

Representative BEF's with uncertainty estimation for boreal forests in Europe.

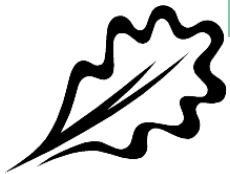
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Introduction

Climate Convention

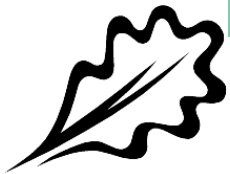
- > Countries have commitment to report changes in their carbon stocks

Kyoto Protocol

- > legally binding commitments to reduce emissions & credits from carbon sinks
- > need to reduce uncertainties of the inventories

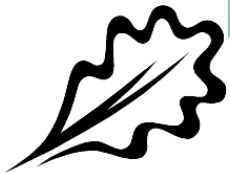
Marrakesh Accord

- > invitation to IPCC to develop inventory guidance



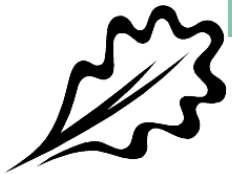
Needs of IPCC work on Good Practice Guidance for LULUCF

- Default values for BEFs
- Uncertainty estimates of BEF's
- Methodologies to analyse uncertainties related to BEFs

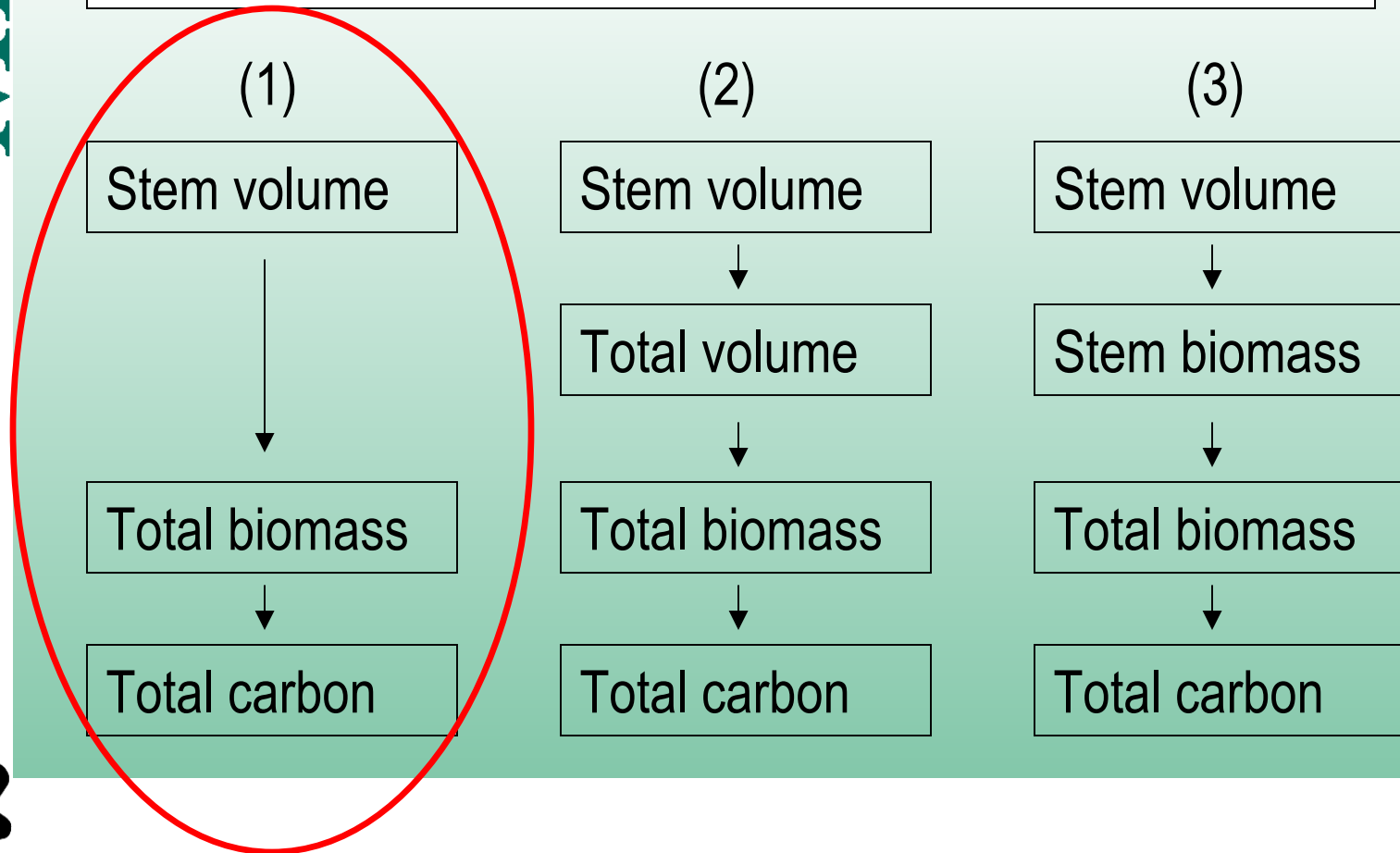


Objective

to introduce applicable BEFs with known precision for boreal forests in Europe



Three ways to estimate forest carbon stock



Three ways to estimate forest carbon stock (cont.)

Why choice number (1)

- minimizing sources of error
- currently applied BEFs are not based on representative data
- availability of reliable functions for allometry of trees

Uncertainties of the conversion factors

	in volume	in WD	in BM	in CC	
Austria	1.6	11.1	6.5	2	
Finland	0.57	1) 7.0 2) 8.5 3) 4.9	>10	1	

Density
Biomass expansion
Carbon

Approximation of RSE of carbon stocks

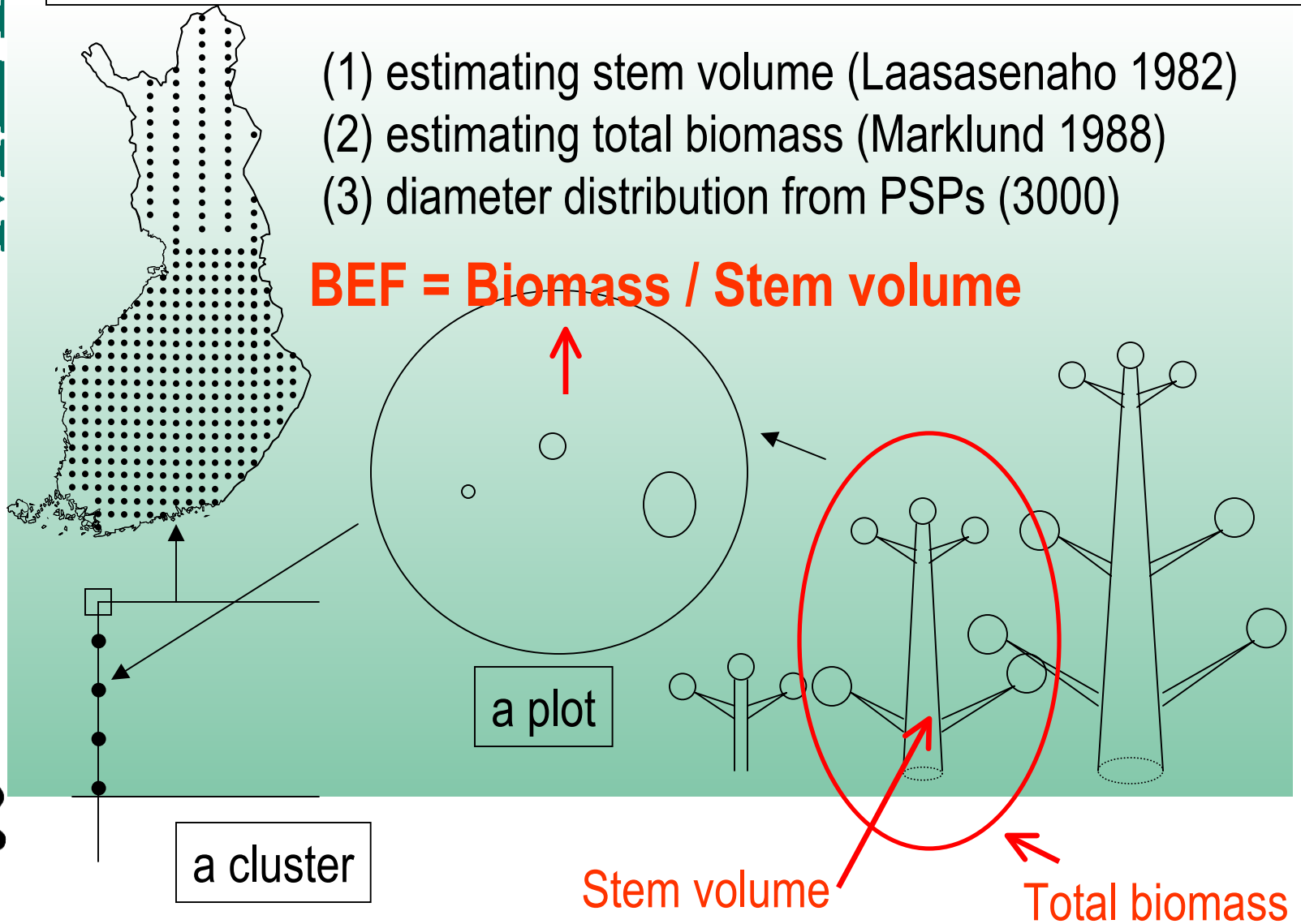
Finland $\sqrt{0.57^2 + 7^2 + 10^2 + 1^2} = 12.3\%$

