



QUICK GUIDE – MCP (MEASURE – CORRELATE – PREDICT)

Purpose:

The MCP module in WindPRO (completely revised for windPRO 3.2) enables you to create long-term corrected datasets, using short-term wind data from local measurements as input, and a long-term dataset.

Long term correction could be applied on the long term data sets or on the short term datasets. Several models are available for these two options:

1. Correction on long term datasets (output: long term corrected dataset)

- Linear regression
- Matrix
- Neural Network
- Simple Mean Wind Speed Scaling

2. Correction on short term dataset (output: local data corrected to be long term representative)

- Scaling local

This guide is intended to provide you with sufficient information on how to use and what to consider, when starting your long term analysis in the new MCP tool of windPRO 3.2.

Outline of Guide:

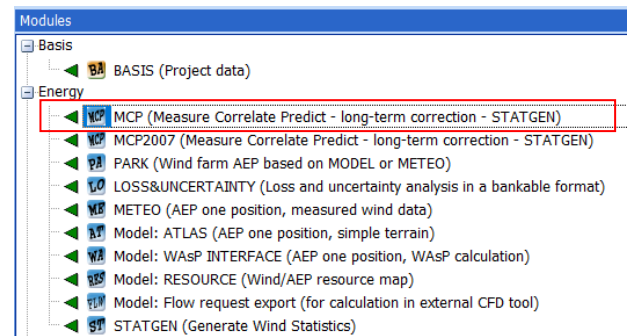
1. Data and licenses required
2. Setup input data in MCP
3. Data filtering in MCP
4. Model selection
5. Create long-term corrected series from MCP

1. DATA AND LICENCES REQUIRED

The MCP module is available under the Energy module group.

The following licensed modules are required to conduct a MCP calculation; Meteo and MCP.

If you want to generate a wind statistic, MODEL and WAsP is also required. A valid license is indicated by the green arrow placed in front of the module.



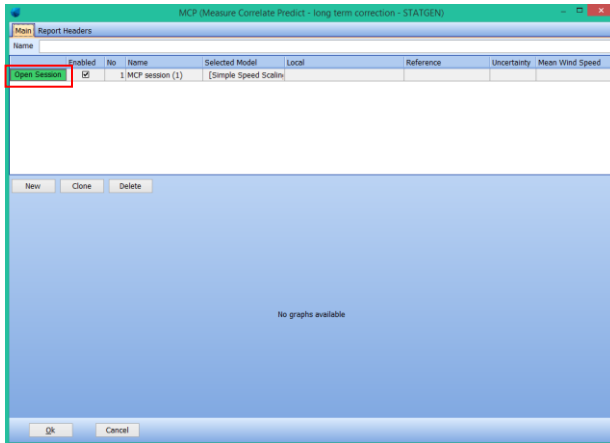
Your project should contain the following data to allow full functionality in MCP calculation:

- A Meteo object with local measurements.
- A long-term reference series, such as mesoscale dataset, reanalysis, METAR or SYNOP. These global datasets are available for download for windPRO users with a MCP license, an active service agreement and an internet connection. For some mesoscale products a subscription is required.
- Optional: For generating wind statistics as the output: A site data object containing topographic information: digital elevation and roughness model is required.

2. SETUP INPUT DATA IN MCP

Start MCP calculation from the Modules menu. Give your MCP calculation a name.

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On the **Main** tab you can start a new Session by selecting **New** and **Open Session**. Each session can have multiple models. Results produced by models within each session and multiple sessions can be compared.

On the **Measure** tab you select the input data desired for the first session.

