Simplified site assessment method

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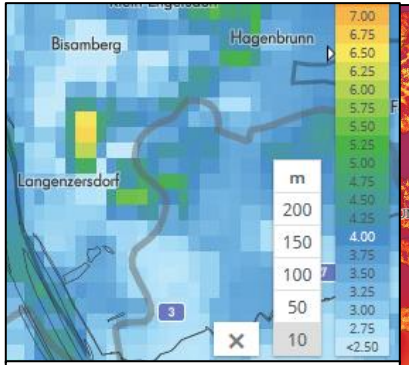
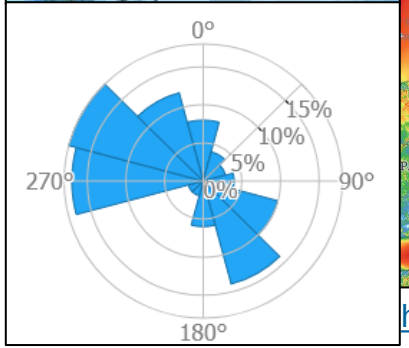
Site as key factor

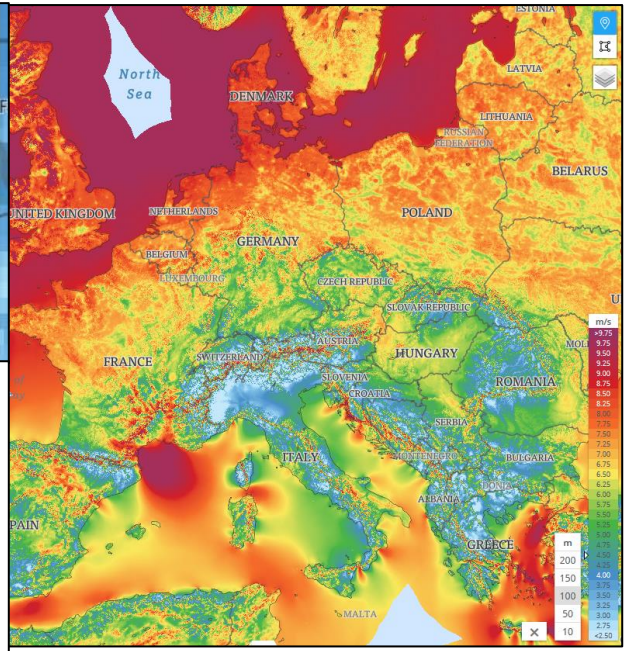
	Full load hours per year	Average annual wind speed	Wind energy per year
Excellent site	>1200	>5 m/s	>1280 kWh/m²a
Good site	800 – 1200	4 – 5 m/s	≤1280 kWh/m²a
Average Site	500 – 800	2.5 – 4 m/s	≤655 kWh/m²a
Bad Site	<500	<2.5 m/s	<160 kWh/m²a

Global Wind Atlas

- Advantages:
  - Average wind speed in 10, 50, 100, ...meters
  - Display of average wind speed on scale
  - Main wind direction (wind rose)
  - k and A factor (for Weibull distribution)
- Disadvantages:
  - Rough resolution (200 x 200 m)
  - Low accuracy
  - Few measuring stations