Austria $\sqrt{1.6^2 + 11.1^2 + 6.5^2 + 2^2} = 13.1\%$

Method to estimate BEFs at stand level

- (1) estimating stem volume (Laasasenaho 1982)
- (2) estimating total biomass (Marklund 1988)
- (3) diameter distribution from PSPs (3000)

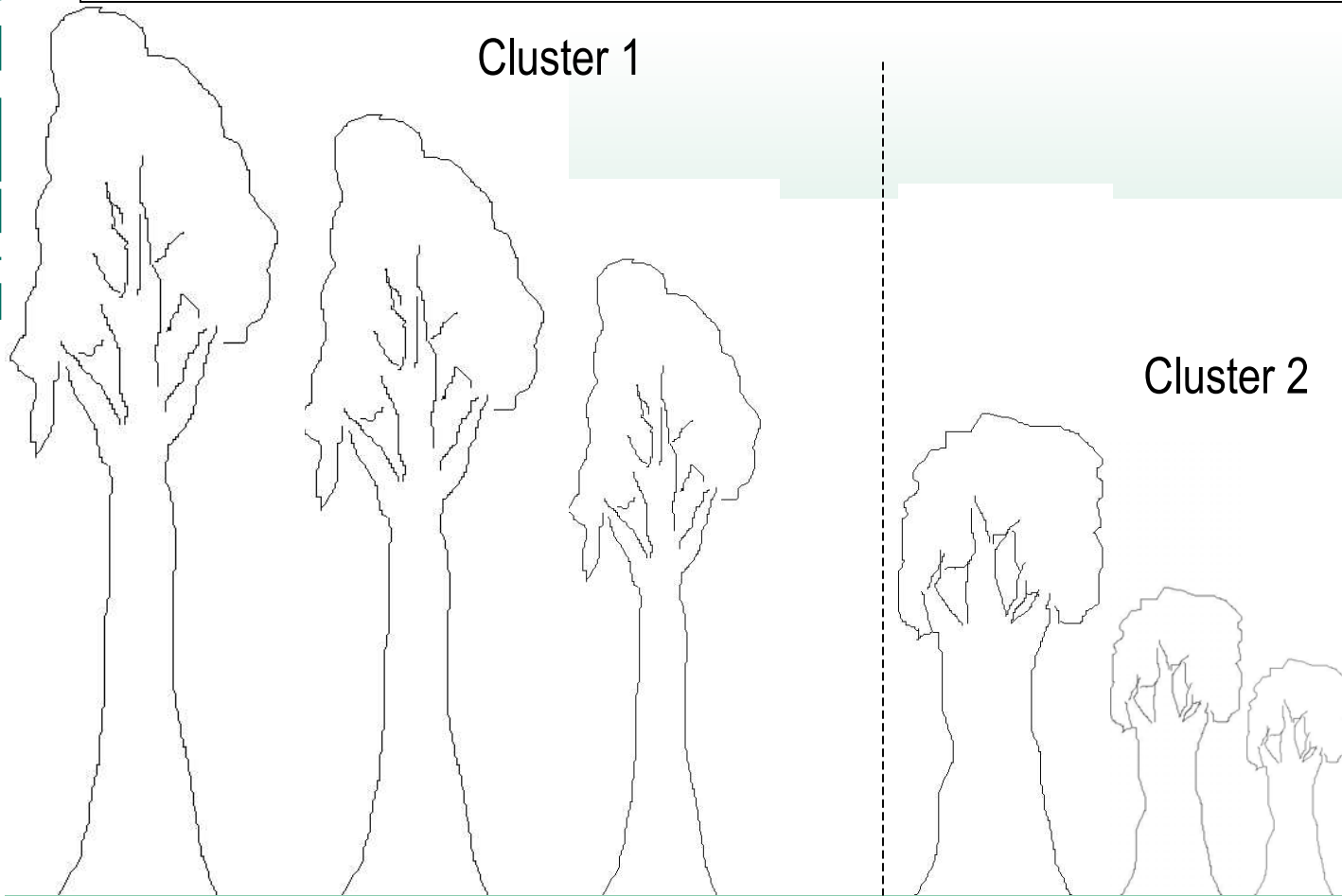
$$\text{BEF} = \text{Biomass} / \text{Stem volume}$$



