Predicting a forest wind profile

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The problem:

How to predict wind speed at hub height based on two low measurement points.

Experience from using WAsP, power profile, logaritmic profile, SODAR and CFD.

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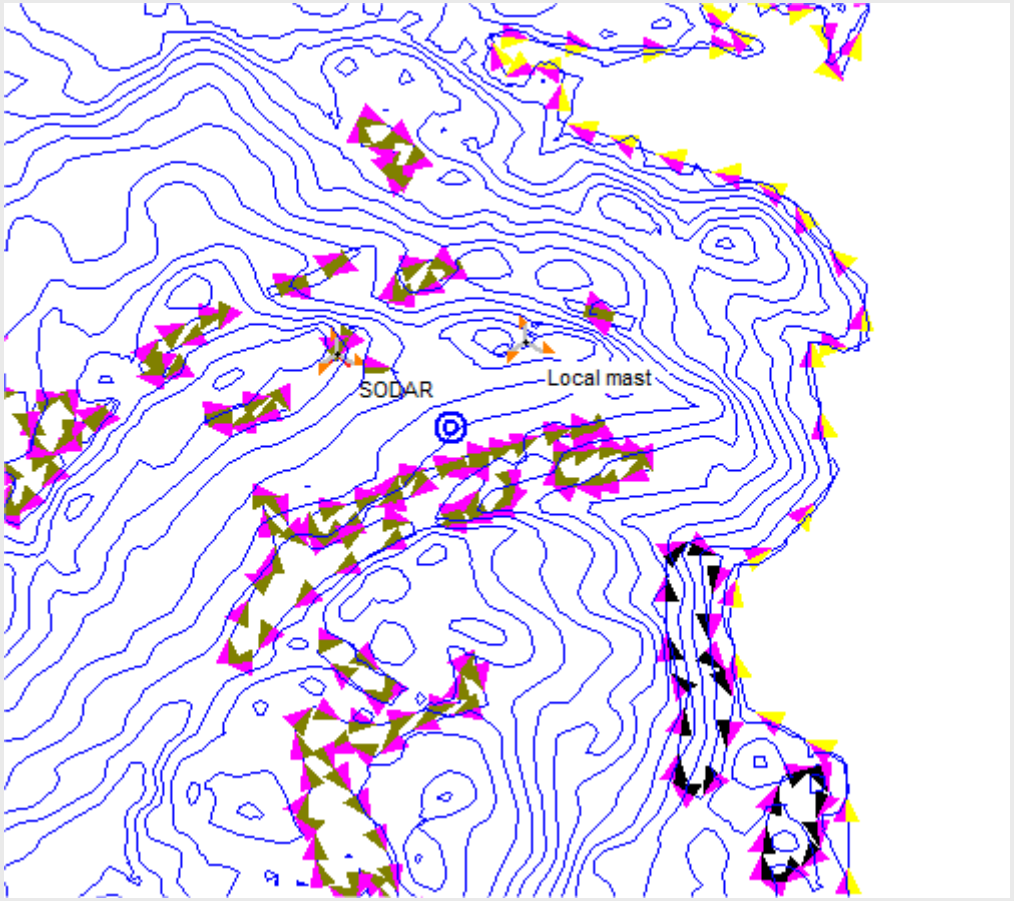
The setup:

Local mast
-50 + 30 m measurements
-+2 years of data

SODAR
-7 days of data

Distance: ca. 1000 m

Terrain
-Low hill
-Massive forest sector 7-11



Extrapolation to hub height

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WAsP profile using standard parameters

-Forest z_0 = 0,4m

-Displacement heigth d = ¾ of observed tree height (7,5m)

