

**ANEXO**  
**ESTUDOS ANEMOLÓGICOS**

# Relatório do Mastro do Local TP\_2839

## Meteo data report - Main results

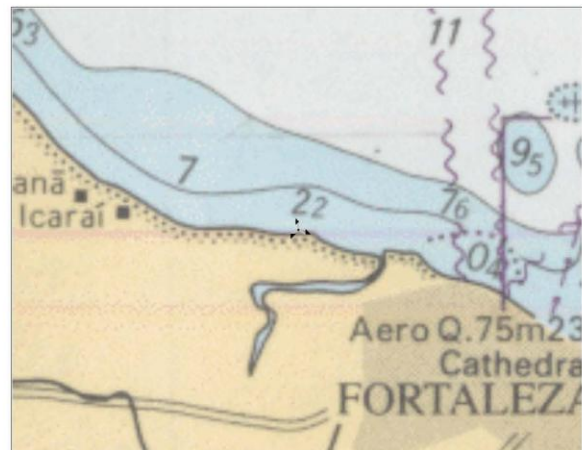
**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

Mast position: UTM WGS84 S Zone: 24 East: 543.279 North: 9.592.142

Measurement heights and wind speeds (in this report)

Disabled data not included in overview table below

ID	Height [m]	Data recovery [%]	Records	U_max [m/s]	U_mean *) [m/s]
60,00m - 1	60,00	87,4	161599	18,5	7,6
60,00m - 1 Subst#)	60,00	94,1	175204	18,5	7,5
60,00m - 3	60,00	91,6	124684	16,4	7,7
40,00m - 2	40,00	72,7	133260	18,0	6,9

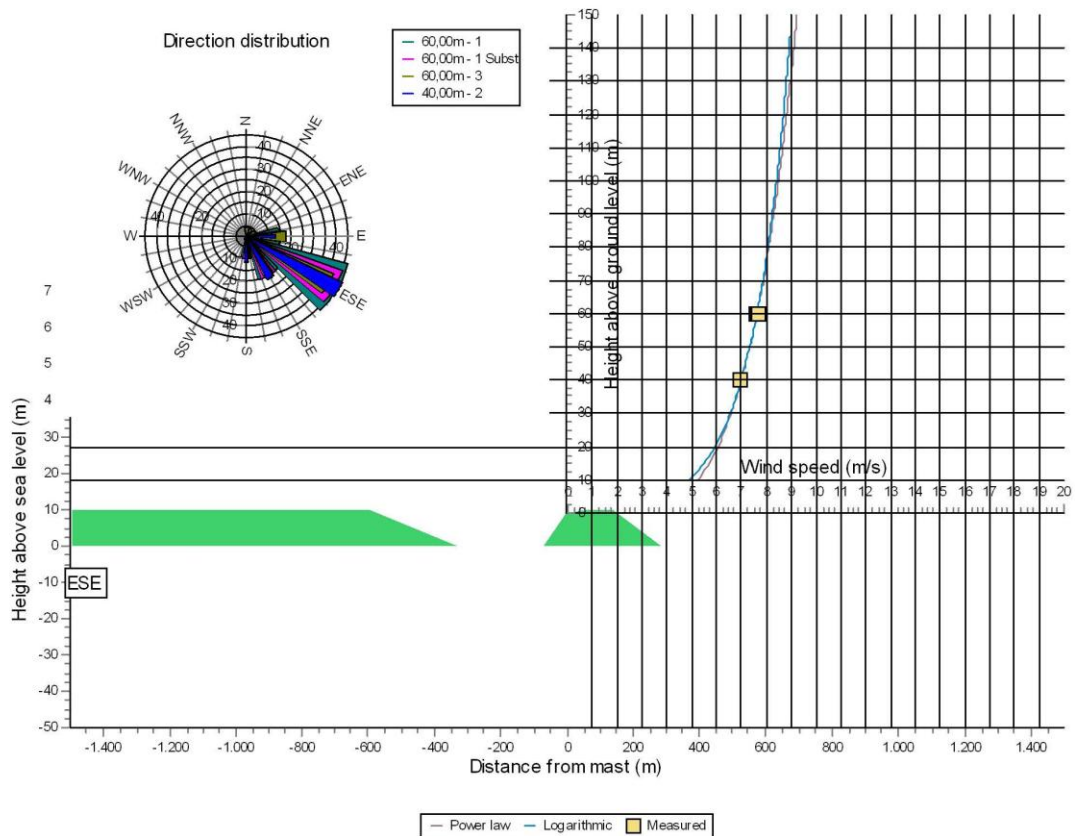


Scale: 200.000

\*) U\_mean is simple arithmetic average

#) Chosen as fixed height in profile graph

Mean wind profile for all concurrent data and terrain profile for the most frequent sector of height: 60,00m - 1: ESE (left side)



Profile characteristics for best curve fit through all data (Note: Values are only fully valid in flat terrain)

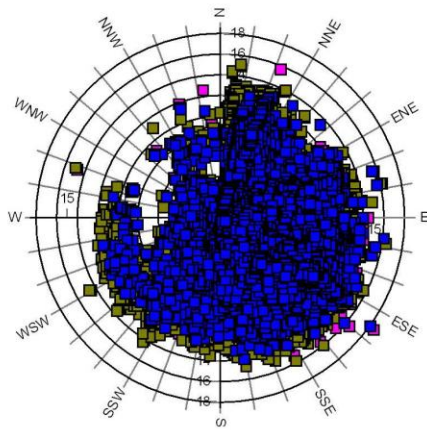
Shear exponent 0,2094 (Power law profile)

Roughness length 0,4118 m class 3,02 (Equivalent roughness for logarithmic profile)