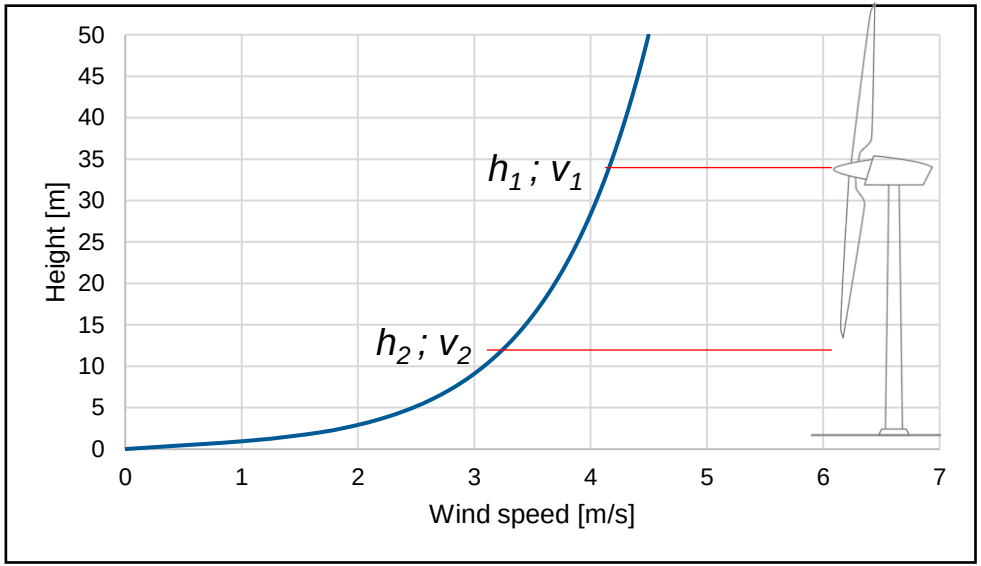




https://globalwindatlas.info/en

Method 1 – Rayleigh distribution

- Use of log wind profile
- Wind speed in 10m and 50m
- Calculation of surface roughness
- Calculation of wind speed in desired height
- Calculation of Rayleigh distribution



$$\frac{v_2}{v_1} = \frac{ln\left(\frac{h_2}{z_0}\right)}{ln\left(\frac{h_1}{z_0}\right)}$$

<u>Disadvantages:</u>

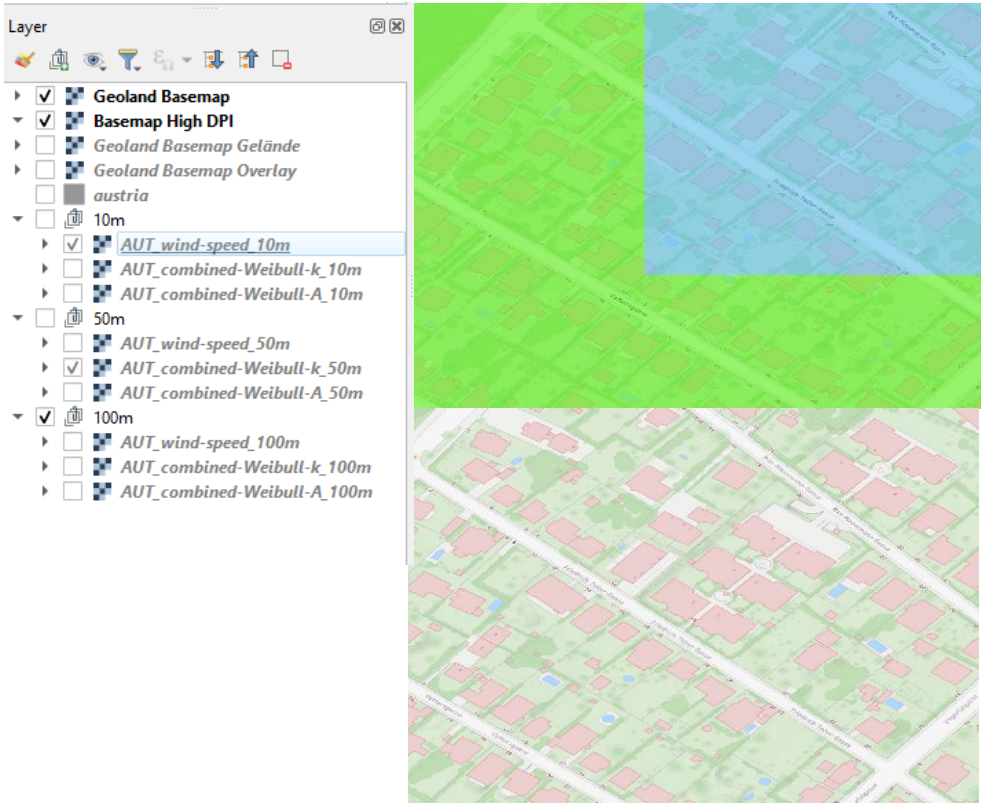
- High inaccuracy – distribution does not match measured data

Method 2 – Weibull distribution

- Export of A and k Values for desired height (10m, 50m, …) from Global Wind Atlas
- Export of maps and geo data of desired country
- Import of maps, geo data, A and k values into software (e. g. QGIS)
- Evaluation of A and k values
- Calculation of weibull distribution