WAsP profile based on observed logaritmic profile

Roughness class and displacement height derived from observed wind profile

-Forest z0 = 1,7m

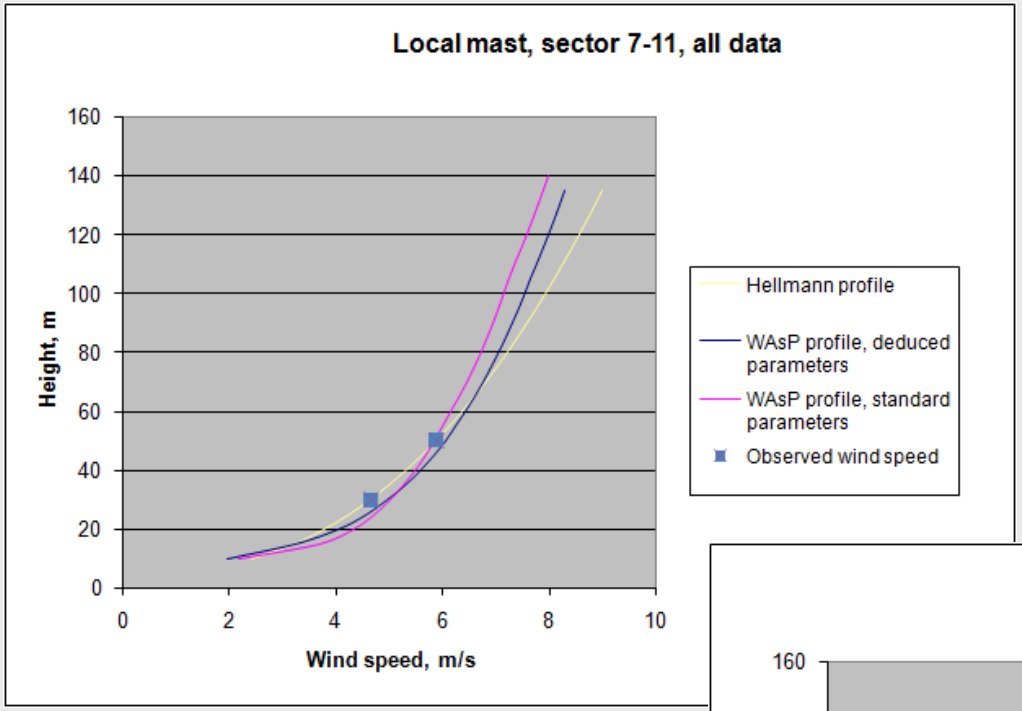
-Displacement height d = 5m

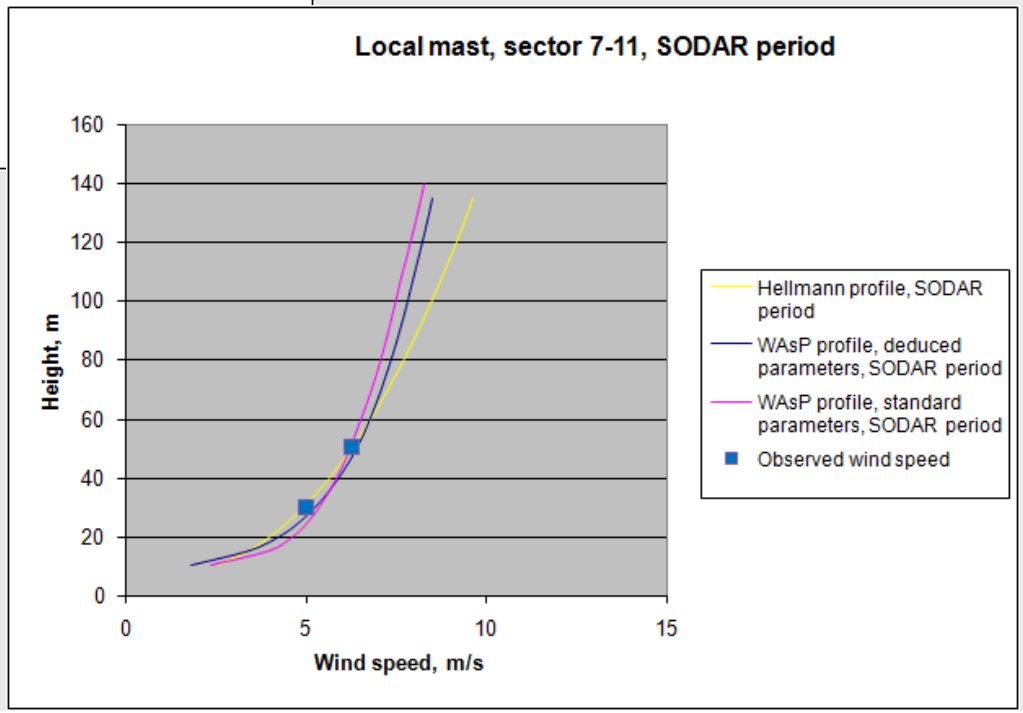
Power (Hellman) profile extrapolation to hubheight

-Observed shear exponent = 0,40

-Displacement height d = 5m

Calculated profiles at mast





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Wind speed at hub height (80m), sector 7-11