# Meteo data report - Main results

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

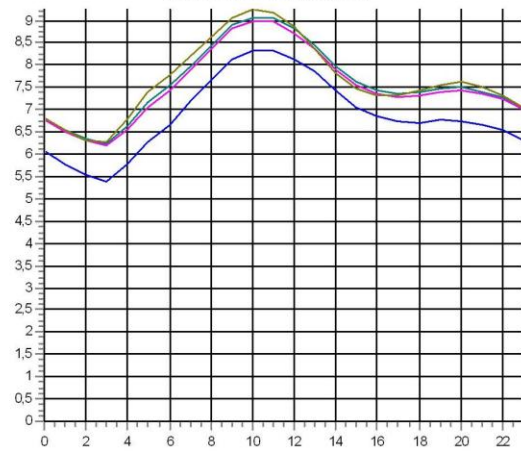
Wind speed/direction



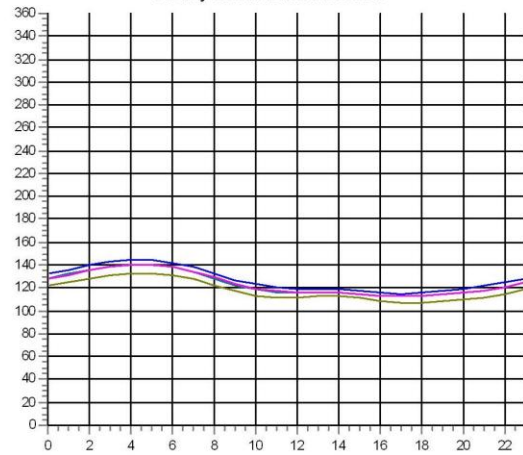
## Statistics

Signal	Unit	Count	Of period [%]	Mean	Weibull mean	Weibull A	Weibull k
60,00m - 1	Mean wind speed, all	m/s	161599	100,0	7,60		
60,00m - 1	Wind direction, all	Degrees	161599	100,0	122,99	7,65	8,46
60,00m - 1	Turbulence intensity, all		161599	100,0	0,16		
60,00m - 1	Turbulence intensity, enabled		151098	93,5	0,08		
60,00m - 1 Subst	Mean wind speed, all	m/s	175204	100,0	7,53	7,58	8,40
60,00m - 1 Subst	Wind direction, all	Degrees	175204	100,0	123,12		
60,00m - 1 Subst	Turbulence intensity, all		175204	100,0	0,16		
60,00m - 1 Subst	Turbulence intensity, enabled		162547	92,8	0,08		
60,00m - 3	Mean wind speed, all	m/s	124684	100,0	7,66	7,76	8,58
60,00m - 3	Wind direction, all	Degrees	124686	100,0	117,51		
60,00m - 3	Turbulence intensity, all		124684	100,0	0,11		
60,00m - 3	Turbulence intensity, enabled		114890	92,1	0,10		
40,00m - 2	Mean wind speed, all	m/s	133260	100,0	6,86	6,91	7,70
40,00m - 2	Wind direction, all	Degrees	133260	100,0	126,94		
40,00m - 2	Turbulence intensity, all		133260	100,0	0,12		
40,00m - 2	Turbulence intensity, enabled		117543	88,2	0,11		

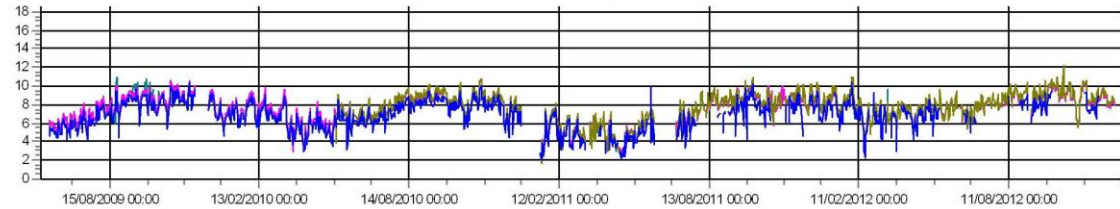
Hourly mean w ind speed



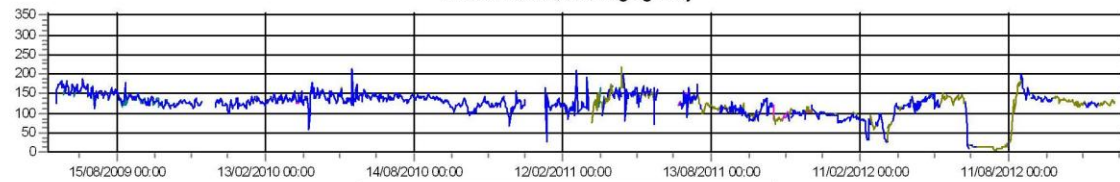
Hourly mean w ind direction



Wind speed, Averaging: Day



Wind direction, Averaging: Day



— 60,00m - 1 — 60,00m - 1 Subst — 60,00m - 3 — 40,00m - 2

## Meteo data report - Import filters, files and heights

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

### Import filter: I1

Files/Folders

\\192.168.1.5\Med-Tp\ARCHIVIO ANEMOMETRI TEN PROJECT\ESTERO\BRASILE\CAUCAIA\_IPARANA\Iparana Old Logger (2839).txt

Time zone for measurements: Same as in the project properties: (UTC-03:00) Brasilia

Line with header: 141

Header field separator: "Tab"

First line with data: 142

Data field separator: "Tab"

Column	Channel	Type	Sub type	Unit	Height	Name
1		Time stamp	Date&Time	d/m/y h:m:s		
2	1	Wind speed	Mean	m/s	60,00 m	CH1Avg
3	1	Wind speed	StdDev	m/s	60,00 m	CH1SD
4	1	Wind speed	Max	m/s	60,00 m	CH1Max
5	1	Wind speed	Min	m/s	60,00 m	CH1Min
6	2	Wind speed	Mean	m/s	40,00 m	CH2Avg
7	2	Wind speed	StdDev	m/s	40,00 m	CH2SD
8	2	Wind speed	Max	m/s	40,00 m	CH2Max
9	2	Wind speed	Min	m/s	40,00 m	CH2Min
10	3	Wind speed	Mean	m/s	60,00 m	CH3Avg
11	3	Wind speed	StdDev	m/s	60,00 m	CH3SD
12	3	Wind speed	Max	m/s	60,00 m	CH3Max
13	3	Wind speed	Min	m/s	60,00 m	CH3Min
26	7	Wind direction	Mean	Degrees	60,00 m	CH7Avg
27	7	Wind direction	StdDev	Degrees	60,00 m	CH7SD
28	7	Wind direction	Max	Degrees	60,00 m	CH7Max
29	7	Wind direction	Min	Degrees	60,00 m	CH7Min
30	8	Wind direction	Mean	Degrees	40,00 m	CH8Avg
31	8	Wind direction	StdDev	Degrees	40,00 m	CH8SD
32	8	Wind direction	Max	Degrees	40,00 m	CH8Max
33	8	Wind direction	Min	Degrees	40,00 m	CH8Min