Select your local wind measurements next to **1. Local measurements (site data)**

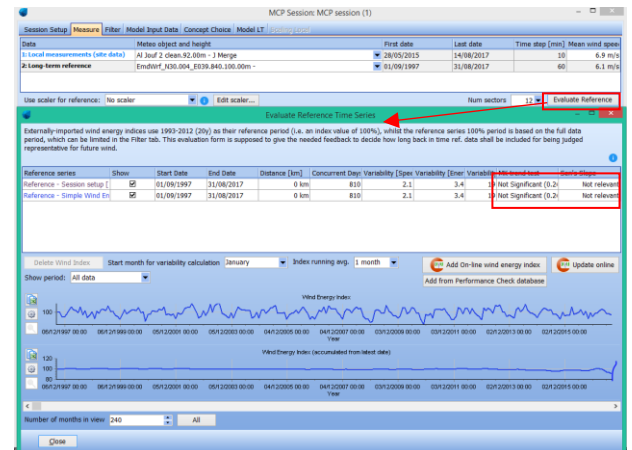
Next to **2. Long-term reference** select a long-term dataset. It is recommended to choose a dataset near your site, with a period length of 10 to 20 years. Mesoscale data or model data are preferable while local Synop or Metar data can often be unreliable and not long-term consistent.



To make a qualified choice on the long-term dataset the correlations both on the wind speed and energy should be analysed. To achieve this, the **Measure** tab provides an overview of several correlation parameters. Visual comparisons of frequency distribution, energy rose, and others are also available, for concurrent or full length periods.

Click the **Data Statistics** button to see a sector-wise correlation analysis between your measured and reference datasets.

The **Evaluate Reference** button gives you the option to analyze your reference dataset, in terms of trend (Mann Kendall trend test) and consistency.



With **Evaluate Reference** long-term wind energy indices can be downloaded or imported so comparisons of additional sources can be performed. This will help indicate which source is better for the specific measurement period and tell how far back in time the different sources seem consistent.

Click on **Add On-line wind energy index** to add one of the pre-run wind index. Depending on your project location, different wind indexes are available, such as EMD ConWx or EMDWrf (based on ERAInterim and ERA5 depending on time period), Merra 2 and CFSR. All indexes have a predefined time length of 20 years, from 1993 until 2012, selected to give 100% in average for entire period.

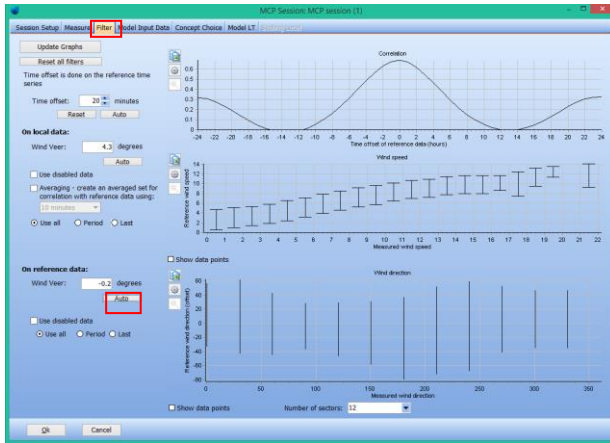
The indexes are created with the power curve defined under **Session Setup** tab. If no power curve is defined, a standard power curve based on u^2 truncated at 13 m/s is used.

With the **Add from Performance Check database** button, you can add your own created index from Performance check module.

3. DATA FILTERING IN MCP

In the **Filter** tab you can make adjustments to your input data, both local measurements and long term dataset. Modifications such as time offset, and veer correction can be performed. These offsets can be applied manually, or they can be calculated automatically with the **Auto** function. Special care should be taken as any offset will influence the final output.

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The three graphs provide a visual representation on the differences between local and reference time-series.

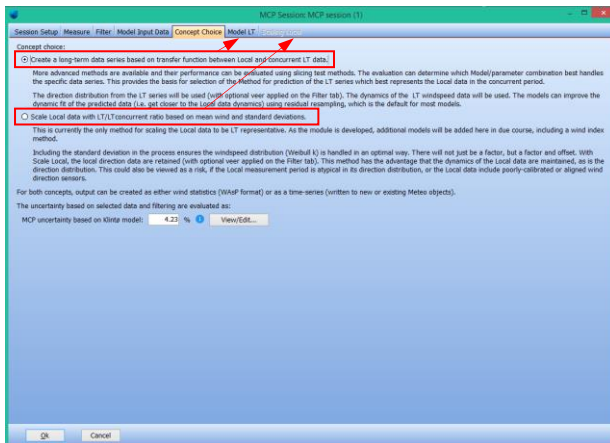
The veer correction can be applied both on local and reference datasets. If local measurements have a veer problem due to, for instance, a poorly calibrated wind vane, the veer correction should be applied here. In very complex terrain, mesoscale data can also experience veer problems.

