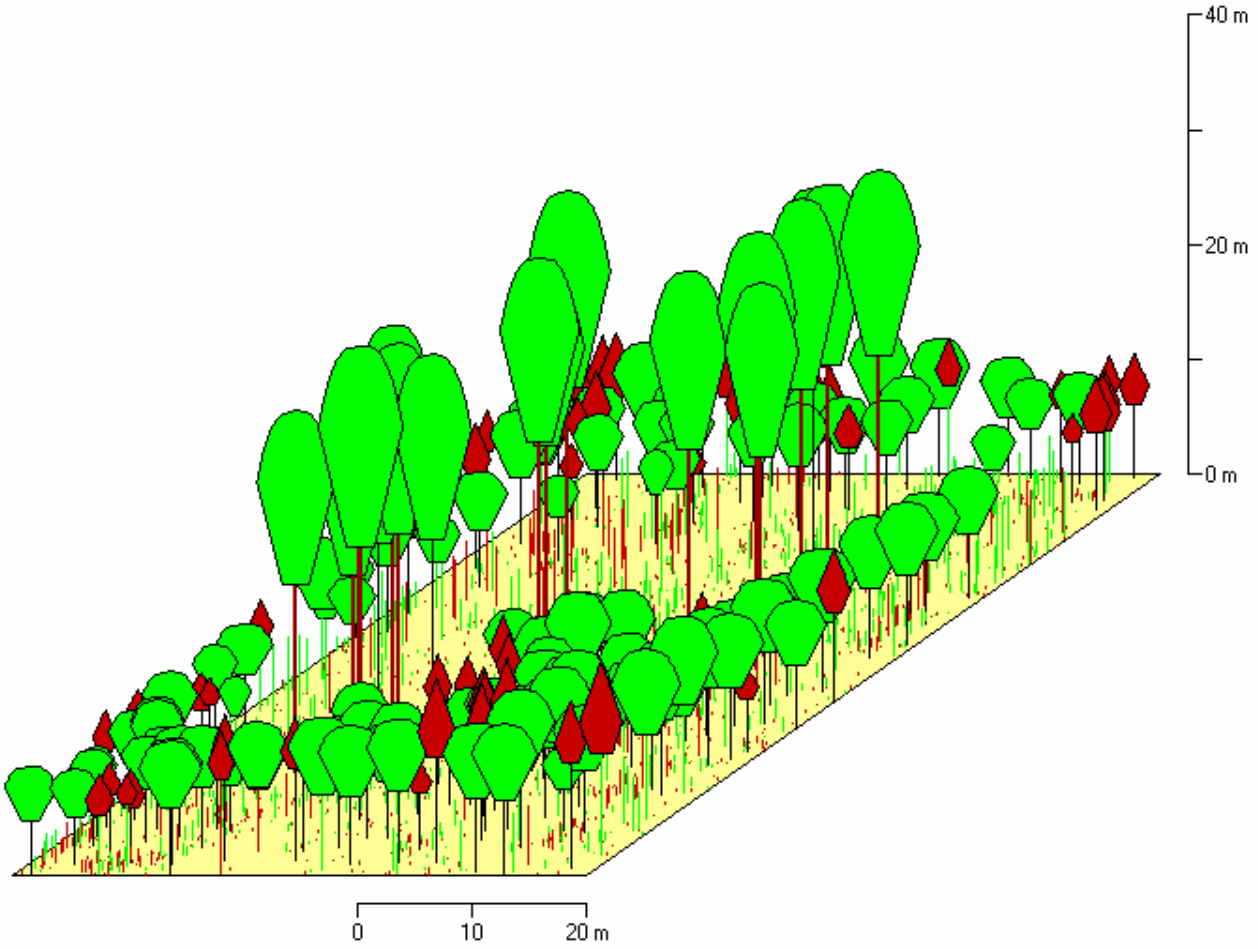

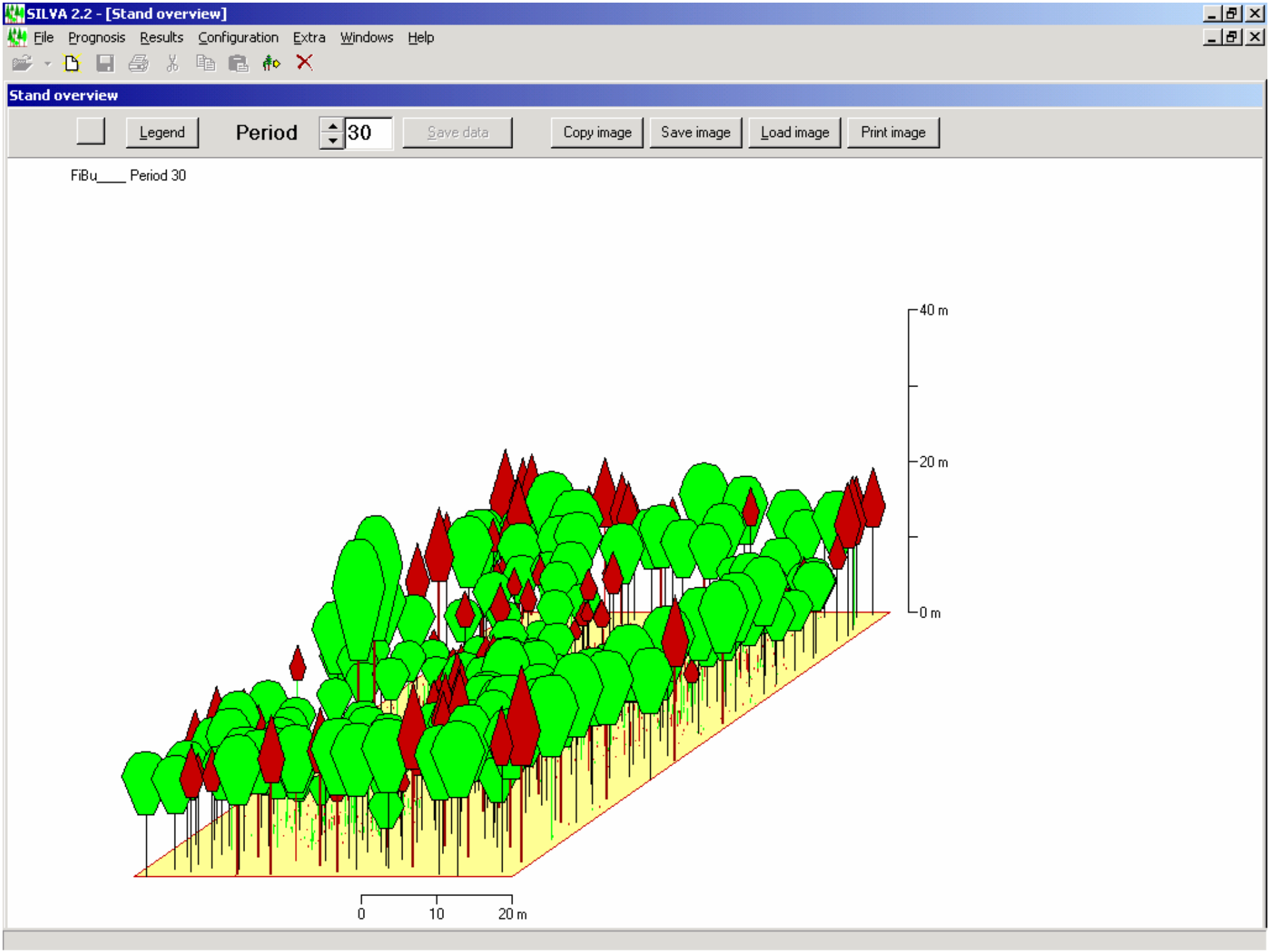
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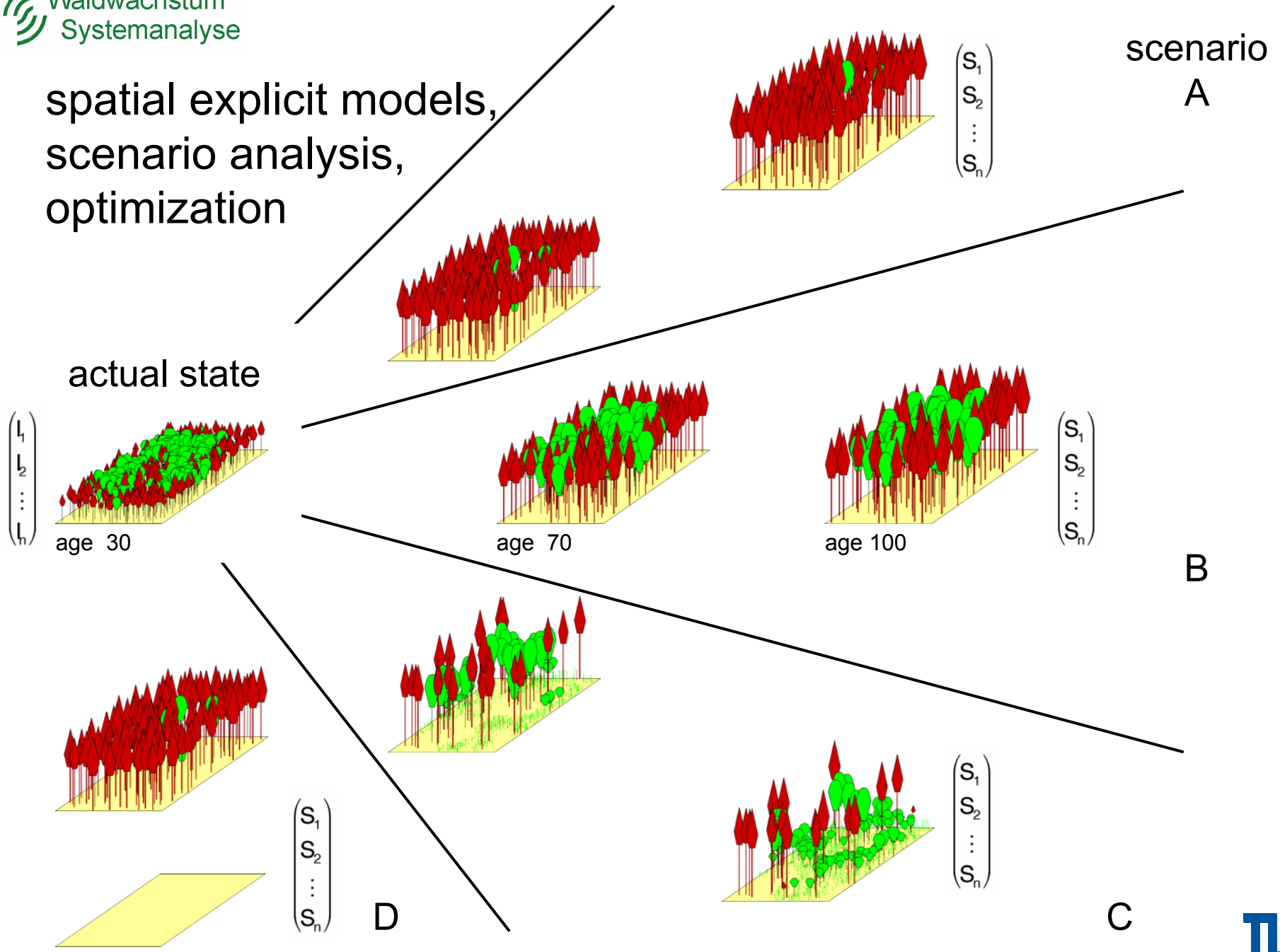
spatial explicit models, scenario analysis, optimization