### Import filter: I2

Files/Folders

\\192.168.1.5\Med-Tp\ARCHIVIO ANEMOMETRI TEN PROJECT\ESTERO\BRASILE\CAUCAIA\_IPARANA\Iparana New Logger (5364).csv

Time zone for measurements: Same as in the project properties: (UTC-03:00) Brasilia

Line with header: 171

Header field separator: "; (Semicolon)"

First line with data: 172

Data field separator: "; (Semicolon)"

Column	Channel	Type	Sub type	Unit	Height	Name	Scale	Offset
1		Time stamp	Date&Time	dd/mm/yyyy hh:mm			1,0000	0,0000
2	1	Wind speed	Mean	m/s	60,00 m	CH1Avg	0,9948	0,0218
3	1	Wind speed	StdDev	m/s	60,00 m	CH1SD	1,0000	0,0000
4	1	Wind speed	Max	m/s	60,00 m	CH1Max	0,9948	0,0218
5	1	Wind speed	Min	m/s	60,00 m	CH1Min	0,9948	0,0218
6	2	Wind speed	Mean	m/s	40,00 m	CH2Avg	1,0000	0,0000
7	2	Wind speed	StdDev	m/s	40,00 m	CH2SD	1,0000	0,0000
8	2	Wind speed	Max	m/s	40,00 m	CH2Max	1,0000	0,0000
9	2	Wind speed	Min	m/s	40,00 m	CH2Min	1,0000	0,0000
10	3	Wind speed	Mean	m/s	60,00 m	CH3Avg	1,0091	-0,1132
11	3	Wind speed	StdDev	m/s	60,00 m	CH3SD	1,0000	0,0000
12	3	Wind speed	Max	m/s	60,00 m	CH3Max	1,0091	-0,1132
13	3	Wind speed	Min	m/s	60,00 m	CH3Min	1,0091	-0,1132
26	7	Wind direction	Mean	Degrees	60,00 m	CH7Avg	1,0000	0,0000
27	7	Wind direction	StdDev	Degrees	60,00 m	CH7SD	1,0000	0,0000
28	7	Wind direction	Max	Degrees	60,00 m	CH7Max	1,0000	0,0000
29	7	Wind direction	Min	Degrees	60,00 m	CH7Min	1,0000	0,0000
30	8	Wind direction	Mean	Degrees	40,00 m	CH8Avg	1,0000	0,0000
31	8	Wind direction	StdDev	Degrees	40,00 m	CH8SD	1,0000	0,0000
32	8	Wind direction	Max	Degrees	40,00 m	CH8Max	1,0000	0,0000
33	8	Wind direction	Min	Degrees	40,00 m	CH8Min	1,0000	0,0000





### Meteo data report - Missing data wind speed and direction - calendar view

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

Height: 60,00m - 3

- some records missing, disabled, erroneous, or out of range current day
- all records missing, disabled, erroneous, or out of range current day

Month/Year	%	Total	Day																																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
May/2010	0,0	0	0																																
Jun/2010	0,0	0	0																																
Jul/2010	0,0	0	0																																
Aug/2010	0,0	0	0																																
Sep/2010	0,0	0	0																																
Oct/2010	0,0	0	0																																
Nov/2010	0,0	0	0																																
Dec/2010	8,1	360	0																																
Jan/2011	66,3	2958	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	78	0	0	0	0	0	0	0	
Feb/2011	0,0	0	0																																
Mar/2011	15,7	702	0																																
Apr/2011	0,0	0	0																																
May/2011	0,0	0	0																																
Jun/2011	72,2	3120	0																																
Jul/2011	31,7	1414	144	144	144	144	34	0	0	0	0	0	0	0	0	0	0	0	74	113	144	144	144	144	144	144	144	41	0	0	0	0	0	0	0
Aug/2011	0,0	0	0																																
Sep/2011	3,6	156	0																																
Oct/2011	18,1	808	0																																
Nov/2011	19,8	855	0																																
Dec/2011	2,8	125	0																																
Jan/2012	0,0	0	0																																
Feb/2012	0,0	0	0																																
Mar/2012	0,1	6	0																																
Apr/2012	0,0	0	0																																
May/2012	0,0	0	0																																
Jun/2012	0,0	0	0																																
Jul/2012	3,1	138	0																																
Aug/2012	0,7	30	0																																
Sep/2012	10,5	452	0																																
Oct/2012	0,0	0	0																																
Nov/2012	0,0	0	0																																
Dec/2012	0,0	0	0																																
<b>Total</b>	<b>8,2</b>	<b>11124</b>																																	

### Meteo data report - Missing data wind speed and direction - calendar view

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

Height: 40,00m - 2

- some records missing, disabled, erroneous, or out of range current day
- all records missing, disabled, erroneous, or out of range current day

Month/Year	%	Total	Day																																		
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31				
Jun/2009	0,0	0	0																																		
Jul/2009	0,0	0	0																																		
Aug/2009	0,0	0	0																																		
Sep/2009	0,0	0	0																																		
Oct/2009	0,0	0	0																																		
Nov/2009	8,5	366	0																																		
Dec/2009	43,7	1949	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Jan/2010	0,0	0	0																																		
Feb/2010	0,0	0	0																																		
Mar/2010	2,2	100	0																																		
Apr/2010	0,0	0	0																																		
May/2010	1,4	63	0																																		
Jun/2010	0,0	0	0																																		
Jul/2010	0,0	0	0																																		
Aug/2010	0,0	0	0																																		
Sep/2010	0,0	0	0																																		
Oct/2010	0,0	0	0																																		
Nov/2010	0,0	0	0																																		
Dec/2010	8,1	360	0																																		
Jan/2011	66,3	2958	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144		
Feb/2011	0,0	0	0																																		
Mar/2011	48,1	2145	0																																		
Apr/2011	43,4	1877	144	86	0	33	144	144	144	144	41	125	144	144	144	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
May/2011	10,4	465	3	122	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Jun/2011	82,9	3583	144	144	98	0	0	0	0	77	96	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
Jul/2011	41,5	1853	144	144	144	144	33	0	0	0	94	102	0	0	74	99	0	0	0	0	0	94	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug/2011	87,4	3902	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
Sep/2011	38,6	1667	0	78	144	144	57	0	76	107	81	0	71	113	0	0	134	94	37	133	61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Oct/2011	32,8	1466	67	52	0	0	67	0	0	70	48	46	0	0	0	0	119	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Nov/2011	57,8	2499	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
Dec/2011	29,1	1301	0	0	0	0	115	144	144	144	144	144	144	144	144	144	82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jan/2012	9,0	402	0																																		
Feb/2012	31,5	1314	0	0	112	144	77	117	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mar/2012	26,6	1189	0																																		
Apr/2012	6,0	260	144	53	0	0	0	0	0	0	0	0	0	0	0	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
May/2012	45,9	2050	0	0	0	0	35	0	0	0	0	0	0	0	0	111	59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Jun/2012	78,3	3384	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
Jul/2012	92,9	4149	0	117	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
Aug/2012	73,3	3272	144	144	144	144	144	144	144	144	144	144	93	20	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	75	24	36	0	0	0	0	
Sep/2012	10,5	452	0																																		
Oct/2012	90,5	4042	0	10	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
Nov/2012	41,6	1639	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
<b>Total</b>	<b>26,6</b>	<b>48707</b>																																			



