



• SOLAR • WIND • HYDRO • BIOMASS •

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A large, white, three-bladed wind turbine is shown from a low angle, extending from the bottom left towards the top right of the frame. The background is a clear, light blue sky.

energy producer &
service provider

A large, semi-transparent image of a white wind turbine is positioned on the left side of the slide, serving as a background for the text.

Wind climate weighting in big wind farm clusters





Wind climate weighting in big wind farm clusters

Description:

- In the presence of two or more measurement masts, the AEP of a WTG can be determined in different ways:
 - Model output based on the nearest wind climate input
 - Weighting of different wind climates based on different criteria:
 - Representativity (considering particular orography properties)
 - 3D - Distance
 - etc.



Wind climate weighting in big wind farm clusters

Important:

The slides will not show a “what-to-do” in order to find your perfect weighting strategy. It simply intends to raise awareness on the necessity of finding your own way, as:

- Weighting strategy is totally project-dependent
- Wind resource analyst needs to evaluate on what makes sense and what not, where the model can be trusted, where not, etc...



Wind climate weighting in big wind farm clusters

Situation right now in WindSim 9.0

- AEP calculation for each WTG and each wind climate input (.tws file)
- For 10 met masts, 10 AEP results are given for each WTG
- In “Results” - “All”, WindSim automatically weights WTG AEP results depending on the 3D-distance to the met masts
 - Weighting: $1/\text{Distance}$
 - Distance (WTG – Met Mast) = $(x^2 + y^2 + z^2)^{1/2}$
 - Example:



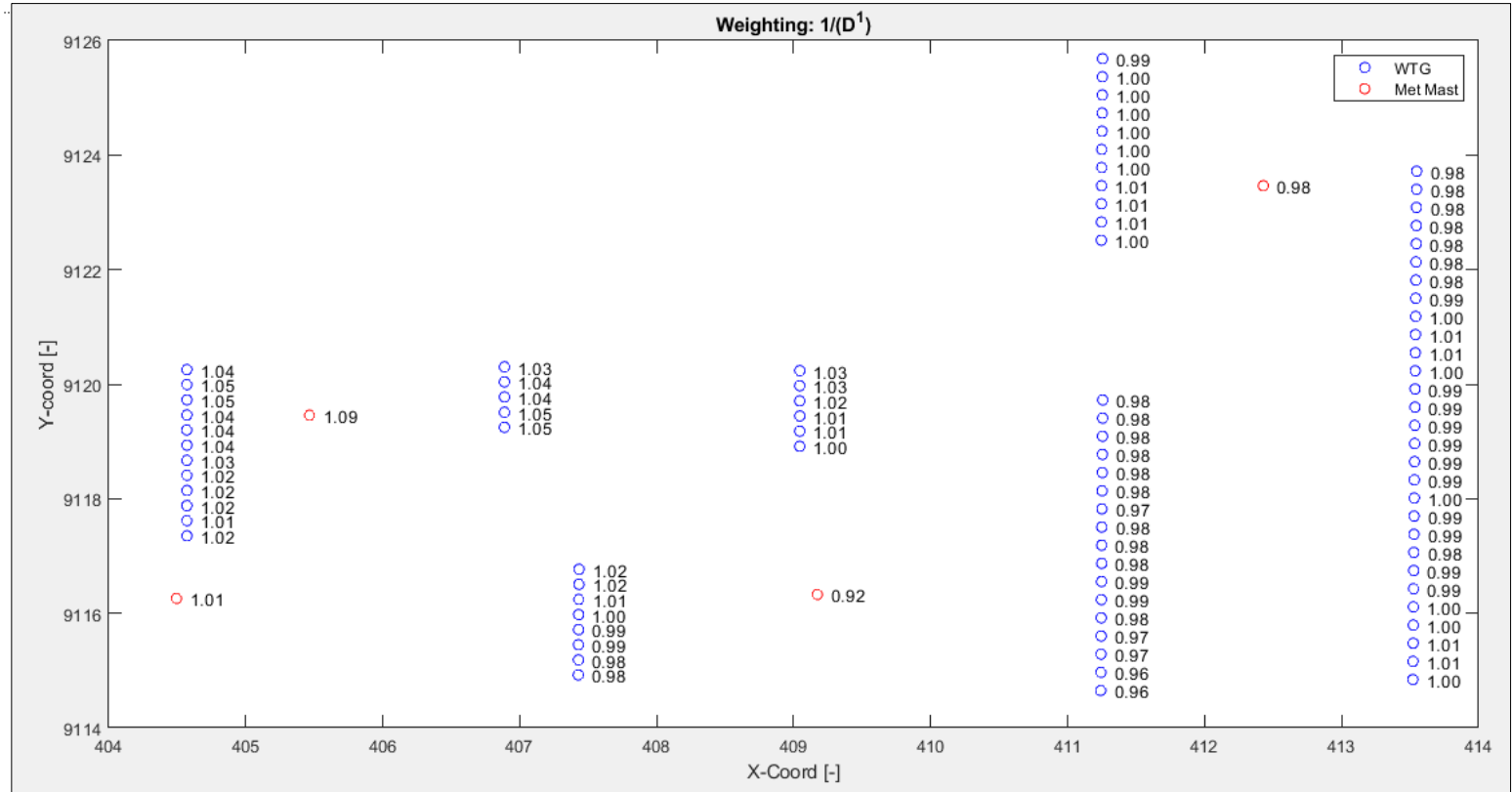
Wind climate weighting in big wind farm clusters