The **Model Input Data** tab presents the same parameters as the **Measure** tab, but only for concurrent data and including all modifications made in the **Filter** tab.

4. MODEL SELECTION

At this stage we assume you have already selected one long-term dataset and filtered it, if considered appropriate.

Concept Choice tab allows you to select between two long term correction options.



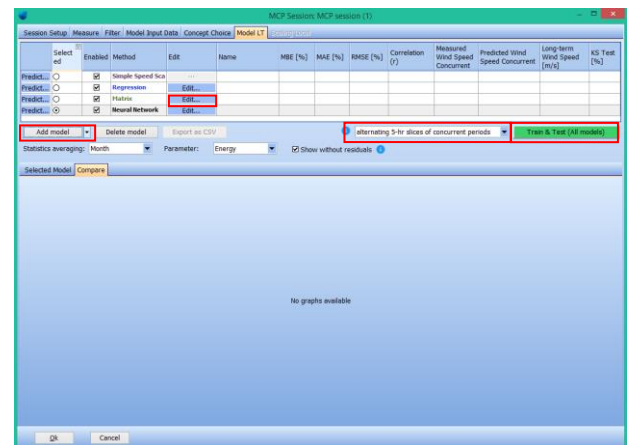
First choice 'Create a long term data series based on transfer function between local and concurrent LT data'

will activate the Model LT tab. Several long term correction models are available. All models apply the correction to the long term dataset, with the use of transfer functions. The output will be a long term corrected dataset.

The second choice 'Scale local data with LT/LT concurrent ratio based on mean wind speed and standard deviations' allows you to apply the correction on the local measurements (short term dataset). This correction is done in the **Scaling local** tab, which activates once you choose this option. This option has only one model, and the output of the correction is your local data corrected to be long term representative.

An uncertainty on the estimate is provided as guidance and can be used as input for in the Loss & Uncertainty module. Be aware that the inter-annual variability is included in the formula. The uncertainty figure is calculated based on the Klintø method. (Klintø, April 2015). This method considers four main parameters as uncertainty contributors to the overall estimate. These parameters are weighted based on their contribution to the long-term correction. The contributors are: The wind index in concurrent period; the correlation (Pearson factor) between short and long-term dataset; The inter-annual variability of the long-term dataset and the number of concurrent years between measurements and long-term series.

Model LT tab can be regarded as a dashboard. Here you can choose between four available models, to establish the transfer functions between measurements and reference data: Regression, Matrix, Neural Network and Simple Mean Wind Speed Scaling



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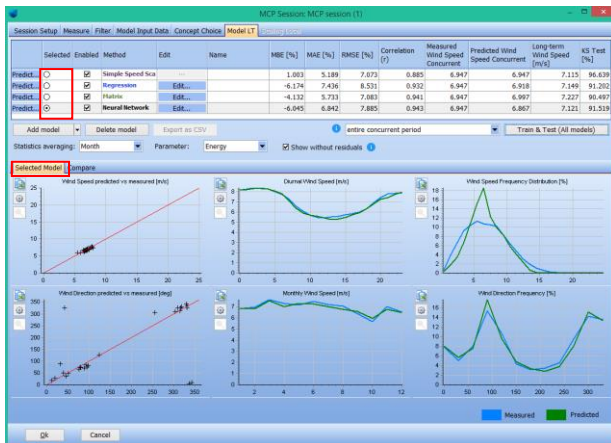
Click on **'Add model'** button to select one of these models. You can edit the parameters of these models by clicking the **'Edit'** button. For comparison purposes we recommend adding all four models in the list.