## Meteo data report - Table of missing data

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

Height: **60,00m - 1**

23/06/2009 16:00:00	-	23/06/2009 20:00:00	No data
25/06/2009 05:40:00	-	25/06/2009 10:20:00	No data
26/06/2009 03:30:00	-	26/06/2009 07:40:00	No data
17/07/2009 18:50:00	-	18/07/2009 03:30:00	No data
18/07/2009 08:40:00	-	19/07/2009 10:10:00	No data
21/08/2009 03:40:00	-	22/08/2009 14:10:00	No data
23/08/2009 04:30:00	-	23/08/2009 22:50:00	No data
24/08/2009 05:20:00	-	24/08/2009 22:00:00	No data
25/08/2009 01:50:00	-	25/08/2009 14:20:00	No data
25/08/2009 20:30:00	-	26/08/2009 03:00:00	No data
26/08/2009 08:20:00	-	27/08/2009 17:30:00	No data
28/08/2009 05:20:00	-	28/08/2009 08:50:00	No data
11/09/2009 04:10:00	-	11/09/2009 07:20:00	No data
11/09/2009 20:30:00	-	11/09/2009 22:40:00	No data
12/09/2009 00:30:00	-	12/09/2009 08:00:00	No data
12/09/2009 20:50:00	-	13/09/2009 07:10:00	No data
13/09/2009 17:10:00	-	14/09/2009 10:30:00	No data
14/09/2009 15:50:00	-	14/09/2009 17:50:00	No data
15/09/2009 00:50:00	-	15/09/2009 09:40:00	No data
16/09/2009 16:00:00	-	17/09/2009 07:40:00	No data
17/09/2009 20:00:00	-	18/09/2009 08:30:00	No data
18/09/2009 15:40:00	-	19/09/2009 07:10:00	No data
19/09/2009 23:10:00	-	20/09/2009 07:40:00	No data
26/09/2009 21:30:00	-	27/09/2009 08:50:00	No data
28/09/2009 03:50:00	-	28/09/2009 07:20:00	No data
28/09/2009 20:20:00	-	29/09/2009 08:30:00	No data
29/09/2009 21:00:00	-	30/09/2009 07:10:00	No data
01/10/2009 20:40:00	-	02/10/2009 08:00:00	No data
02/10/2009 16:10:00	-	03/10/2009 07:40:00	No data
03/10/2009 15:40:00	-	04/10/2009 07:20:00	No data
04/10/2009 15:10:00	-	05/10/2009 06:50:00	No data
05/10/2009 15:20:00	-	06/10/2009 08:40:00	No data
06/10/2009 15:20:00	-	08/10/2009 07:00:00	No data
08/10/2009 15:50:00	-	13/10/2009 06:40:00	No data
13/10/2009 16:20:00	-	14/10/2009 06:00:00	No data
14/10/2009 16:40:00	-	15/10/2009 01:10:00	No data
15/10/2009 23:20:00	-	16/10/2009 02:00:00	No data
20/10/2009 13:50:00	-	20/10/2009 16:30:00	No data
27/11/2009 10:50:00	-	07/12/2009 17:40:00	No data
07/12/2009 17:50:00	-	14/12/2009 13:10:00	No data
17/05/2010 07:40:00	-	17/05/2010 12:30:00	No data
28/12/2010 11:50:00	-	21/01/2011 13:00:00	No data
16/03/2011 12:00:00	-	21/03/2011 08:50:00	No data
28/03/2011 07:30:00	-	29/03/2011 12:30:00	No data
30/03/2011 04:10:00	-	02/04/2011 10:30:00	No data
02/04/2011 15:40:00	-	02/04/2011 19:40:00	No data
03/04/2011 11:20:00	-	04/04/2011 14:40:00	No data
04/04/2011 18:20:00	-	09/04/2011 06:50:00	No data
09/04/2011 15:30:00	-	13/04/2011 02:30:00	No data
14/04/2011 05:00:00	-	21/04/2011 13:50:00	No data
22/04/2011 02:00:00	-	22/04/2011 14:50:00	No data
09/05/2011 08:20:00	-	09/05/2011 14:00:00	No data
10/05/2011 22:10:00	-	12/05/2011 11:20:00	No data
08/06/2011 07:50:00	-	04/07/2011 12:00:00	No data
17/02/2012 12:20:00	-	16/03/2012 09:00:00	No data
30/07/2012 07:50:00	-	31/07/2012 07:00:00	No data
24/08/2012 10:00:00	-	07/09/2012 15:20:00	No data

Height: **60,00m - 1 Subst**

27/11/2009 10:50:00	-	07/12/2009 17:40:00	No data
07/12/2009 17:50:00	-	14/12/2009 13:10:00	No data
28/12/2010 11:50:00	-	21/01/2011 13:00:00	No data
16/03/2011 12:00:00	-	21/03/2011 08:50:00	No data
08/06/2011 07:50:00	-	04/07/2011 12:00:00	No data
16/03/2012 07:50:00	-	16/03/2012 09:00:00	No data
30/07/2012 07:50:00	-	31/07/2012 07:00:00	No data
04/09/2012 11:50:00	-	07/09/2012 15:20:00	No data

## Meteo data report - Table of missing data

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

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17/09/2011 16:30:00	-	17/09/2011 19:20:00	No data
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06/11/2011 14:50:00	-	06/11/2011 20:10:00	No data
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10/12/2011 16:30:00	-	11/12/2011 02:30:00	No data
12/12/2011 05:10:00	-	12/12/2011 11:20:00	No data
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10/08/2012 04:50:00	-	10/08/2012 06:00:00	No data
10/08/2012 06:00:00	-	10/08/2012 10:10:00	No data
04/09/2012 11:50:00	-	07/09/2012 15:20:00	No data
21/03/2011 08:50:00	-	21/03/2011 09:00:00	Missing Turbulence intensity

