

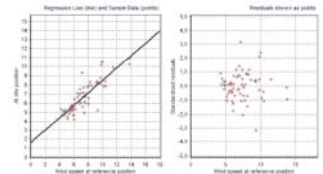
Function

The MCP (Measure-Correlate-Predict) module is for long-term correction of measured wind data on site based on correlation with long-term reference data.

Calculation models

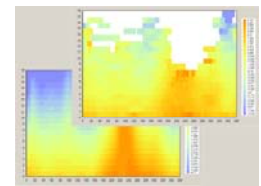
Linear Regression MCP

The (Linear) regression tool enables the user to inspect the fit directly through an animated graph. If the fit is not satisfactory, a wide range of parameters may be fine-tuned to provide a better fit. The regression tool is not limited to linear regression, but also higher order polynomials may be used in modelling wind speeds and wind veer.



Matrix MCP

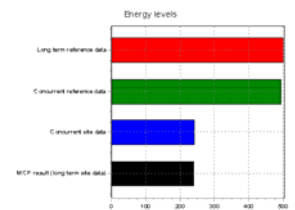
The matrix method in WindPRO models the changes in wind speed and wind direction through a joint distribution fitted on the 'matrix' of wind speed bins and wind direction bins. The user may choose to either use polynomials fitted to the data statistics or – where appropriate - to use the measured samples directly when doing the matrix MCP.



Weibull Scale MCP

The Weibull Scale method is a very simple empirical method, which does its manipulation directly on the Weibull form and scale parameters (A,k) as well as on the frequency distribution.

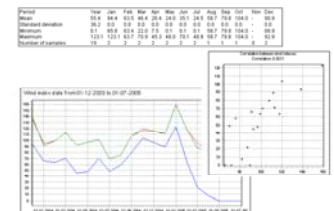
The Weibull scale method has the advantage, that it will match the nature of the wind at most places, but beware that application of this method should be done with caution on locations with significant non-Weibull distributions.



Wind Index MCP

The index correlation method typically uses monthly averages of the energy yield for the MCP analysis, thus disregarding the directional distribution of the winds. Even though this method may seem rather crude and primitive when comparing to other MCP methods, it has its advantages in stability and performance – even in the cases where other MCP methods seem to fail.

The Wind Index MCP method offers the opportunity to calculate the wind indexes using real power curves from the wind turbines included in the wind turbine catalogue in WindPRO. Also a generic power curve may be chosen.



Access to On-line Long-term Reference Data

Within the module, users can download NCEP/NCAR wind data sets from 1948 until now in a grid resolution of 2.5-degree longitude/latitude. These data can be imported directly into a Meteo object and used as long-term reference data.

Necessary Input Data (objects)

Please note that the objects are entered in the WindPRO module BASIS, where objects are put directly on a map and properties applied. The MCP module uses the Meteo object as a data container:



Meteo object: The data container for wind data either as time series data, table data or Weibull distribution parameters.

Results and Calculation Reports

The "end result" from the MCP analysis is a wind statistic generated with WAsP based on a terrain description and the long term corrected site data. This can be used directly in a PARK calculation or for a wind resource map calculation. For non-WAsP use or further analyses, the long term corrected site data can be exported as time series.

A very strong feature of the MCP module is the graphic comparison between local measurements and concurrent predictions based on long-term reference and calculated transfer function from any of the four methods.

Numerous reports are available, including a generalized overview report and a detailed report for each method used.

Project: CronalaghtMCP-1	Description: This project primarily illustrates how to calculate energy production, based on either EU-Wind Atlas data, or on local measurements. Also ATLAS contra WASP is illustrated, and the powerfull VISUAL module for exact positioning of the WTGs, measurement masts etc.	Printed/Page: 08-11-2006 10:28 / 1 Licensed user: EMD International A/S Niels Jernesvej 10 DK-9220 Aalborg Ø +45 9635 4444 Calculated: 08-11-2006 10:28/2.5.5.74
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MCP - Main report Regression MCP

Calculation: Two time series

1: Local measurements (site data)	Cronalaght met mast
Height	30,00 m
Period	14-01-1994 to 09-04-1996 2,2 years
Mean wind speed	9,40 m/s
Filters used	Not Filtered
2: Long term reference	Malin Head Long Term
Height	27,00 m
Period	01-01-1991 to 31-12-2004 14,0 years
Mean wind speed	8,09 m/s
Filters used	Not Filtered

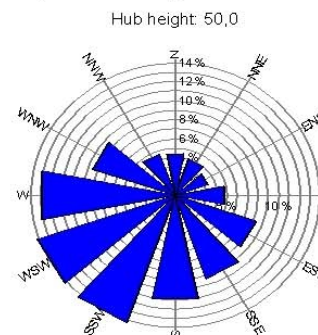
Calculation setup

Method	Find transfer function for each 1 degree
Sector window	30,00 [deg]
Skip angle differences larger than	360,00
Skip wind speeds less than	2,00
Regression model (wind speed)	Linear (1st order polynomial)
Regression model (wind direction)	Constant (0th order polynomial)
Wind speed model - use residual resampling	Yes
Wind direction model - use residual resampling	No