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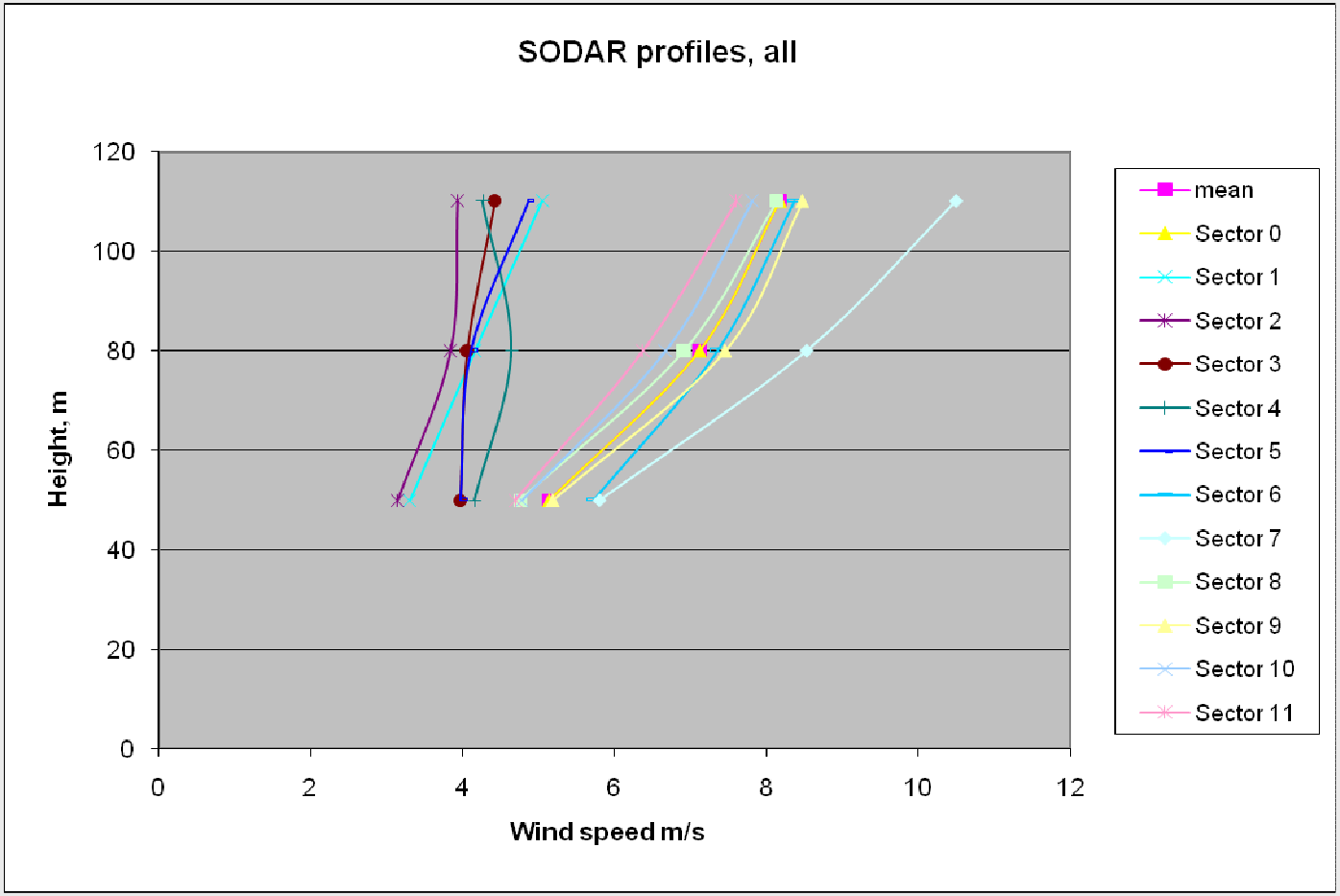
Full period

Power (Hellman) profile:	7,23 m/s
WAsP deduced parameter profile:	7,05 m/s
WAsP standard parameter profile:	6,72 m/s

SODAR period

Power (Hellman) profile:	7,72 m/s
WAsP deduced parameter profile:	7,37 m/s
WAsP standard parameter profile:	7,07 m/s

Measured profiles at SODAR



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Calculation of wind profiles at SODAR location