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14/03/2011 10:00:00	-	14/03/2011 19:50:00	No data
16/03/2011 12:00:00	-	02/04/2011 10:30:00	No data
02/04/2011 15:40:00	-	02/04/2011 19:40:00	No data
04/04/2011 18:20:00	-	09/04/2011 06:50:00	No data
10/04/2011 03:00:00	-	14/04/2011 07:10:00	No data
24/04/2011 13:40:00	-	27/04/2011 08:00:00	No data
01/05/2011 23:20:00	-	02/05/2011 20:20:00	No data
23/05/2011 10:30:00	-	23/05/2011 18:10:00	No data
24/05/2011 11:50:00	-	24/05/2011 16:30:00	No data
27/05/2011 08:00:00	-	27/05/2011 19:40:00	No data
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10/07/2011 08:10:00	-	11/07/2011 17:00:00	No data
14/07/2011 11:30:00	-	15/07/2011 16:30:00	No data
20/07/2011 08:10:00	-	21/07/2011 16:30:00	No data
25/07/2011 02:50:00	-	25/07/2011 22:00:00	No data
27/07/2011 00:00:00	-	30/07/2011 13:00:00	No data
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08/09/2011 06:00:00	-	09/09/2011 13:30:00	No data
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15/09/2011 01:30:00	-	16/09/2011 15:40:00	No data
17/09/2011 02:40:00	-	17/09/2011 09:00:00	No data
18/09/2011 01:40:00	-	19/09/2011 10:10:00	No data
24/09/2011 04:50:00	-	24/09/2011 14:40:00	No data
26/09/2011 02:00:00	-	26/09/2011 10:00:00	No data
28/09/2011 04:00:00	-	29/09/2011 08:50:00	No data

*To be continued on next page...*

## Meteo data report - Table of missing data

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

*...continued from previous page*

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04/09/2012 11:50:00	-	07/09/2012 15:20:00	No data
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## Meteo data report - Monthly wind speeds

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

### Monthly wind speeds

60,00m - 1

Month	2009	2010	2011	2012	Mean	Mean of month
January		7,20	4,35	8,27	7,25	6,61
February		7,91	5,73	7,97	7,08	7,20
March		6,52	5,07	6,95	6,14	6,18
April		5,91	3,55	7,13	6,04	5,53
May		6,26	5,27	7,65	6,42	6,39
June	5,98	6,72	6,17	7,34	6,73	6,55
July	6,72	7,35	6,53	8,08	7,19	7,17
August	7,75	8,69	8,15	8,92	8,37	8,38
September	8,98	9,12	8,53	8,86	8,87	8,87
October	8,71	7,95	8,51	9,46	8,65	8,66
November	9,11	8,79	8,65	8,36	8,71	8,73
December	7,66	7,27	8,54	8,50	7,99	7,99
mean, all data	7,88	7,47	7,03	8,14	7,45	
mean of months	7,84	7,47	6,59	8,12		7,36

### Monthly wind speeds

60,00m - 1 Subst

Month	2009	2010	2011	2012	Mean	Mean of month
January		7,20	4,35	8,27	7,25	6,61
February		7,91	5,73	7,00	6,88	6,88
March		6,52	5,12	6,85	6,22	6,16
April		5,91	4,49	7,13	5,84	5,84
May		6,29	5,29	7,65	6,41	6,41
June	5,88	6,72	6,17	7,34	6,63	6,53
July	6,67	7,35	6,53	8,08	7,17	7,16
August	7,73	8,69	8,15	8,97	8,38	8,38
September	8,89	9,12	8,53	8,96	8,87	8,88
October	8,49	7,95	8,51	9,46	8,60	8,60
November	9,11	8,79	8,65	8,36	8,71	8,73
December	7,66	7,27	8,54	8,50	7,99	7,99
mean, all data	7,78	7,47	6,89	8,03	7,41	
mean of months	7,78	7,48	6,67	8,05		7,35

### Monthly wind speeds

60,00m - 3

Month	2010	2011	2012	Mean	Mean of month
January		4,22	8,38	7,33	6,30
February		5,65	7,06	6,37	6,36
March		5,01	6,86	6,01	5,93
April		4,43	7,14	5,79	5,79
May	6,93	5,21	7,68	6,54	6,61
June	6,69	6,13	7,39	6,94	6,74
July	7,40	6,73	8,16	7,50	7,43
August	8,82	8,30	9,06	8,73	8,73
September	9,24	8,70	9,11	9,01	9,02
October	8,03	8,52	9,65	8,75	8,73
November	8,89	8,73	8,53	8,72	8,72
December	7,40	8,74	8,73	8,24	8,29
mean, all data	8,00	6,86	8,12	7,49	
mean of months	7,92	6,70	8,15		7,39

## Meteo data report - Monthly wind speeds

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

### Monthly wind speeds

40,00m - 2

Month	2009	2010	2011	2012	Mean	Mean of month
January		6,83	4,08	7,61	6,73	6,17
February		7,41	5,33	6,56	6,42	6,43
March		6,17	4,53	6,26	5,83	5,65
April		5,45	3,89	6,70	5,57	5,35
May		5,79	4,58	7,16	5,64	5,84
June	5,32	6,15	5,13	6,39	5,78	5,75
July	6,04	6,71	5,52	6,54	6,19	6,20
August	7,22	8,04	6,71	8,26	7,65	7,56
September	8,45	8,49	7,70	8,03	8,22	8,17
October	8,02	7,55	7,85	9,24	7,83	8,17
November	8,73	8,30	7,96	7,63	8,26	8,16
December	7,33	6,86	7,73	7,27	7,27	7,31
mean, all data	7,30	6,98	5,93	7,20	6,78	
mean of months	7,30	6,98	5,92	7,31		6,73







