

Comparison of measured wind profiles with WindSim calculations

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Overview

- some theory
- measurement
- WindSim setup
- results – comparison
- conclusions

Some theory

- logarithmic wind profile

$$u_{z_2} = u_{z_1} * \frac{\ln\left(\frac{z_2}{z_0}\right)}{\ln\left(\frac{z_1}{z_0}\right)}$$

$u_{z_{1,2}}$ wind speed in height 1,2

$z_{1,2}$ measuring height

z_0 roughness length

Logarithmic wind profile with consideration of thermal stratification

$$u_{z_2} = u_{z_1} * \frac{\ln\left(\frac{z_2}{z_0}\right) - \psi\left(\frac{z_2}{L}\right)}{\ln\left(\frac{z_1}{z_0}\right) - \psi\left(\frac{z_1}{L}\right)}$$

$$\psi\left(\frac{z}{L}\right)$$

correction function

L

Monin-Obukhov-Length

Measurement Site



-met mast, operated by
Ingenieurbüro Kuntzsch GmbH

-located at Thuringia

-Measurement heights used for
comparison:

-36 m; 50 m; 70 m; 101,5 m

-Anemometer: Thies classic

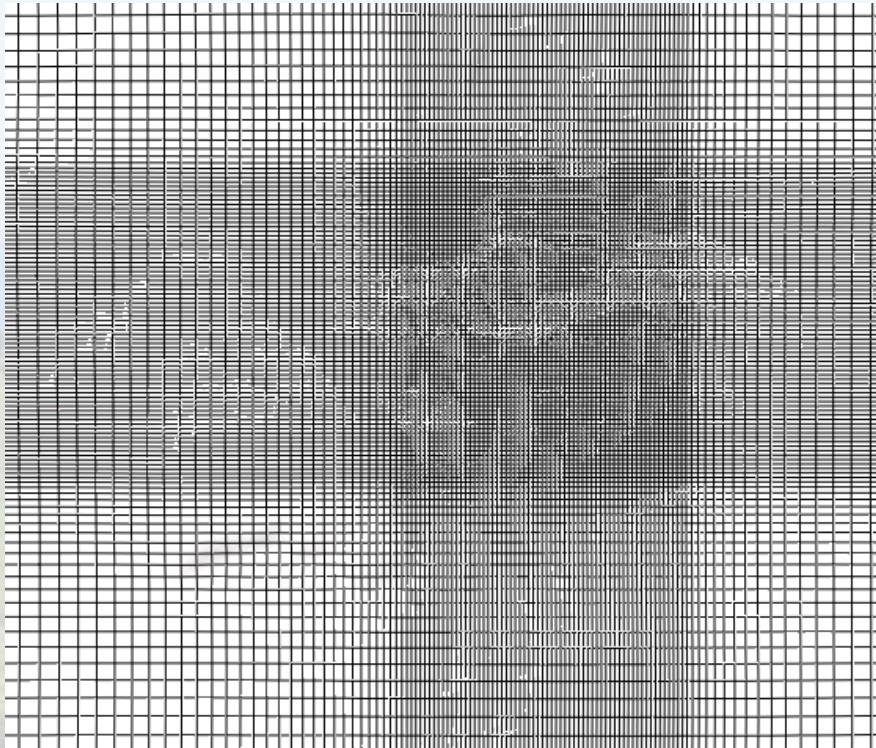
-Time period available for
comparison:

Nov 2004 – Mai 2005

WindSim setup

- two models:
- Model 1: refined
- Model 2: nested

- Model 1



13.2 x 11.2 km

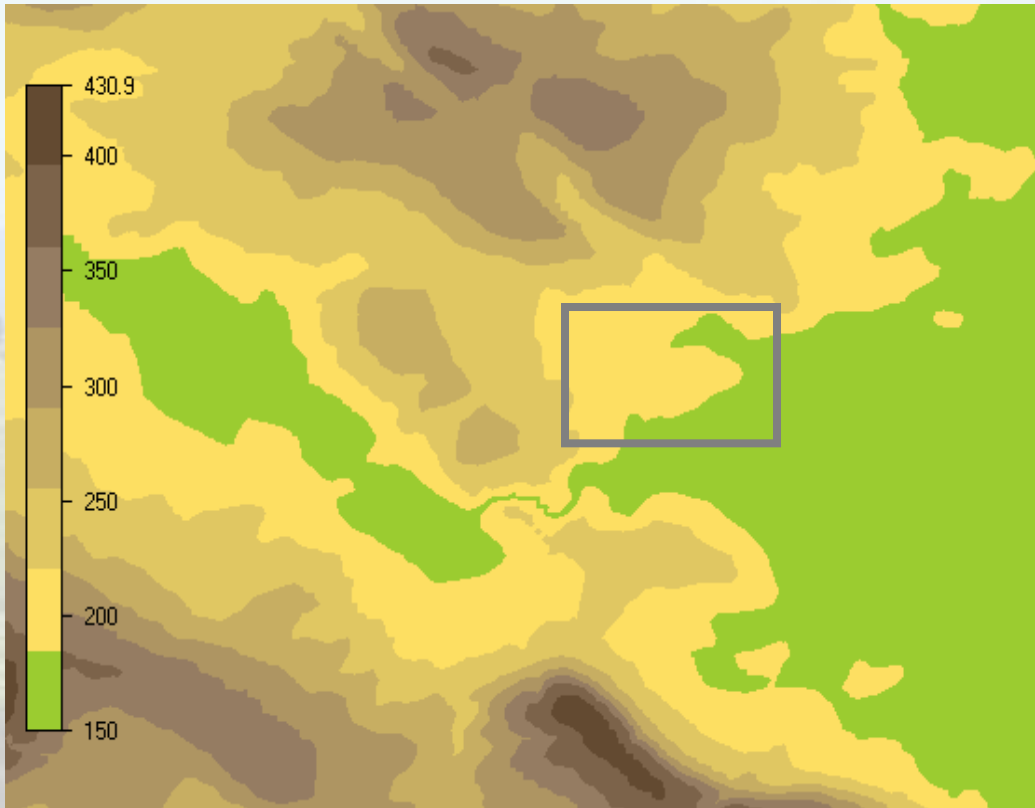
110 x 106 x 40 cells

66 – 300 m resolution

height of boundary layer: 1200 m

wind speed above boundary
layer height: 9.5 m/s

- Model 2



Meso model

35 x 25 km
139 x 100 x 30 cells
250 m resolution

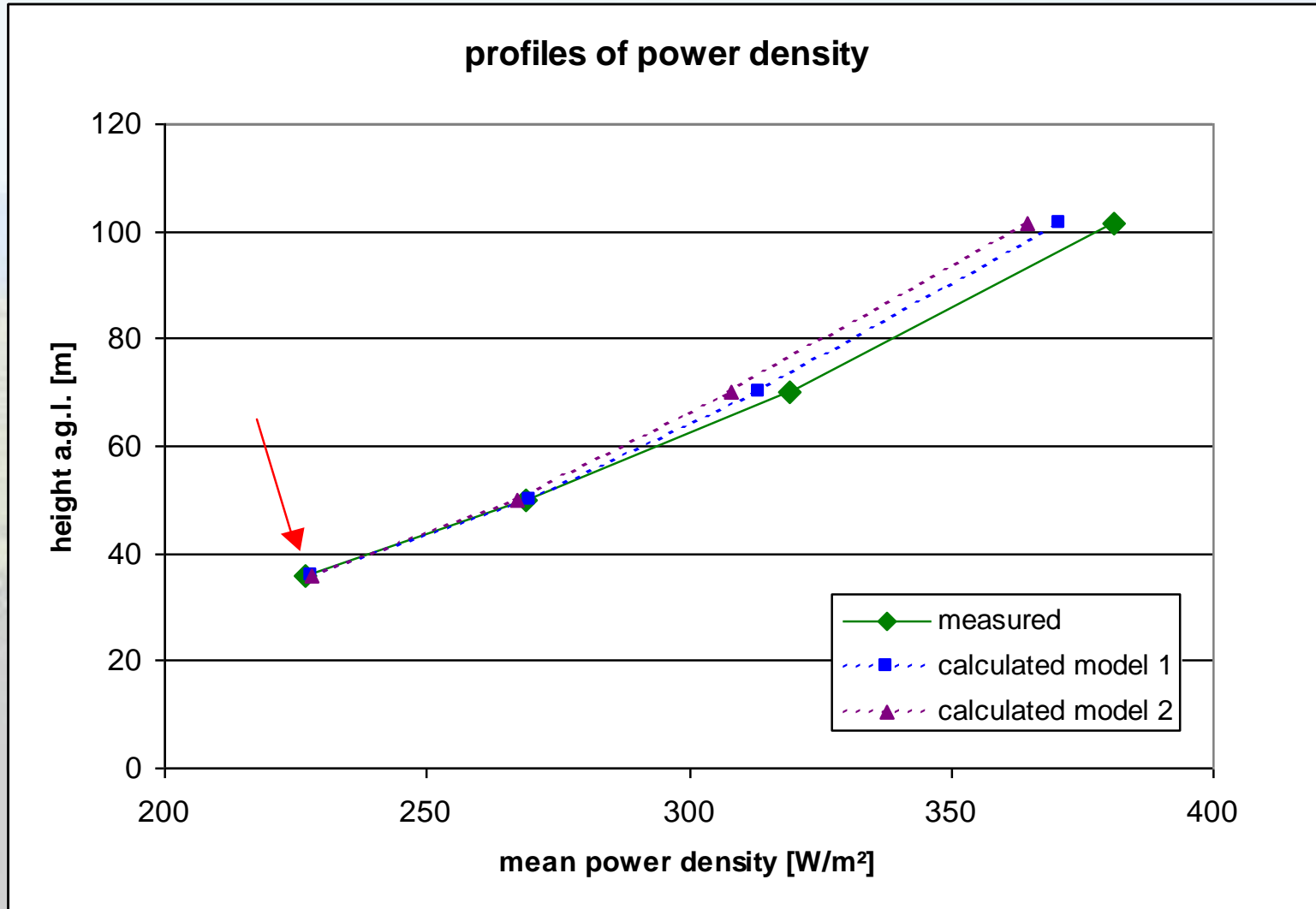
Micro model

2975 x 2500 m
119 x 100 x 30 cells
25 m resolution

