QUICK GUIDE - PARK WITH SCALER AND MEASURED WIND DATA

Purpose:

This quick guide shows you how to calculate expected Annual Energy Production (AEP) as time-step calculations based on local wind measurements.

Here, PARK calculates in time steps (e.g. 10 min) using measured data, with the SCALER extrapolating the measurements to each turbine position. The SCALER can handle multiple measurement heights and mast positions, and individual displacement heights by sector for individual masts and turbines. The SCALER transfer functions are obtained from WASP, WASP-CFD or FLOWRES (generalized format open for all model providers) calculations, and include speed up and veering. Also, measured turbulence can be transformed to turbine positions.

In this guide we assume you are familiar with the basic use of windPRO, like the creation of objects and how to import data into Meteo objects.

Outline of Guide:

- 1. License and version requirements
- 2. Setup input and data input in PARK
- 3. Calculation
- 4. Results of PARK calculation
- 5. Additional Scaler options

1. LICENSE AND VERSION REQUIREMENTS

WindPRO 4.1 or above, with license to the module PARK and METEO. Also, WASP (11 or above) must be installed.



2. SETUP AND DATA INPUT IN PARK

Establish the site measured wind data in Meteo Objects.

If not already established in the project:

- Insert the WTG objects to simulate.
- Establish roughness and elevation data and make a site data object linking these together.

3. CALCULATION

Upon starting PARK, choose the Time-varying calculation based on measured data.



After choosing the turbines for calculation in the **WTG** tab, go to **Scaling**. Here, select the wind data to be used. The model chosen later in the Scaler will be able to interpolate, if the hub height is between measurement heights, or to extrapolate, if it is above.

灯 P#	ARK (Wir	nd farm A	AEP based	on MODEL	or N	1ETEO)				
Main	Setup	WTGs	Scaling	Wake Po	wer	correction	Costs	Descrip	otion	
Scal	ing set	up								
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~	New S	Salem S	outh	Other/ur	1 <mark>knc</mark>					
>	59,23	m - A				\checkmark		10,0		1,0
>	48,90	m - B						10,0		1,0
>	39,98	m - C						10,0		1,0

Now choose the "EMD Default Measurement Mast Scaler", and access its Setup.

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e: EMD Default Measurement Mast Scale	ler 🗹 Terrain scaling 🖉 Post calibration
rain Displacement height Turbulence Po	Post calibration
caler type	
Meso-scale Data Downscaling	 Measured Data Scaling (Neutral stability / Raw flow)
Measured Data Scaling (WAsP Stability)	y / A-Parameter) Ouser Defined (experimental)
Description	
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Make sure the correct Site Data Object is chosen – or if WAsP-CFD, .flowres, .rsf or .siteres files should be used as the model. The number of sectors can be chosen as well (only if you're not using CFD results). This affects how many sectorwise transfer functions shall be calculated and, later, when scaling each time record from the time series. Normally, 12 is recommended. The use of 36 can, in some special cases, improve accuracy, but it requires very good data, e.g., a very high accuracy of the measured direction. Close the Setup with Ok.

More advanced options will be described later.

In the **Wake** tab, a list of wake models is available. The recommended one is the N.O. Jensen PARK2 (2018), which is default. In this model, the critical parameter is the Wake Decay Constant (WDC), whose default value for onshore sites is set as default (0.090). The WDC should be otherwise chosen based on ambient turbulence. If this is not available, different terrain types are listed together with their roughness class (RC) and length (z0) to help the user choose.

There are more **Advanced** options. If turbulence is available for the entire calculation period, the WDC can be controlled by turbulence in each time step – this is the easy and "safe" choice. For very large wind farms (+5 rows), deep-array model corrections are available.

Finally, the **Power curve correction** is entered. The recommendation here is only to activate the temperature correction, since this gives a more precise month by month calculation.

Include air density correction			
○ Fixed air density kg/m ³	Use standard (1.225 kg/m³)		
Elevation dependent air density	Data from setup will be used when no time varying correction or when no data available in a time series sample Station: MANDAN EXP STN V3 2014, Temperature base height: 533,4 m,		
✓ Use temperature in air density of	correction		
○ from scaler ● from meteo object:	EmdWrf_N46.732_W101.402 - 100.00 m -	View	
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If there is no temperature data in the measurements, it is possible to get temperature from mesoscale data out of models such as EMD-WRF, where an interpolation will be made in the hourly data to establish 10' data. The other corrections are more for "experimental use". In general, these do not affect the AEP result significantly.

Under **Output** tab, note especially the "Aggregate" options. By default, this is set to Month, partly to save memory. If there is a need for e.g. 10' values (for use in PERFORMANCE CHECK or for some detailed calculations in LOSS & UNCERTAINTY), this must be changed to "None".

Main Setup WTGs Scaling Wake Power correction Costs Out	Description
Output to PERFORMANCE CHECK and/or Result to File/Wake Cleani	ng/Hybrid/Cost functions
Individual results for ALL (relevant) WTGs	
 Individual results for SELECTED WTGs 	Select WTGs to include
\bigcirc Only SUM for turbines (NO data for PERF. CHECK/Wake cleaning	g) 🗌 Wind speeds inside wind farm 👔
Sum column only for NEW WTGs (if any, else for all)	Edit wake calculation settings
Addregated time series values	
Month	
Sector aggregation	
Jettora. 12	
Report features	
WTG area(s) on map: None selected	*
Handling of losses and uncertainties: (Decides text in report)	
Bring calculation to "bankable" level by using Loss & Uncerta	inty module
 Show results with no extra text explanation 	
 Add "simple reduction" with text: 	%
WTGs used in Time varying AEP report pages	
All new WTGs	
All existing park WTGs	
All existing non-park WTGs	
Use Reduction % from above in page on figures in reports	

Under Report features, the old default of adding a simple 10% reduction to roughly account for losses can be switched to *Bring calculation to "bankable" level*.

Now run the calculation.



The standard report document provides the calculation assumptions and gives the expected AEP as the average for the period calculated. There will automatically be compensation for data recovery, and, optionally, season unbiasing can be chosen. Note that free as well as wakereduced wind speeds are shown.

The strongest feature when calculating in time steps is the very detailed validation options offered. With the "result to file" output, the result in time can be taken into Excel for further processing or analyses.

5. ADDITIONAL SCALER OPTIONS

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eso-scale Data Downscaling Measured Data Scaling (Neutral stability / Raw flow)
asured Data Scaling (WAsP Stability / A-Parameter) User Defined (experimental)
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ors /directions: 36
ct site data object: for STATGEN -

Using the Scaler on local measurements offers additional choices.

- One is to use the "Neutral stability/Raw flow" as alternative to the "WAsP Stability/A Parameter": no atmospheric stability is applied, and a neutral atmosphere is assumed.
- The other is to use WAsP-CFD result files or FLOWRES files (from other CFD providers).