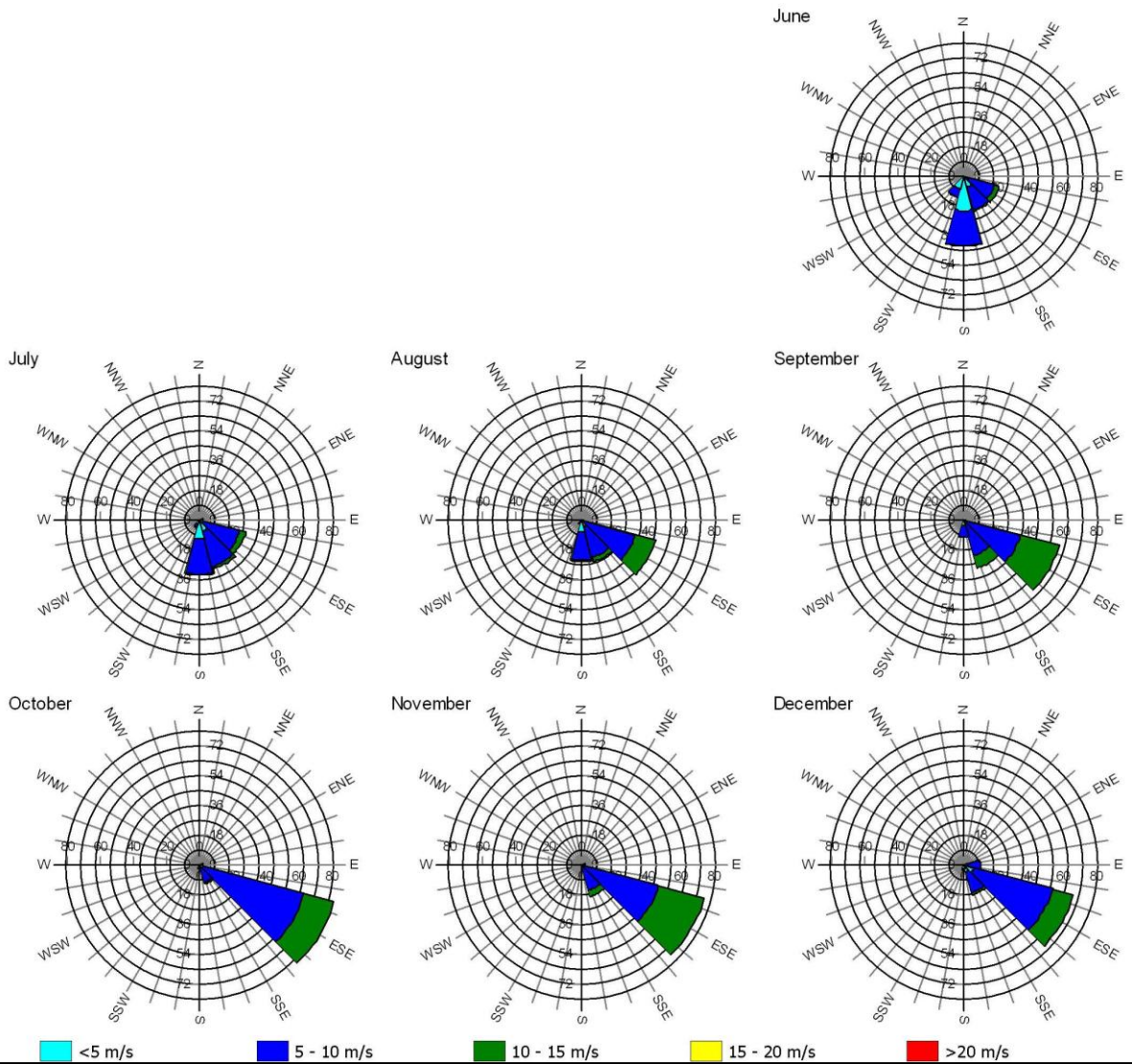


## Meteo data report - Monthly wind rose graphs

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

Height: 60,00m - 1 Subst

2009





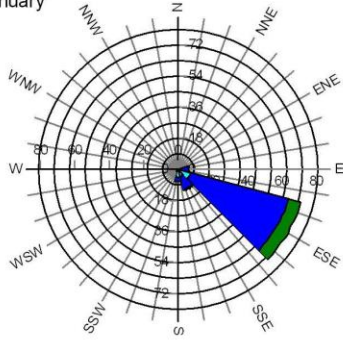
## Meteo data report - Monthly wind rose graphs

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

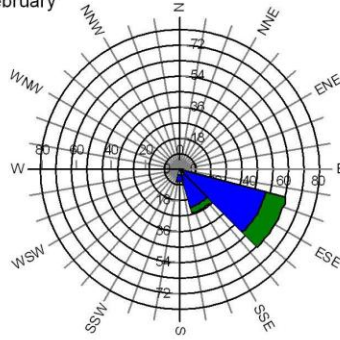
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**2010**

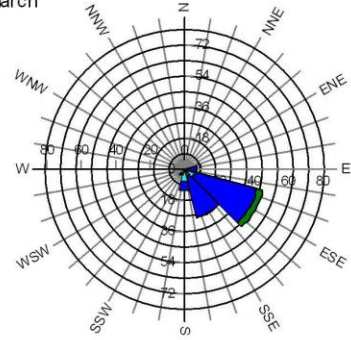
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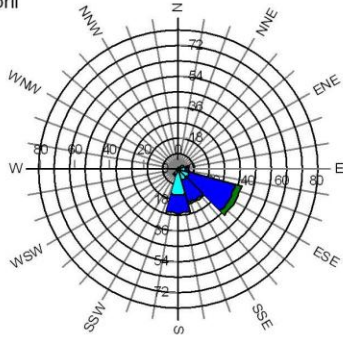
February



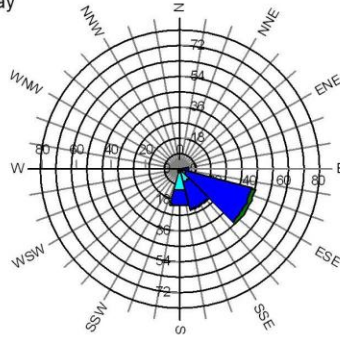
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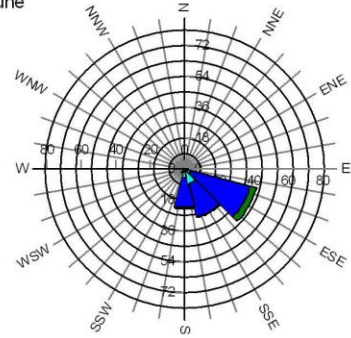
April