1. Vertical extrapolation using a Hellman profile, horizontal using the deduced roughness and displacement

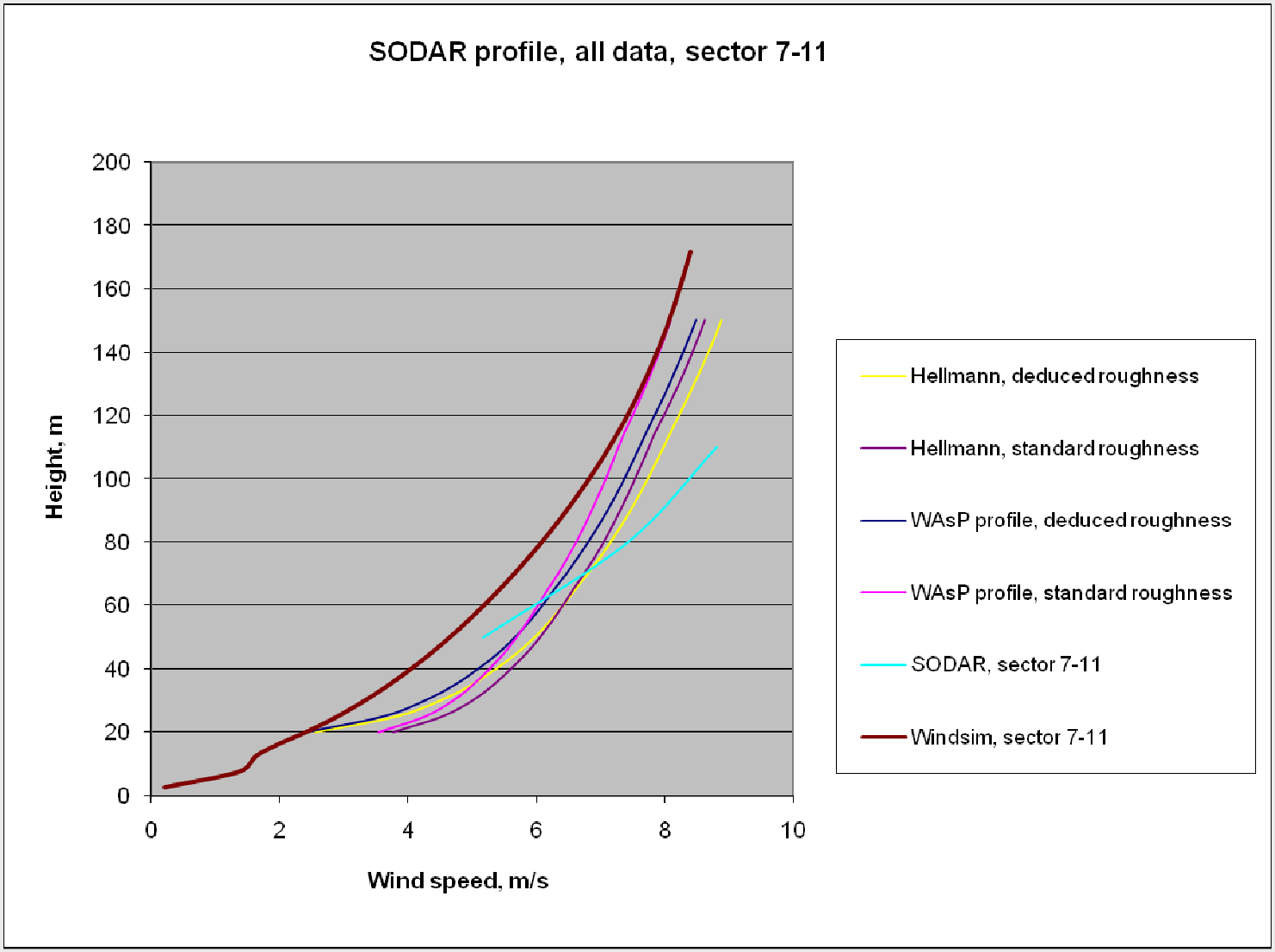
2. Vertical extrapolation using a Hellman profile, horizontal using the deduced roughness and displacement