Select one of the slicing options available to train and test the models. Information on the slicing options and their meaning are found [here](#).

Click **Train and Test (All models)** button to run the long-term corrections.

After the models have run, the page will populate with results which help you choose one of all methods tested. In the table you can find information about the correlation, error, and long-term predicted mean wind speed.

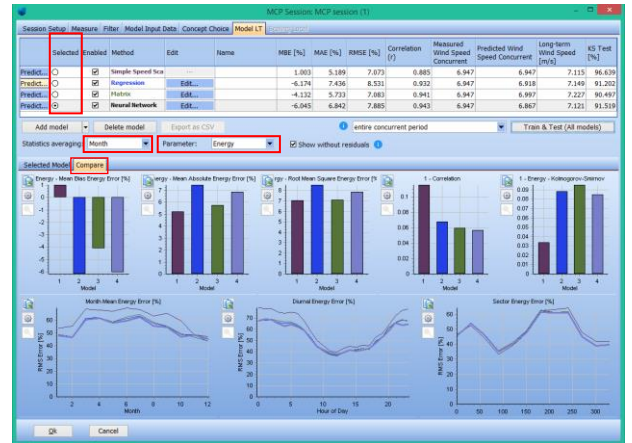
Graphs on the **Selected Model** tab below show a comparison between your measured dataset and the predicted dataset. Note, these graphs correspond to the selected model in the table (selection made using the radio buttons).



The **Parameters** drop-down menu lets you toggle between energy and wind speed errors and correlations.

The **Statistics-averaging** drop-down menu lets you change the averaging period of the compared datasets.

Click the **Compare** tab to get a visual overview of the errors and correlations between all used models.



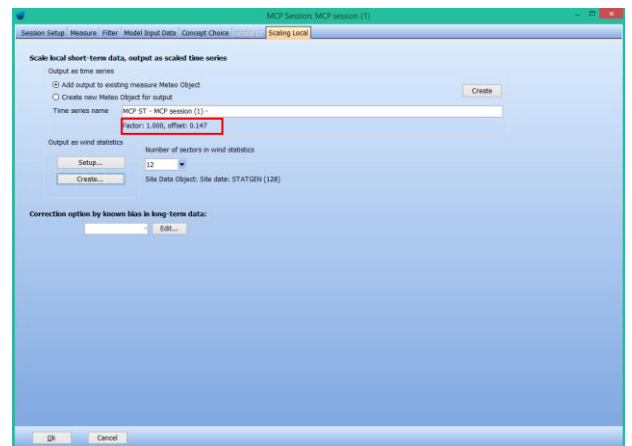
The color code seen in the MCP graphs represents the color-coded models (text color) selected in the table above.

Upon analyzing the results, you should select one model by selecting the corresponding radio button.

You can choose to view the comparisons with or without residuals. Residuals add noise to the predicted time-series, which move the wind speed distribution closer to real measurements. However, it reduces the correlation and increases the errors. A more "fair" measure for errors and correlations is seen without residuals.

When you have found a preferred method (model + parameter settings), click the **Predict** button next to it. This leads you to the output section.

Scaling Local tab allows you to scale the local short term data set by using a factor and an offset. These two parameters make it possible to correct both the wind speed and standard deviation from concurrent to long term conditions.