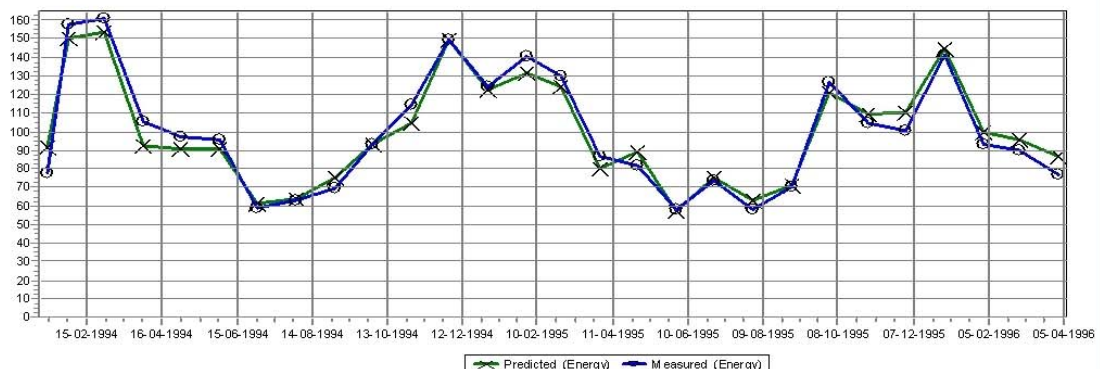
Results

Measure height	30,0 m
Wind energy	198,6
WTG energy	185,3
Very long term wind	105,3 %
r - wind speed	0,8828
s - wind speed	3,3173 m/s
r - wind index	0,9724
s - wind index	5,7718 %
Time of calculation	08-11-2006 10:20:25

Expected long term WTG energy direction distribution AT SITE



Comparing measured and predicted data



WindPRO is developed by EMD International A/S, Niels Jernesvej 10, DK-9220 Aalborg Ø, Tlf. +45 96 35 44 44, Fax +45 96 35 44 46, e-mail: windpro@emd.dk

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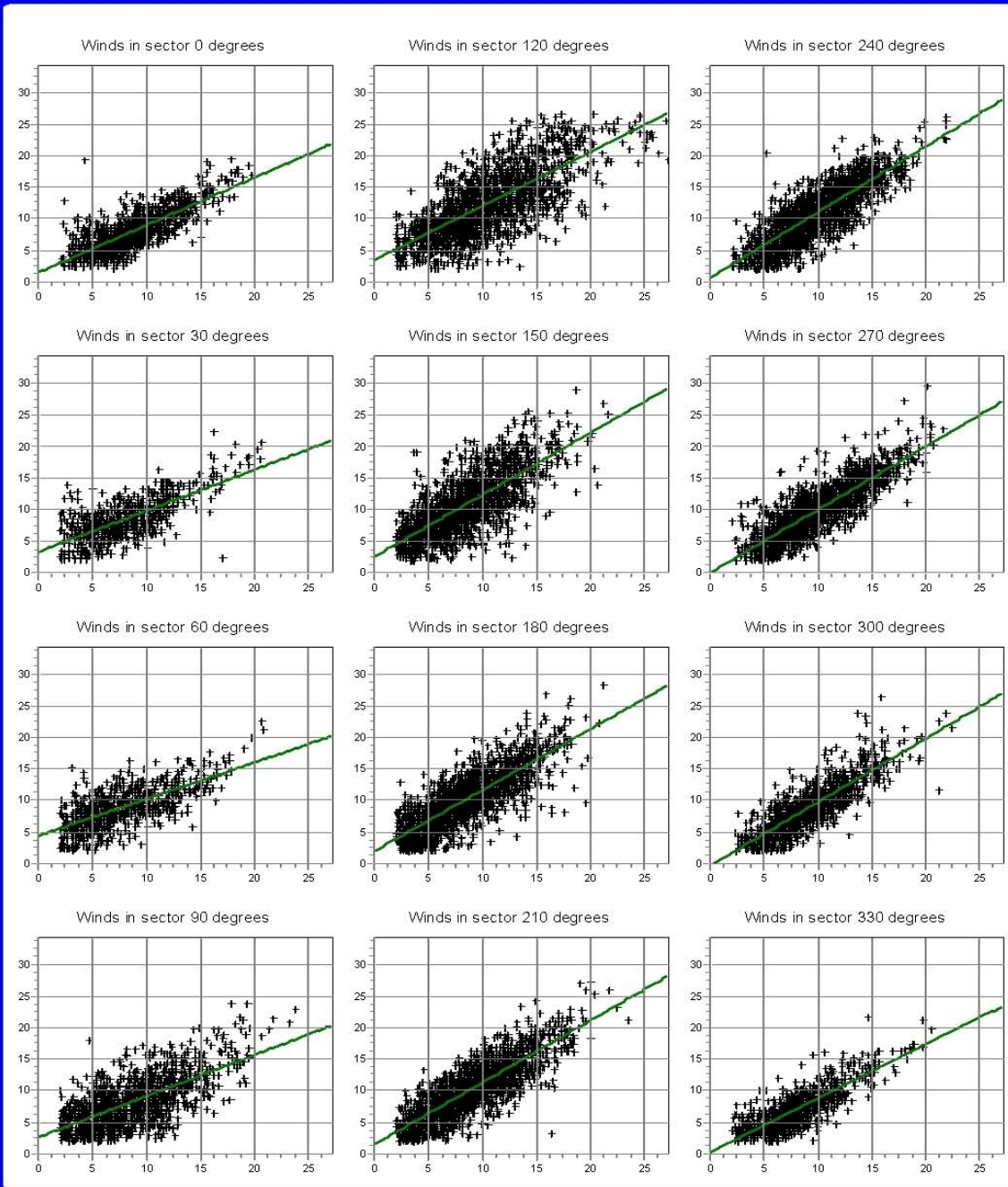
EMD International A/S
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+45 9635 4444