3. Vertical and horizontal using WAsP with deduced roughness and displacement

4. Vertical and horizontal using WAsP with standard roughness and displacement

5. Windsim modelling

Calculated profiles at SODAR based on all data



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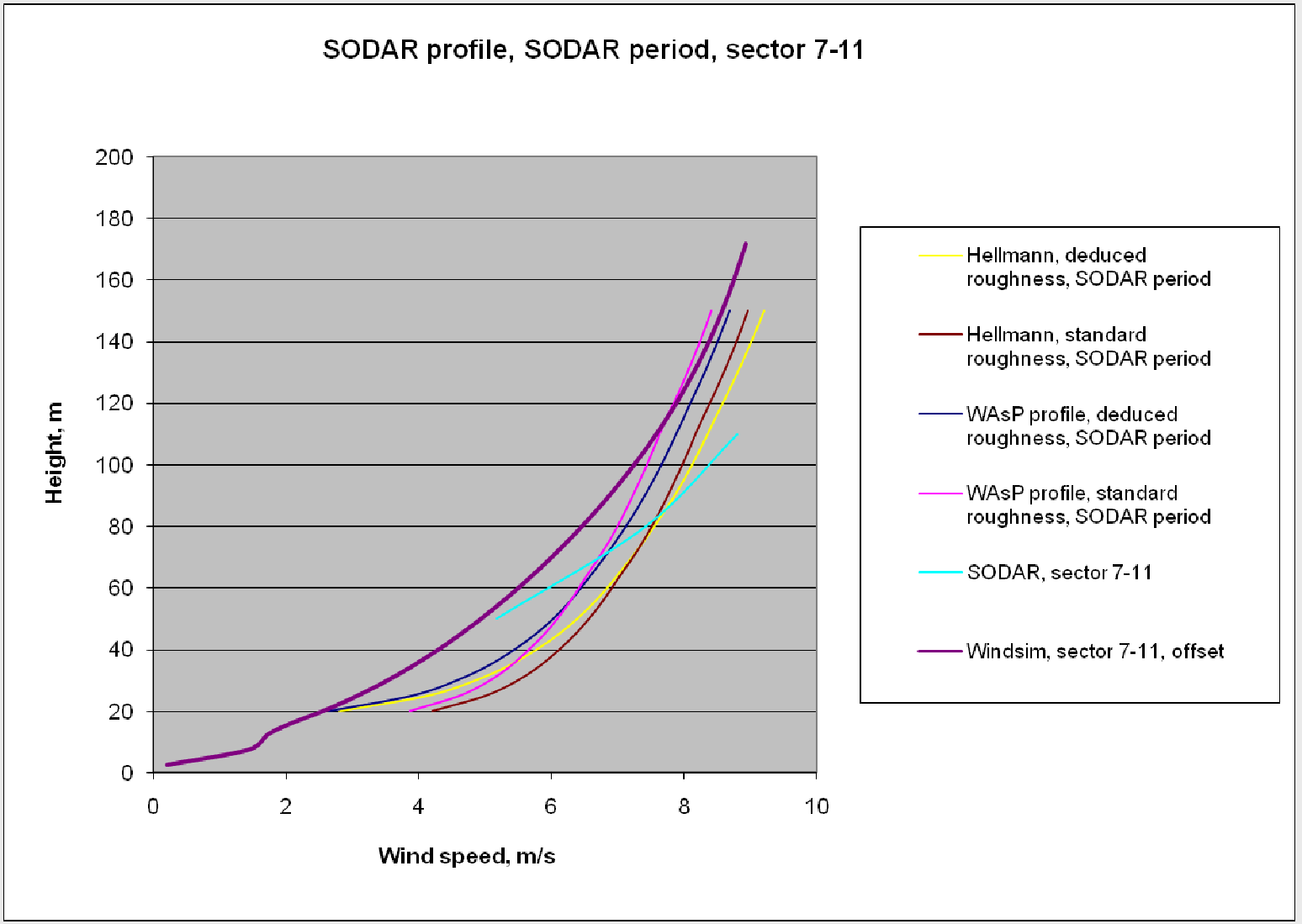
Calculated profiles at SODAR based on SODAR period