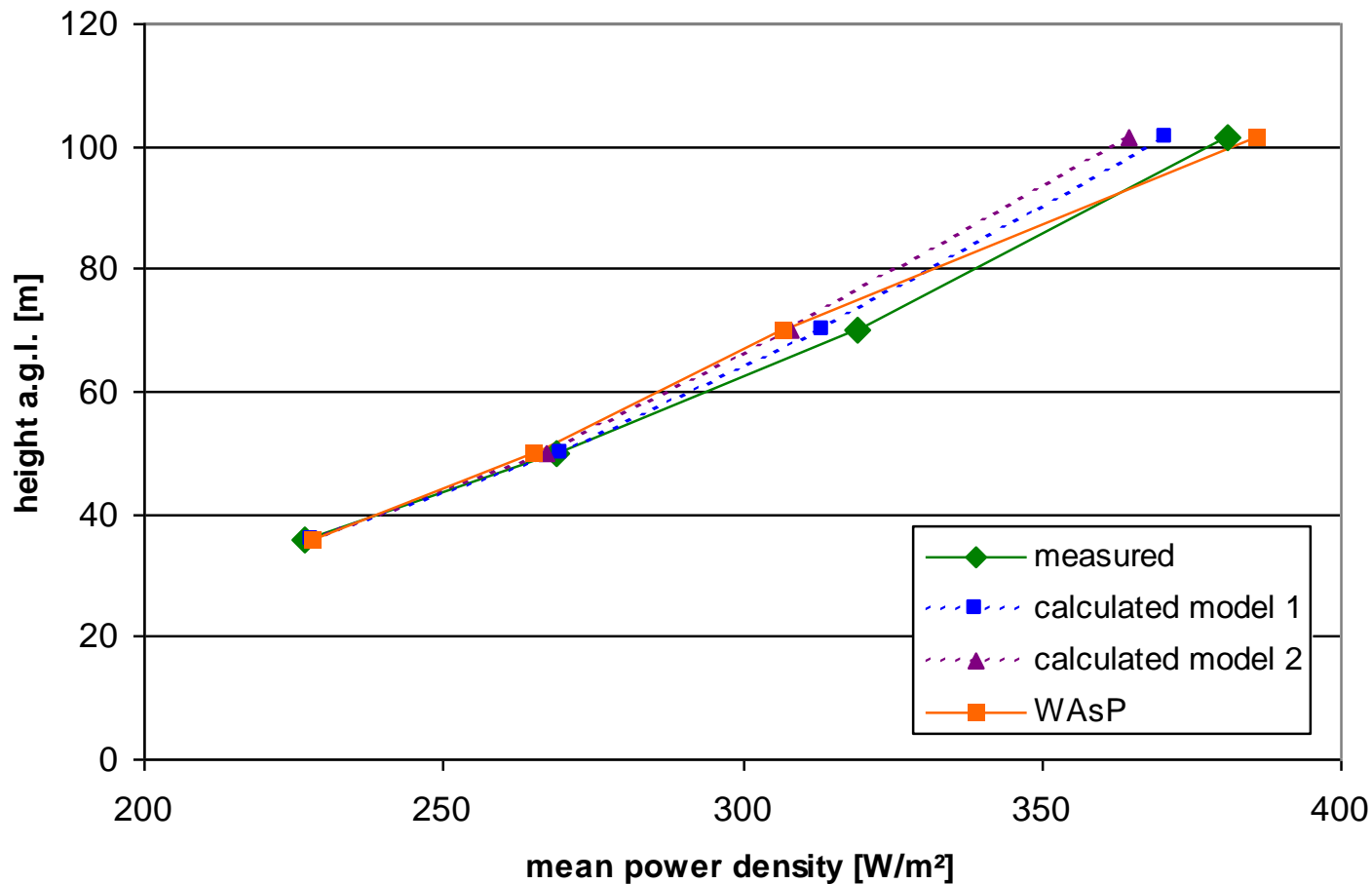
height of boundary layer:
1200 m

wind speed above boundary
layer height: 9.5 m/s

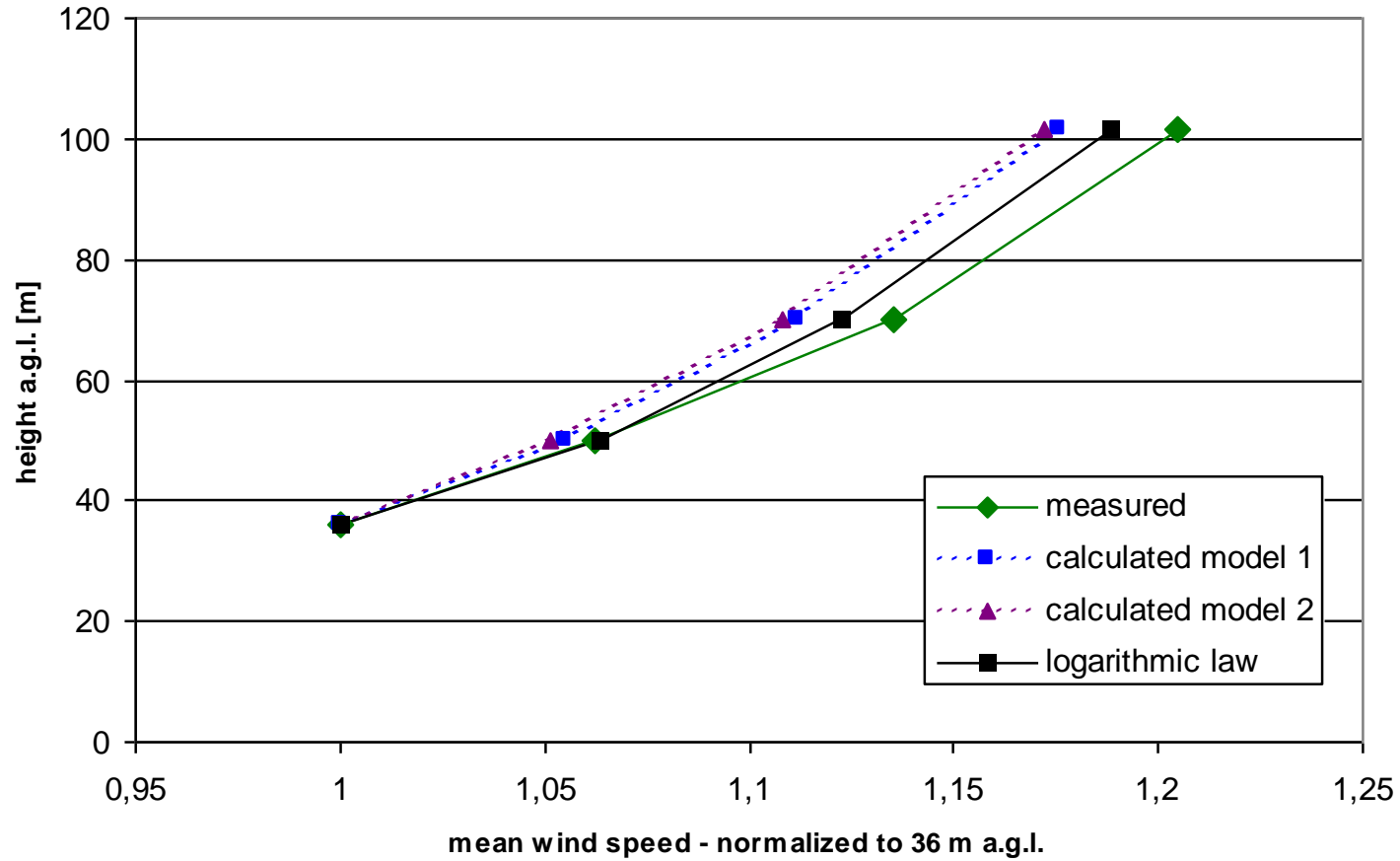
Results



profiles of power density



profiles of wind speed



Comparison of weibull parameters

height a.g.l. [m]	measured		calculated model 1		calculated model 2	
	A	k	A	k	A	k
101,5	7,5	1,83	7,17	1,69	7,15	1,7
70	7	1,79	6,78	1,69	6,74	1,69
50	6,52	1,73	6,41	1,67	6,39	1,67
36	6,08	1,68	6,08	1,68	6,08	1,68

Conclusions

- WindSim tends to underestimate the increase of wind speed with height
- profile of mean power density seems acceptable
- Approximation of weibull distribution should be better

Conclusions

Possible changes in WindSim to improve results:

- Change of logarithmic law as boundary condition
- Introduction of some kind of stability consideration

Future work?



42 m met mast in spruce forest
anemometers in several heights

→ Possibility to verify the forest
module

Thank you for your attention !