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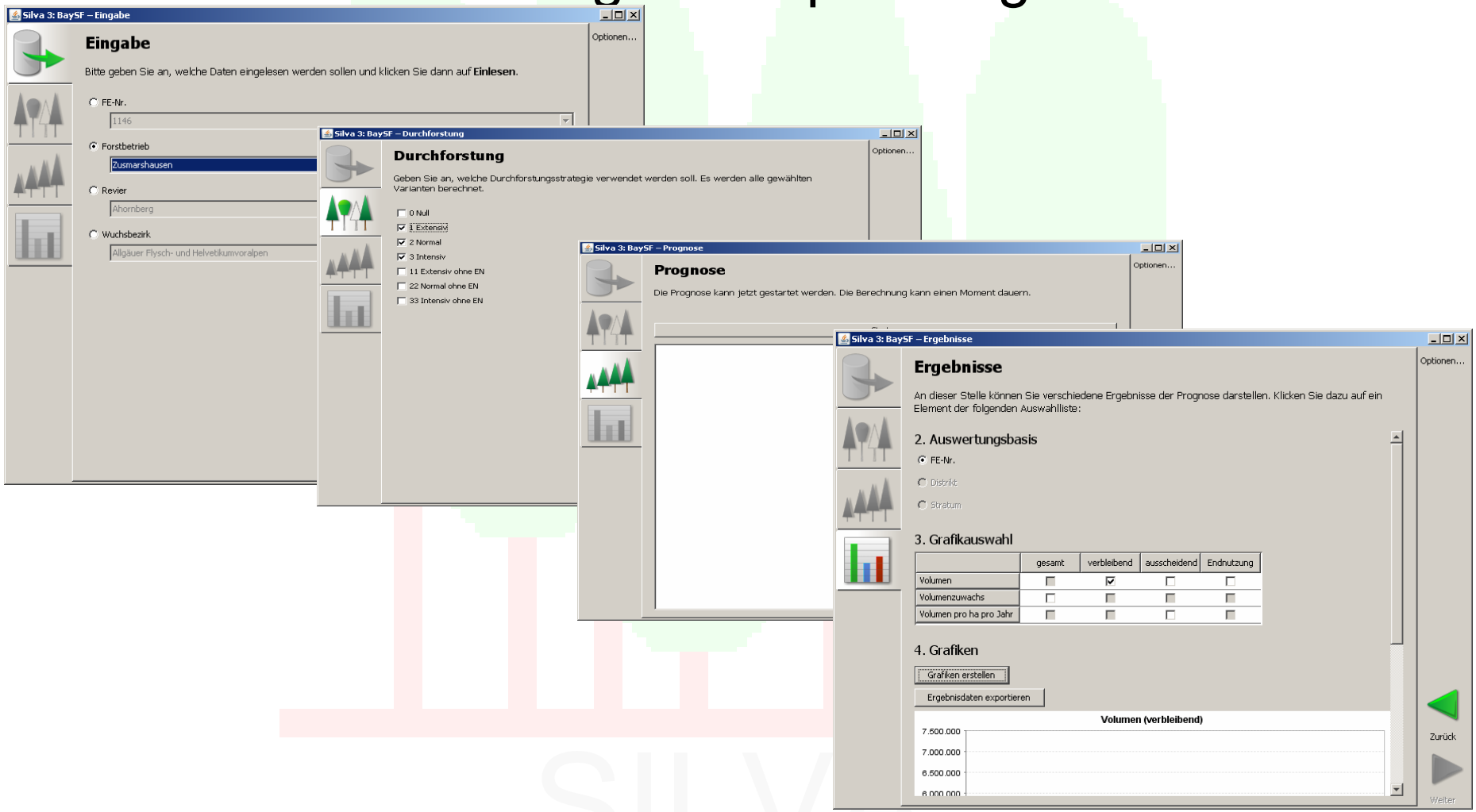
SILVA 3.0-BaySF for routine application for management planning



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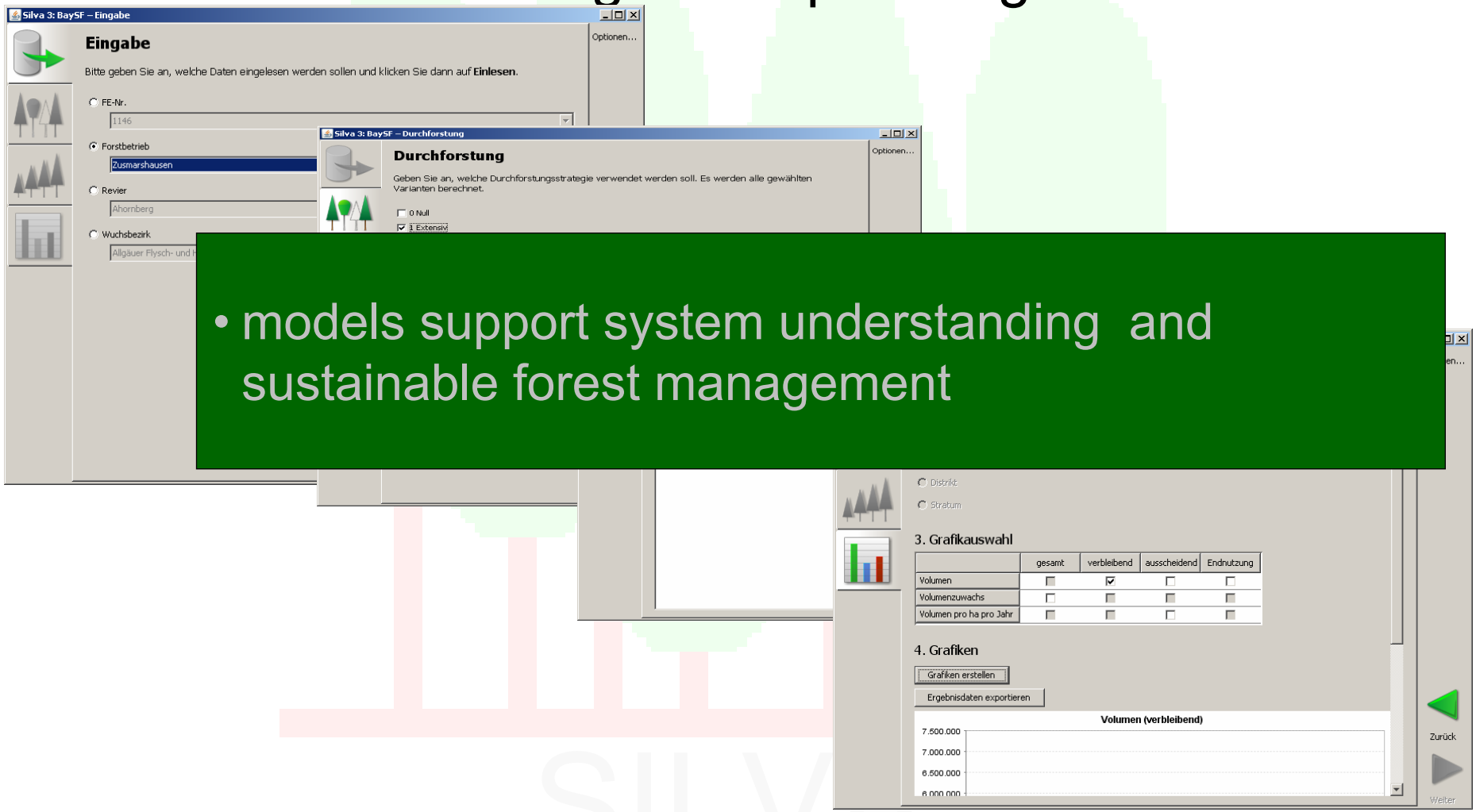
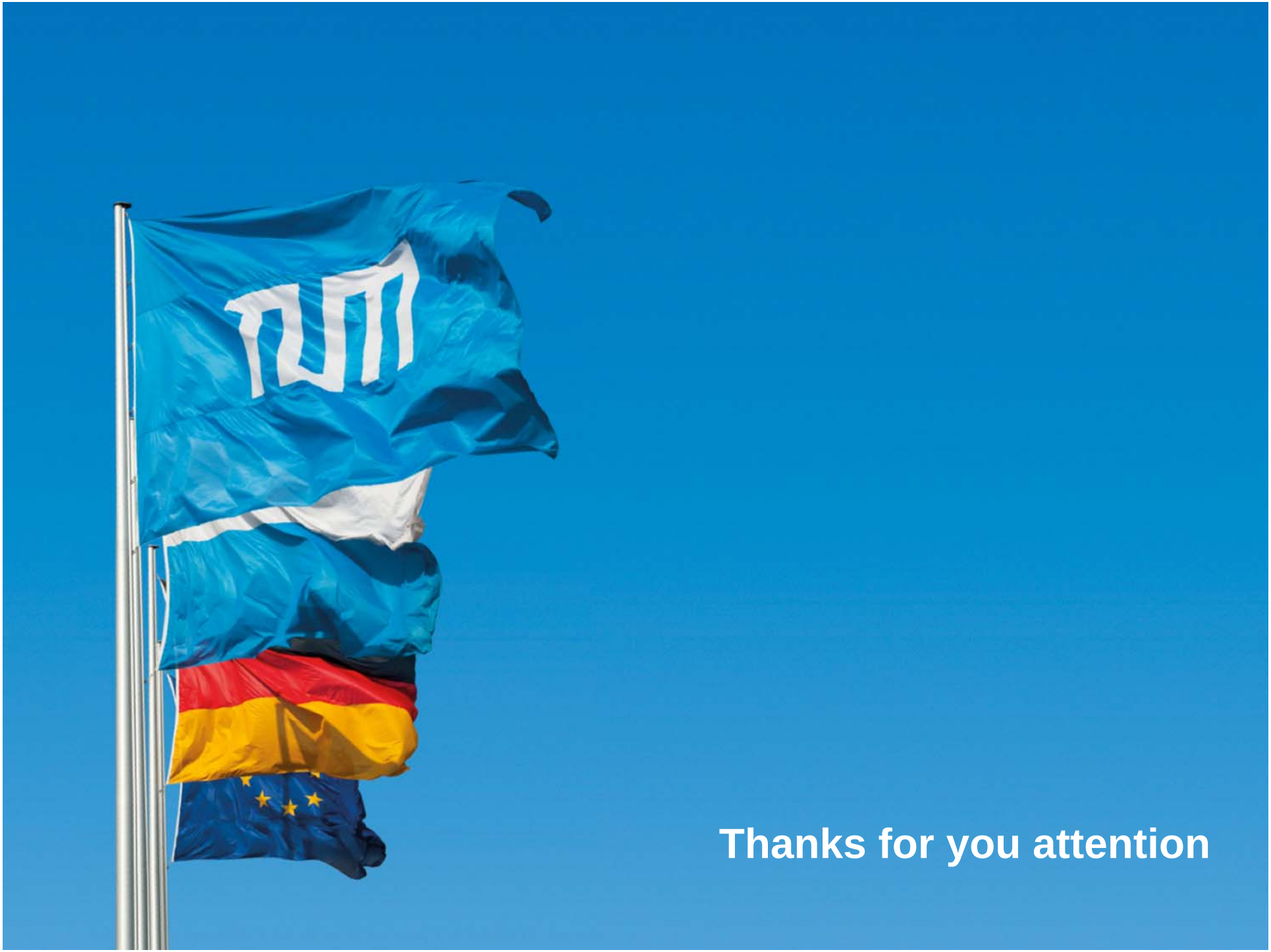
SILVA 3.0-BaySF for routine application for management planning



- models support system understanding and sustainable forest management

Perspectives

- Substantiation of empirical research by models & theory
- Extension of research from pure to mixed stands
- From wood to other functions and services of forests (wood quality, climate change, carbon, water...)
- Extension of research from forest trees to urban trees
- Trends: closer link to ecology, biology, resource economy


Thanks for you attention

Criteria for sustainable forest ecosystem management. Example: Objective hierarchy for the municipal forest Traunstein

Criteria for sustainable forest management	Indicators	Weight (%)
Forest resources	timber resources, area of forest, extension of area	20
Health and vitality	stability, fitness, elasticity	17
Productive functions	growth, yield, net return	12
Biological diversity	habitat quality, richness flora/fauna, conservation	10
Protective functions	soil, water, climate, noise, protection	10
Socio-economic functions	employment, recreation, esthetics, proximity to nature	31