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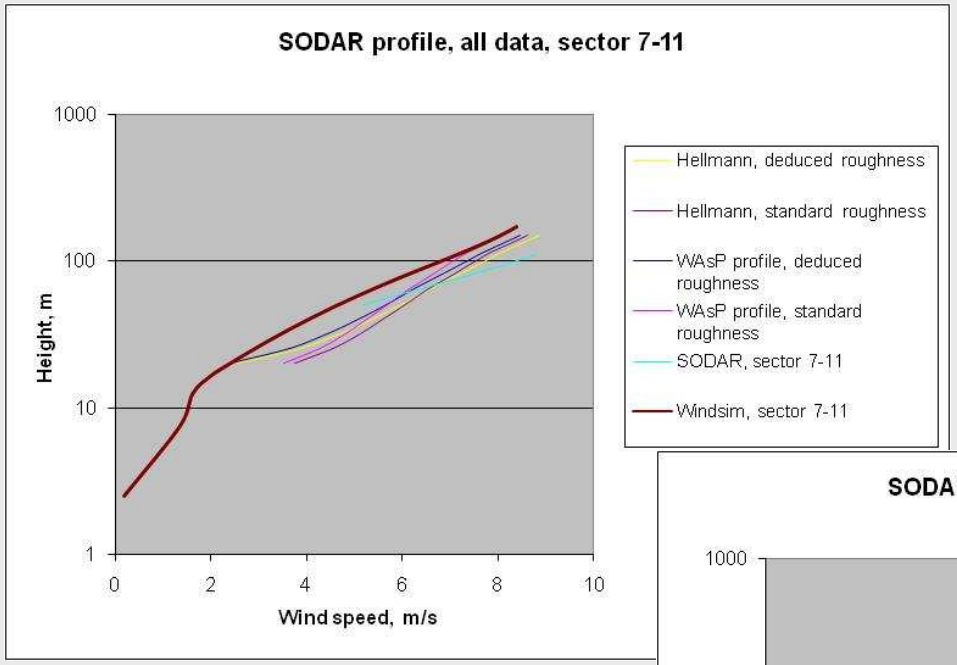
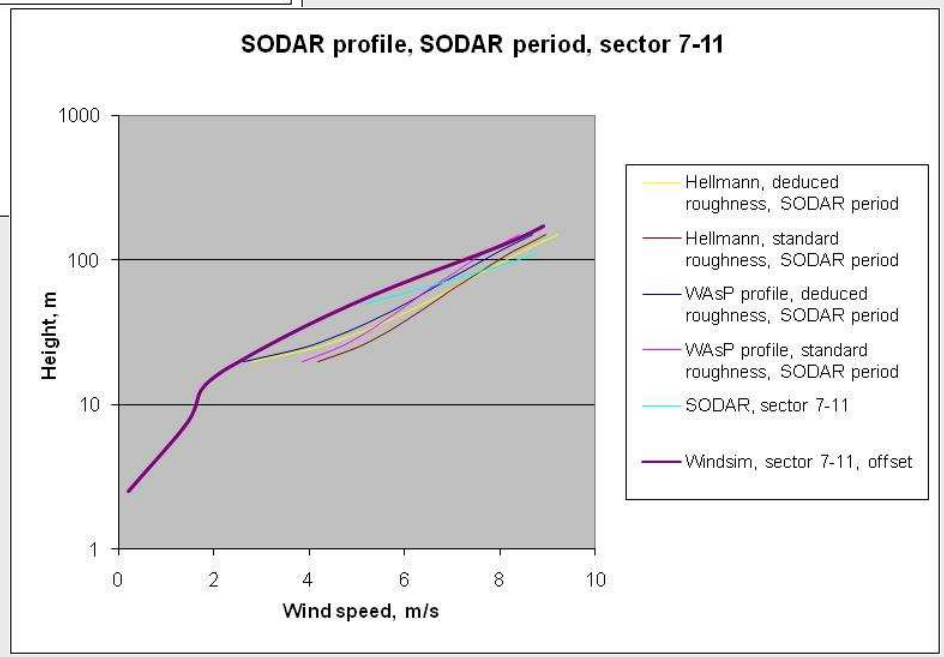
Semi-logaritmic plots





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Wind speed at hub height (80m), sector 7-11

Full period

Power (Hellman) profile + WAsP deduced parameters:	7,15 m/s
Power (Hellman) profile + standard parameters:	7,04 m/s
WAsP deduced parameters:	6,80 m/s
WAsP standard parameter:	6,61 m/s
Windsim:	6,10 m/s
SODAR:	7,42 m/s

SODAR period

Power (Hellman) profile + WAsP deduced parameters:	7,56 m/s
Power (Hellman) profile + standard parameters:	7,52 m/s
WAsP deduced parameters:	7,12 m/s
WAsP standard parameter:	6,99 m/s
Windsim:	6,47 m/s
SODAR:	7,42 m/s

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Conclusion

Many ways to predict a wind profile in a forest

Many possible results

Many possible errors

Still none of them may give the right result

So, measure at or near hub height (please!)