In this way both the mean wind speed and shape of the distribution are corrected. The two highlighted figures,

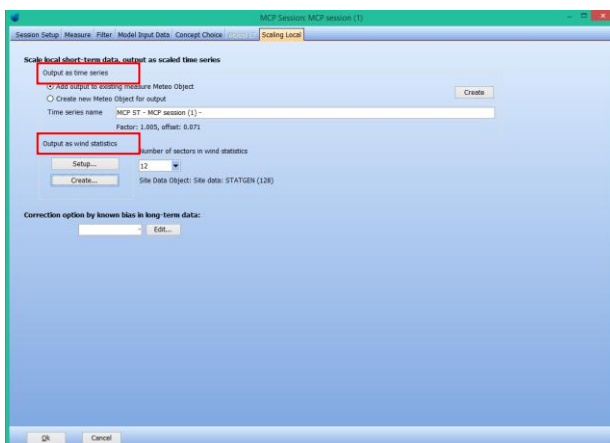
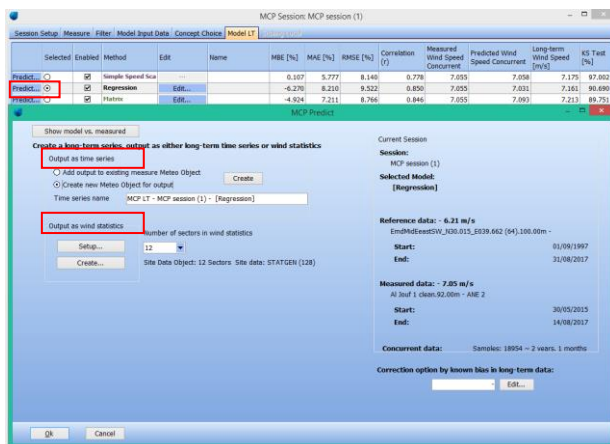
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factor and offset are based on the mean wind speed ratio and standard deviation between reference dataset and concurrent reference dataset. Formulas are available in the MCP manual, chapter 3.5.3.5.

5. CREATE LONG-TERM CORRECTED SERIES FROM MCP

The long-term corrected series can be created as a wind statistic and/or a time-series in a Meteo object. Generating a wind statistic requires you to select a previously-prepared Site Data Object, with roughness and orography. A WASP and MODEL license is required.

In **Model LT** tab you can create your data by pressing **Predict** button, while in **Scaling Local** tab data can be created directly from this window.

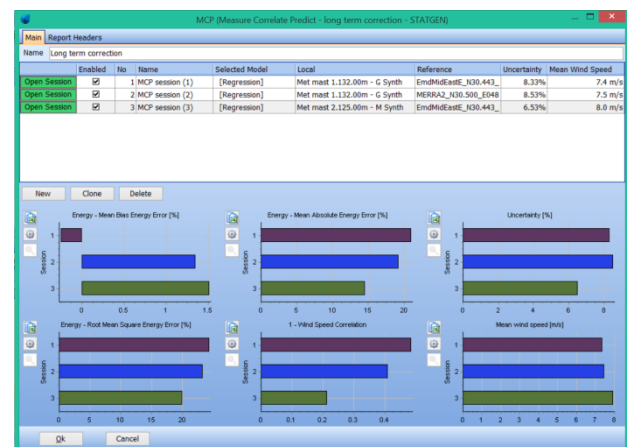


Under **'Output as time series'** select **'Create new Meteo Object for output'** and click on **Create** button. This will automatically create a new Meteo object or add to an existing object with the long-term corrected dataset. This will be based on the long-term reference series and the selected method.

As a second option, you can create a wind statistic under **'Output as wind statistics'**. Click on **Setup** to choose the preferred Site Data Object. By default, the wind statistics will be based on 12 sectors. You can change the number of sectors using the drop-down menu. Click on **Create** button to create a wind statistic.

Click **Ok** to return to the **Models** tab. Following the above method, you can create other wind statistics and time series from the already run correction models.

To return to **Main** window, click **Ok** in the current session window. In the **Main** window you can now see an overview of the created session.



You can start another session, independent of the previously created one.

Multiple sessions allows you to combine various long-term datasets with the same measurement mast or different sensors on the same mast. The overview window allows for comparison on the long-term corrected series, enabling you to decide which method to use for the final output.

Reports will show both the session overview and the details for each method within each session.

REFERENCES

Klintø, F. (April 2015). *Long-Term Correction - Uncertainty Model using different Long-Term data*. London: Wind Power Conference 2015 - Wind Resource Assessment.