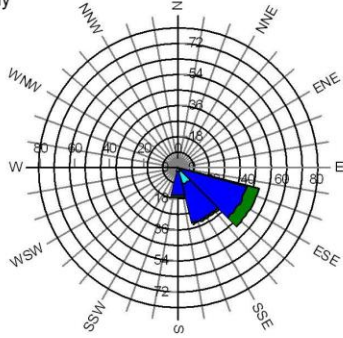
May



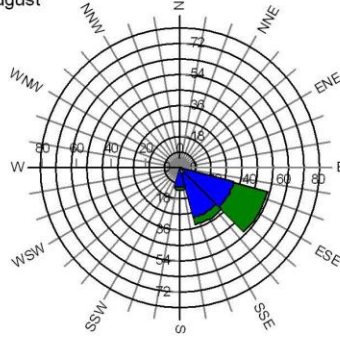
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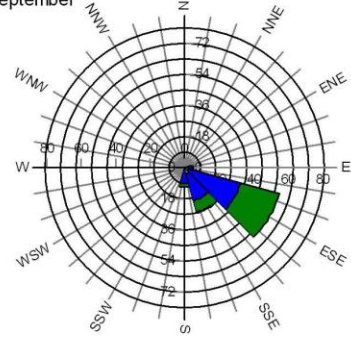
July



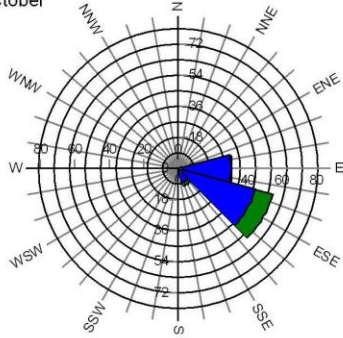
August



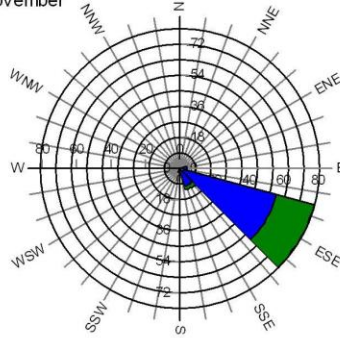
September



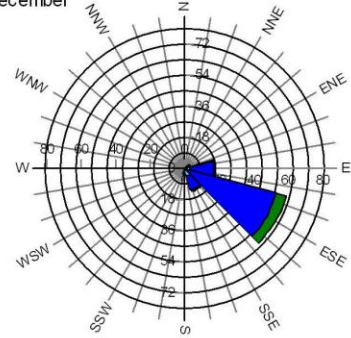
October



November



December



<5 m/s

5 - 10 m/s

10 - 15 m/s

15 - 20 m/s

>20 m/s

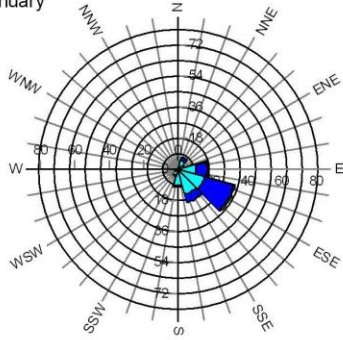
## Meteo data report - Monthly wind rose graphs

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

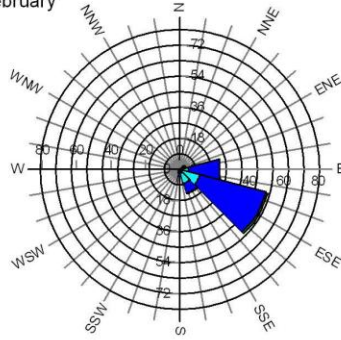
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**2011**