Method to assess error budget

- **Model error of stem volume estimation**
 - * Relative standard error of estimate, s_r
- **Model error of biomass estimation**
 - * Standard error -> relative standard error
 - * Assuming that autocorrelation between errors of estimated biomass components doesn't exist at tree level (reality it does, but.....)
- **Sampling error of permanent sample plots**
 - * By age classes
 - * With assumption of randomness > overestimates (ignores spatial trends in sampling)

Autocorrelation at cluster level

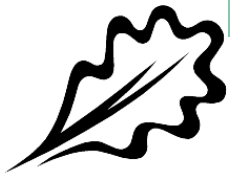


Errors between single trees and their estimates in the same cluster have at least same direction...?

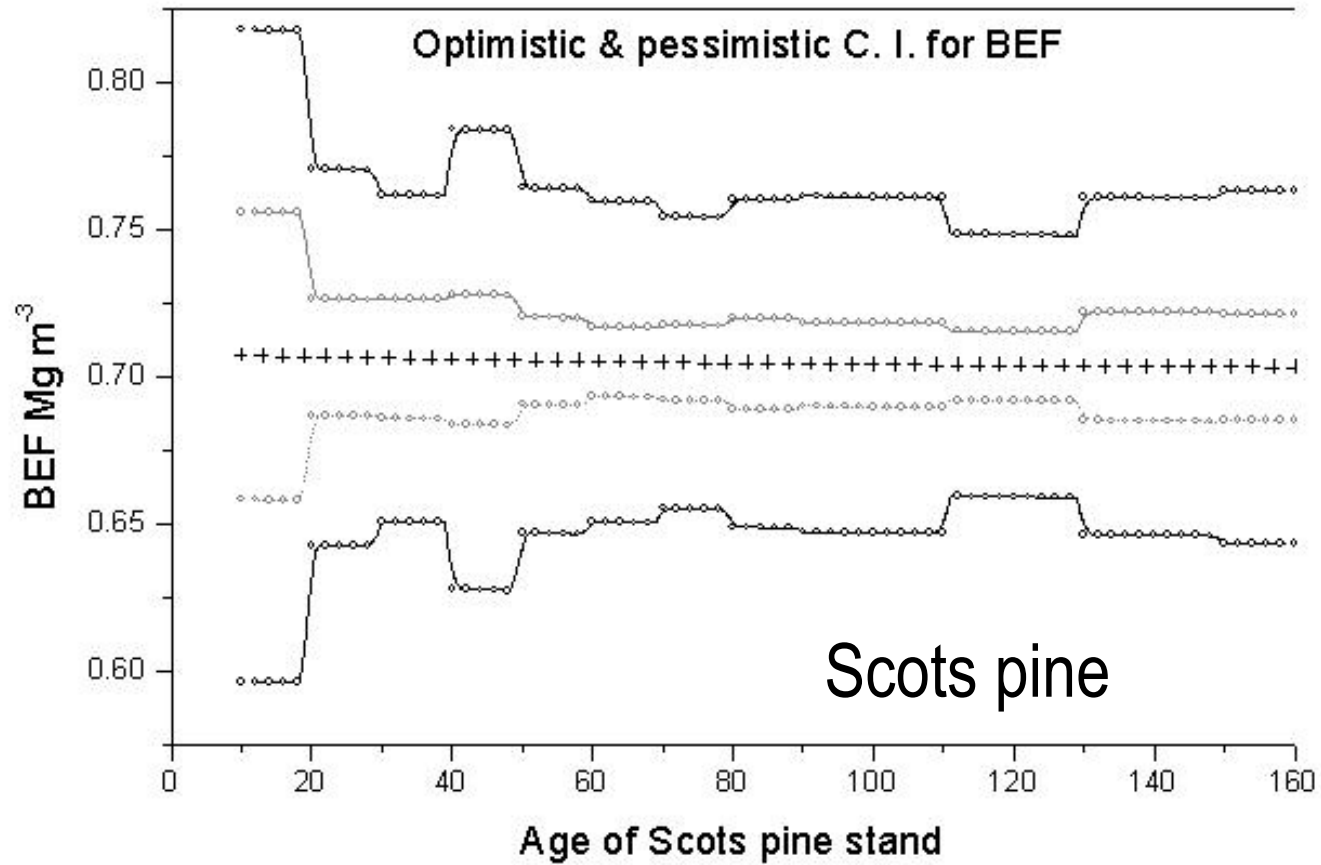
Lower and upper limit of sampling error

(1) Assuming independent trees in the cluster, no correlation between errors of estimates in the cluster between single trees (*lower limit of error estimate*)