Wind farm complex in Brazil:

- Wind farm area: 10 x 15 km, smooth orography, uniform low roughness parameters, low turbulence, high mean wind speed speeds, high k-parameter, unidirectional wind
- 6 measurement masts, measurement height: 120 m
- 88 WTG (hub height: 120 m)
- Values present the ratios of the individual wind speeds at both met mast and WTG positions and the mean long-term value of all six met masts



Wind climate weighting in big wind farm clusters - 1 / D methodology





Wind climate weighting in big wind farm clusters – 1 / D methodology

Observations:

- Wind speed ratios at the WTG positions can differ significantly from the wind speeds at the closest met mast position
- Standard deviation of the WTG wind speed ratios is low
 - 1/D methodology averages out the WTG wind speed predictions
 - Local wind climates (measured) might not be well represented in the wind speed predictions at the nearby WTG
 - Distant met masts still have a considerable influence on the predicted wind speeds WTG positions



Wind climate weighting in big wind farm clusters – Test

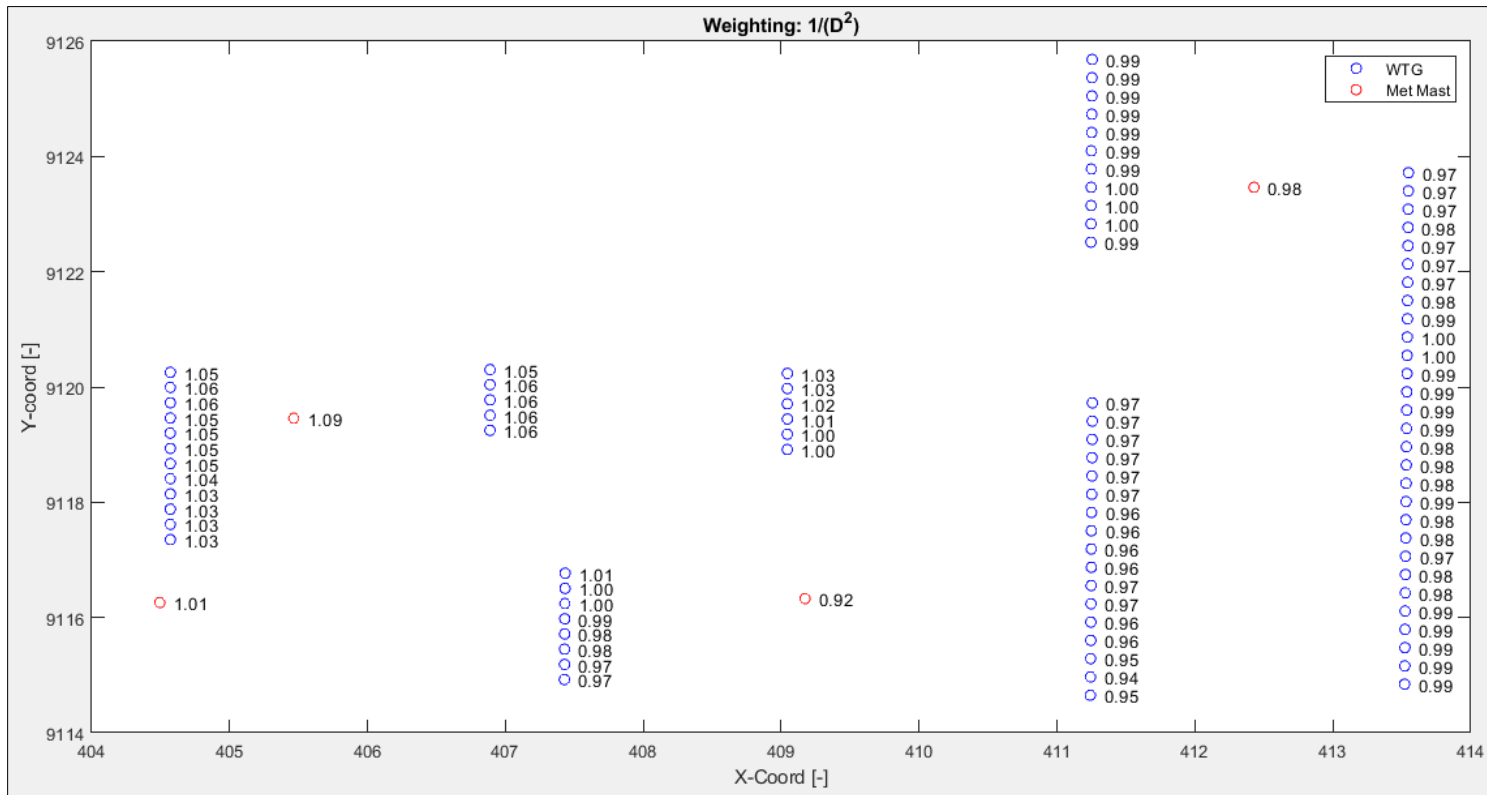
Test:

- Different weighting methodologies:
 - $1 / \text{Distance}^2$
 - $1 / \text{Distance}^3$
 - $1 / \text{Distance}^4$

Giving less weight to more distant met masts and vice versa.

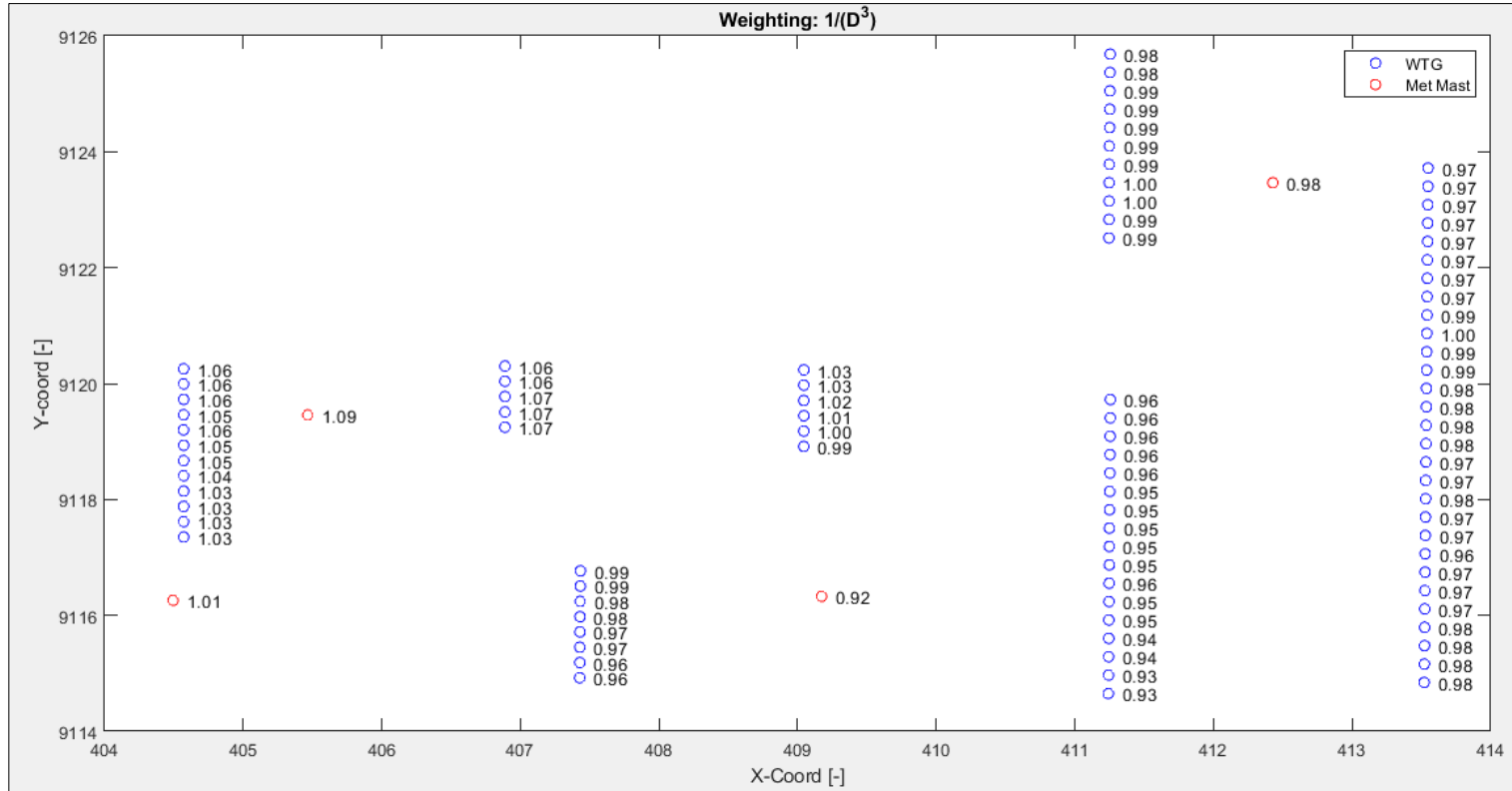


Wind climate weighting in big wind farm clusters - 1 / D² methodology



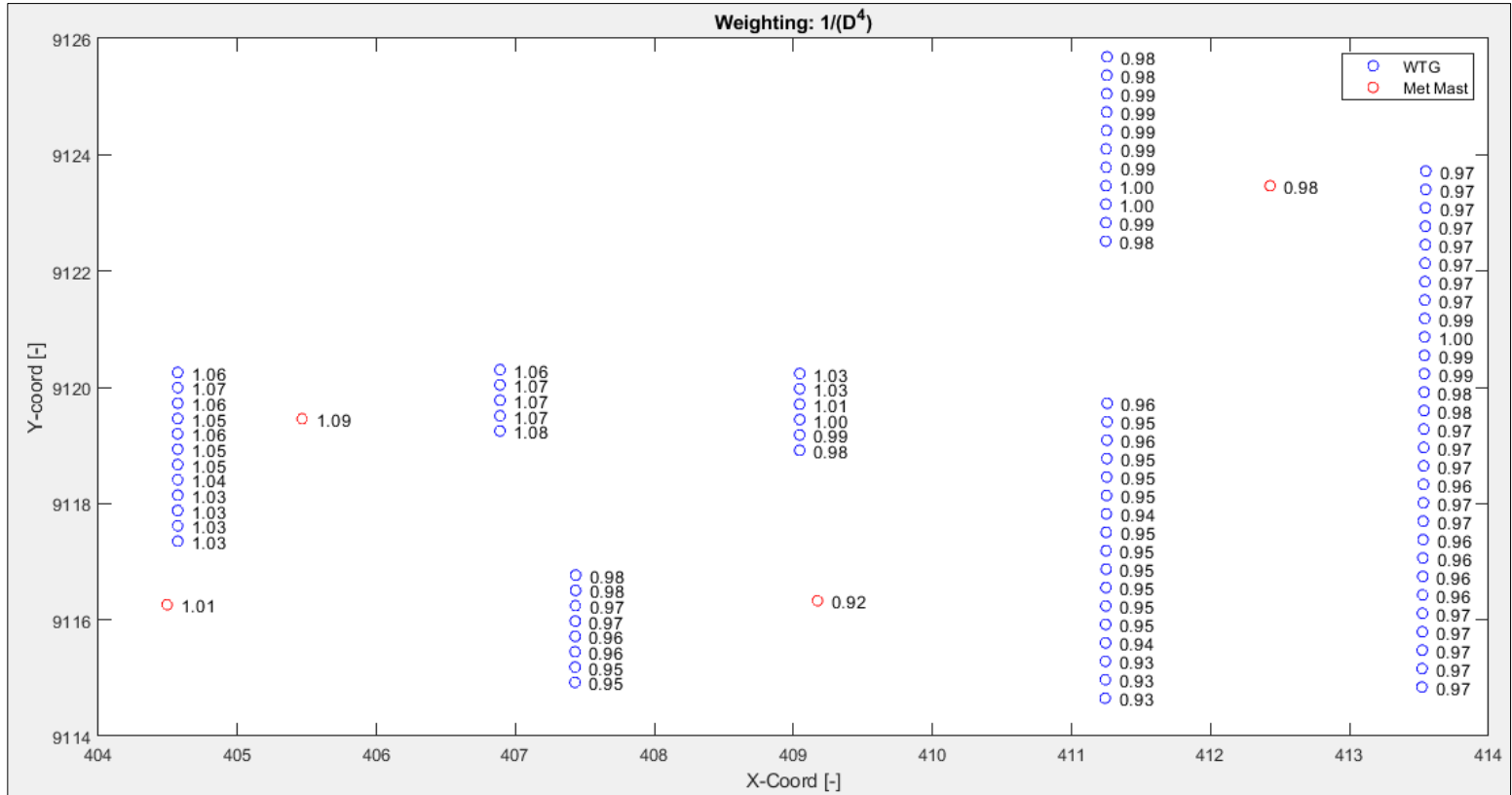


Wind climate weighting in big wind farm clusters - 1 / D³ methodology





Wind climate weighting in big wind farm clusters - 1 / D⁴ methodology





Wind climate weighting in big wind farm clusters – Resumé

Resumé:

- Important to test different weighting scenarios and their influence on the results.
- Evaluate which scenario makes most sense, trying to understand the flow model results and compare them against what you would expect on the site.
- And in case of doubts: Measure again if possible.



Wind climate weighting in big wind farm clusters

Thank you.

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