Calculated:

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MCP - Linear MCP report - details on wind speed fit

Calculation: Two time series



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MCP - Wind Index Calculation - results

Calculation: Two time series

Wind index results for the total period considered

Very long term wind index: 100,0
Index for the reference period:95,0
Index for the reference period (concurrent period): 103,1
Index for the local data (concurrent period):103,1
Long term correction factor: 0,92

WTG Power curve used: Generic power curve based on squares of wind speeds, with stall onset set to 14,00 m/s.
Only months with at least 60,0 % data availability have been used.

Wind speed scaling: Scale both site and reference to mean wind speed 8,00 m/s

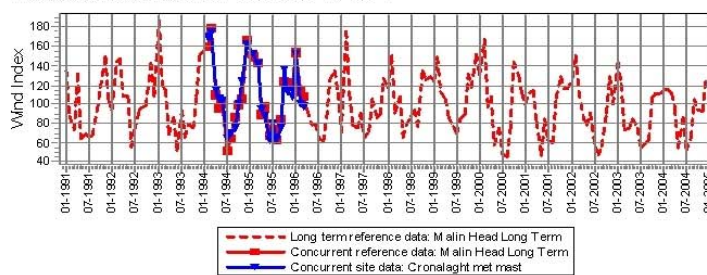
Monthly wind indices - Long term reference data: Malin Head Long Term

Period	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	100,2	128,8	137,1	113,5	95,6	77,0	77,2	65,7	67,0	86,2	111,0	119,6	123,5
Standard deviation	31,1	29,6	25,3	28,2	17,4	17,7	13,5	13,2	14,9	15,4	21,2	17,5	19,9
Minimum	44,4	69,9	67,0	72,8	68,9	46,3	51,7	48,5	44,4	55,9	74,8	89,9	99,9
Maximum	187,8	187,8	175,3	178,6	132,1	108,7	100,6	93,3	94,7	106,2	143,9	149,9	166,4
Number of samples	168	14	14	14	14	14	14	14	14	14	14	14	14

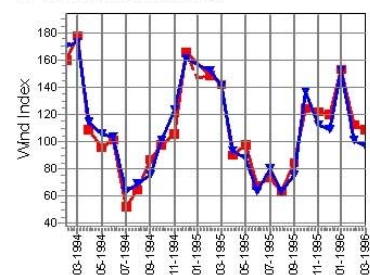
Monthly wind indices - Concurrent site data: Cronalaght met mast

Period	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	109,0	152,5	141,1	137,2	103,8	96,8	83,2	71,7	65,7	75,4	118,7	118,2	135,1
Standard deviation	34,5	-1,0	36,0	38,7	14,7	12,3	29,0	11,6	3,8	0,2	25,6	7,8	37,5
Minimum	62,7	152,5	100,8	96,8	93,4	88,0	62,7	63,4	63,0	75,2	100,6	112,7	108,5
Maximum	174,0	152,5	170,2	174,0	114,1	105,5	103,7	79,9	68,4	75,5	136,8	123,7	161,6
Number of samples	25	1	3	3	2	2	2	2	2	2	2	2	2

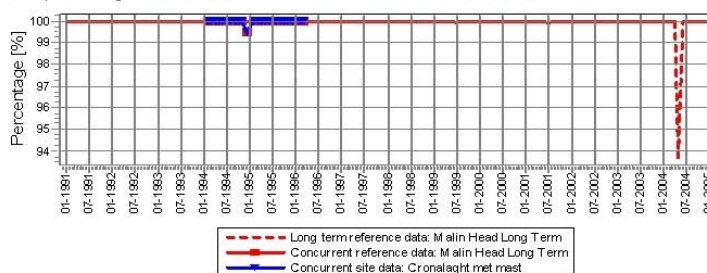
Wind index data from 01-01-1991 to 01-12-2004



01-02-1994 to 01-03-1996



The percentage of data available in each month from 01-01-1991 to 01-12-2004



Correlation between wind indices
Correlation: 0,9679