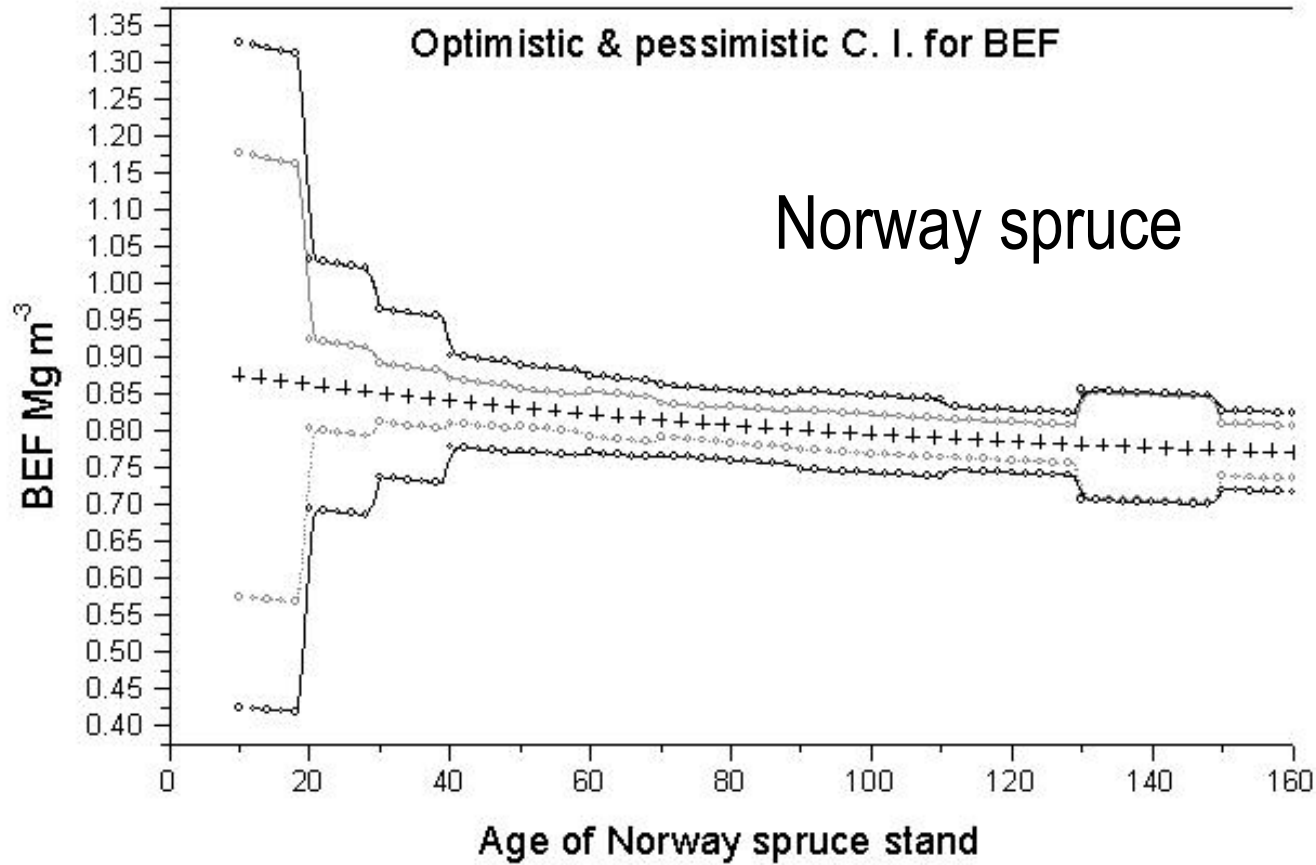
(2) Assuming dependent trees in the cluster, errors are fully correlated in each cluster between single trees (*higher limit of error estimate*)



Results



Results (cont.)



Conclusions

- (1) These BEFs could be applied in Boreal forests of Europe where allometry and diameter distribution does not differ greatly
- (2) This approach could be applied anywhere, if there sufficient information available (diameter distribution, biomass equations and volume equations)

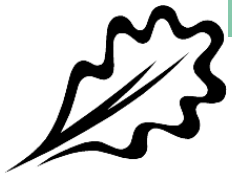
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