<u>Disadvantages:</u>

- Need of GIS – Software (Geographic information system)
- Lot more time consuming



Wind distributions in the research park Lichtenegg

Measurement data:

- Average Windspeed = 5.05
- A Value = 5.62
- k Value = 1.84
- AEP - SWT (5kW): 9,266 kWh

Wind map data:

- Average Windspeed = 6.16
- A Value = 5.50
- k Value = 1.50
- AEP - SWT (5kW): 9,521 kWh

Results:

- Map data overestimates the average wind speed therefore Rayleigh distribution cannot be used accurately
- Map data provides good approximations with A and k Values
  - AEP difference between measurement and map data of 255 kWh → 2.68 %

Wind distributions in Vienna on the Energy Base

Measurement data

- Average Windspeed = 3.63 m/s
- A Value = 4.00
- k Value = 1.68
- AEP - SWT (5kW): 3,984

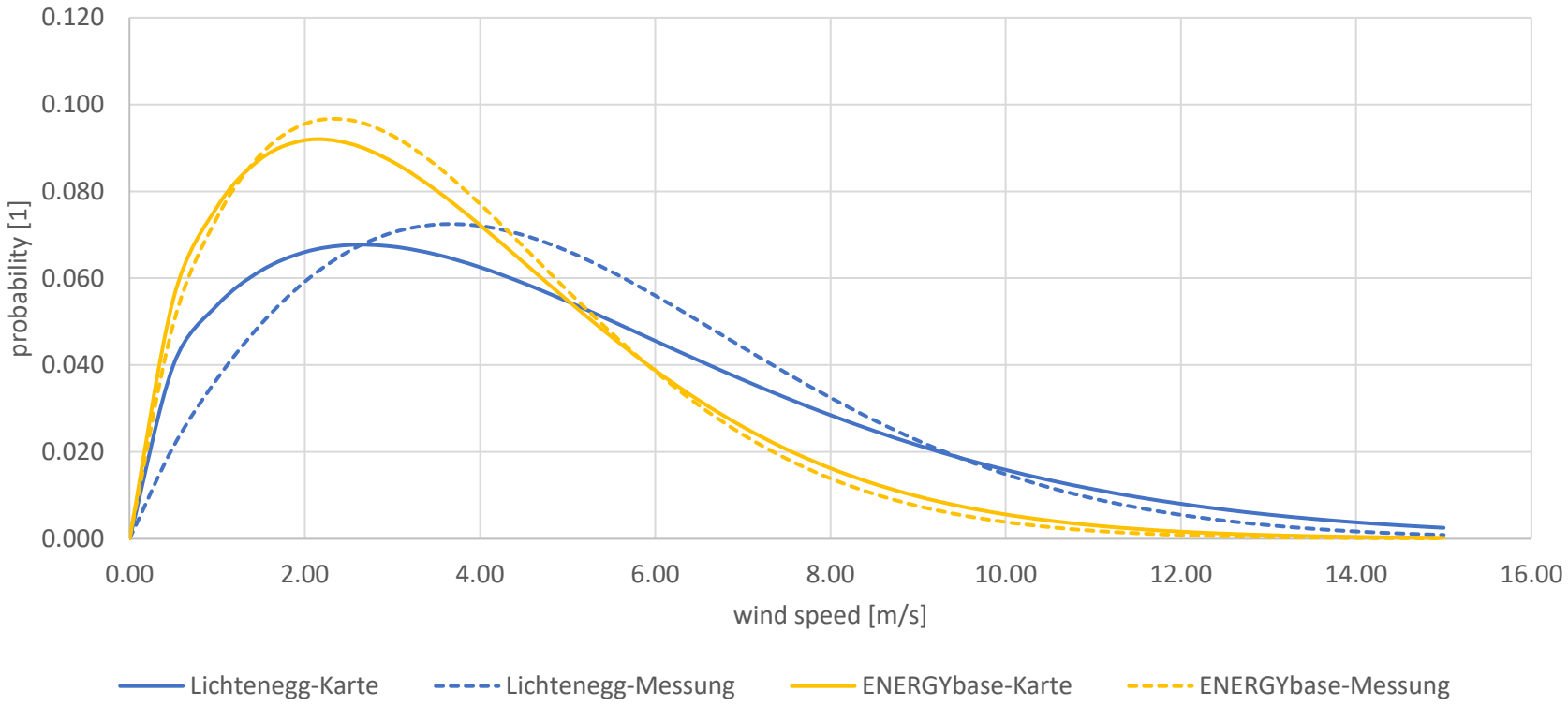
Wind map data:

- Average Windspeed = 3.90
- A Value = 4.11
- k Value = 1.57
- AEP - SWT (5kW): 4,663

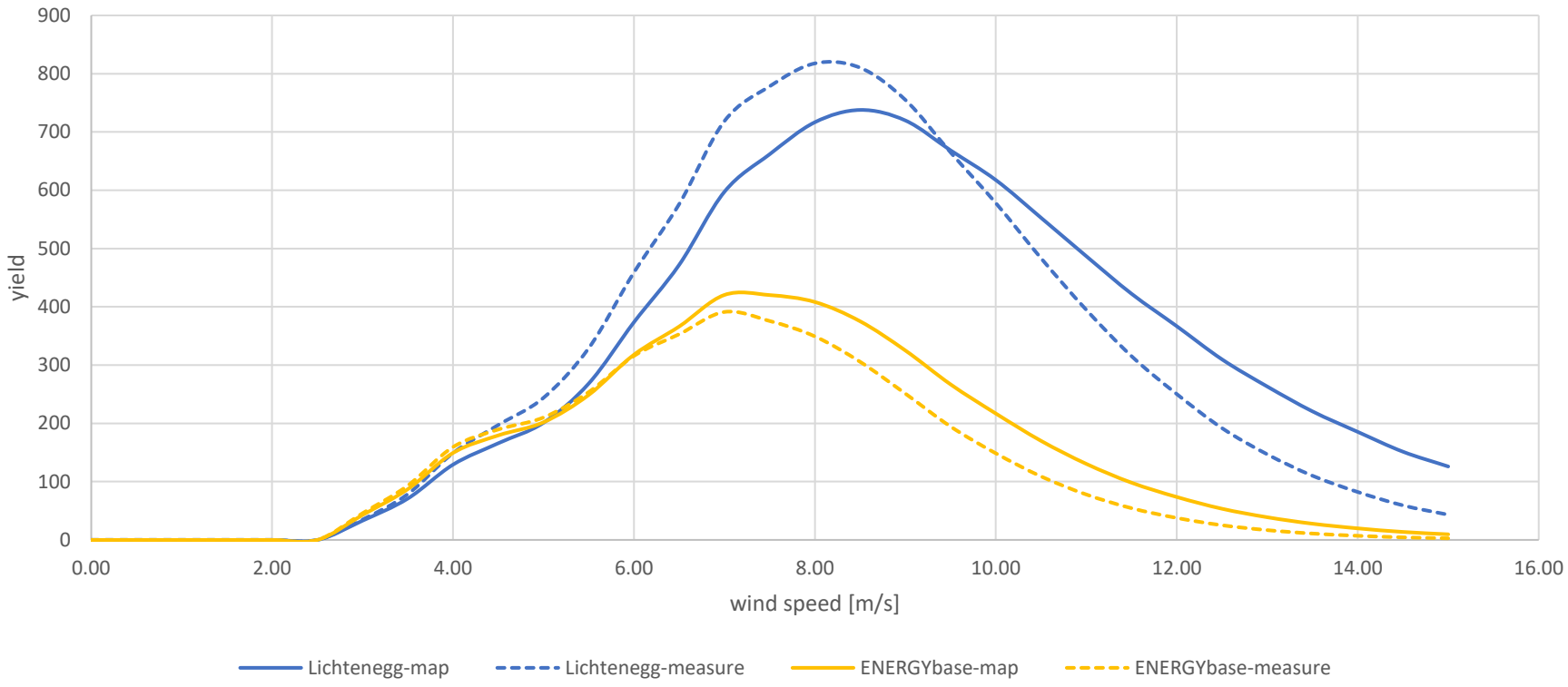
Results:

- Average wind speed overestimated.
- Approximation of Weibull values to 30m height.
  - AEP difference between measurement and map data of 679 kW → 14.56 %

Weibull distribution ENERGYbase (Vienna) vs. Lichtenegg



Yield ENERGYbase (Vienna) vs. Lichtenegg



Recommendations & Questions

- Approximation of A and k values for different heights ?
- Better wind data sources?

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