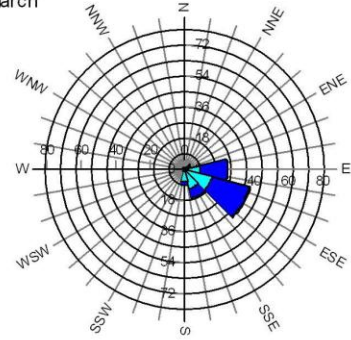
January



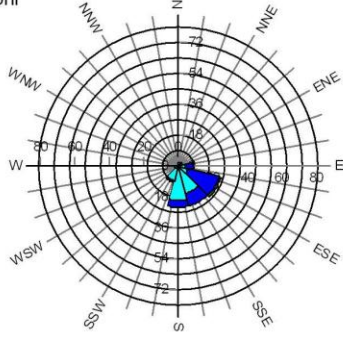
February



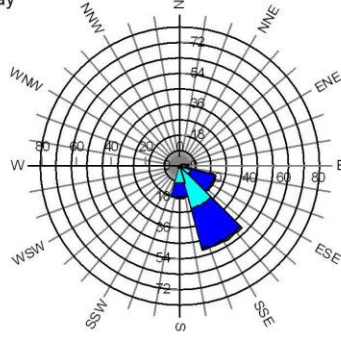
March



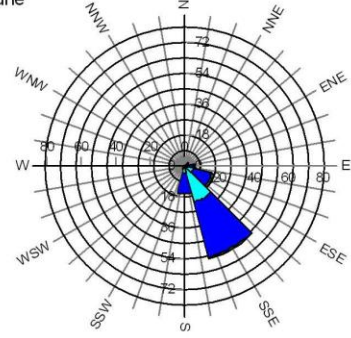
April



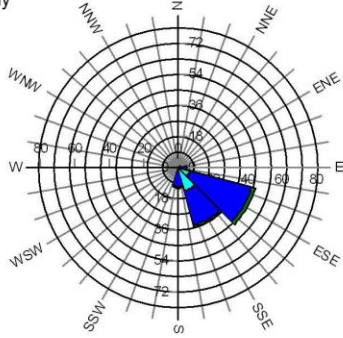
May



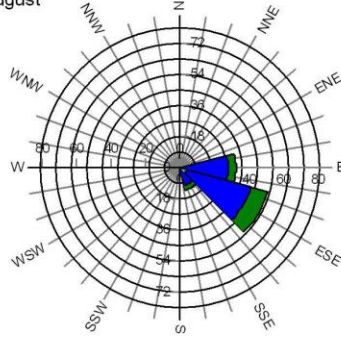
June



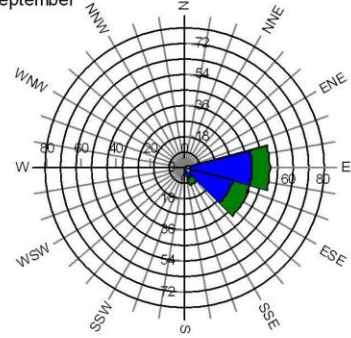
July



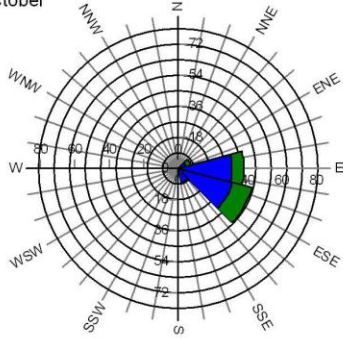
August



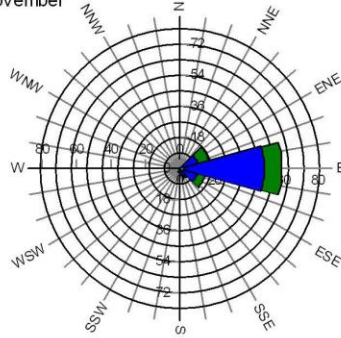
September



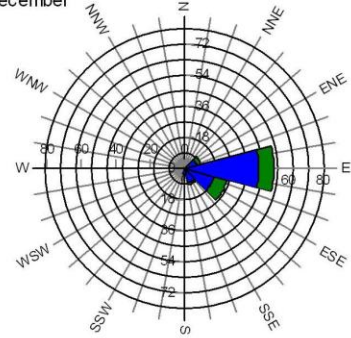
October



November



December



<5 m/s

5 - 10 m/s

10 - 15 m/s

15 - 20 m/s

>20 m/s



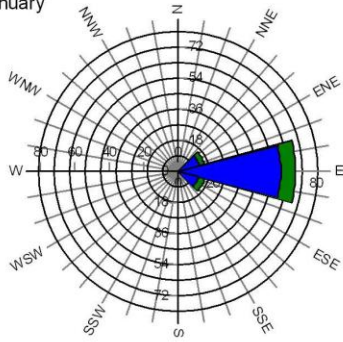
## Meteo data report - Monthly wind rose graphs

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

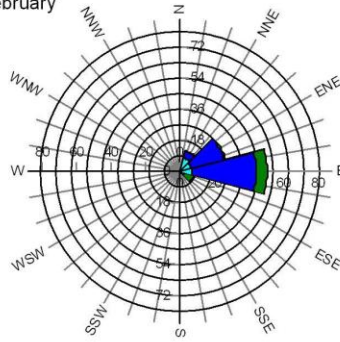
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**2012**

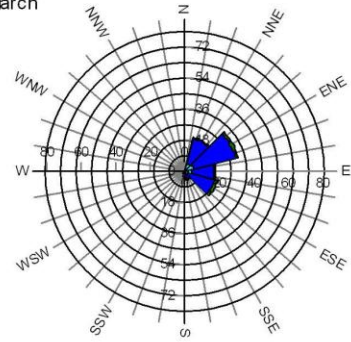
January



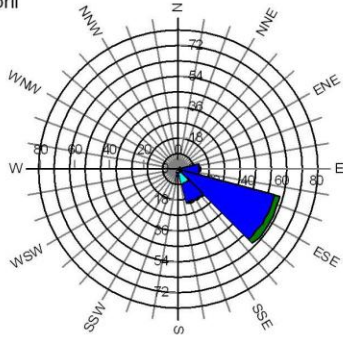
February



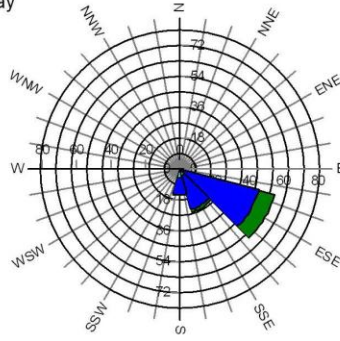
March



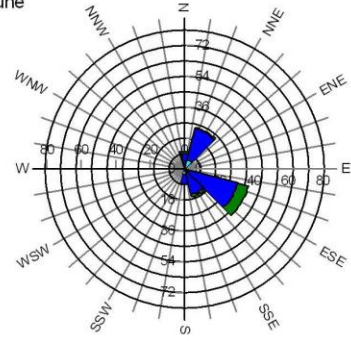
April



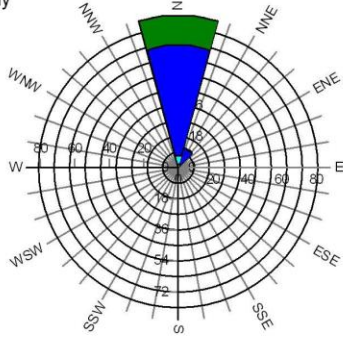
May



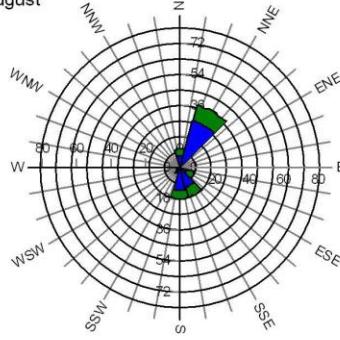
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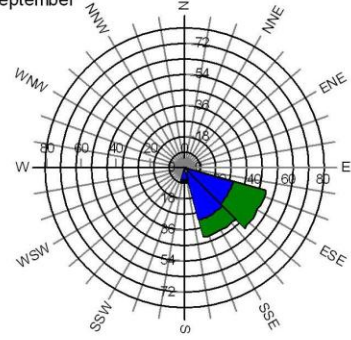
July



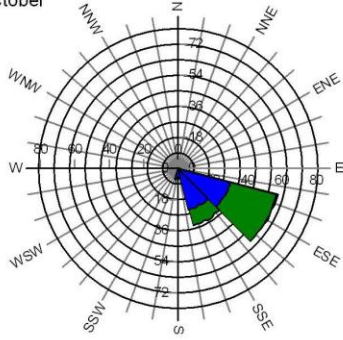
August



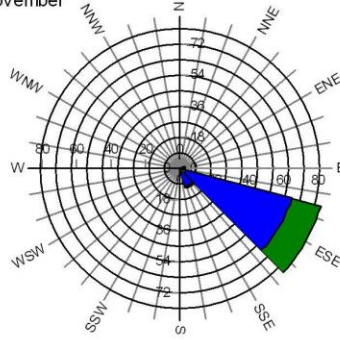
September



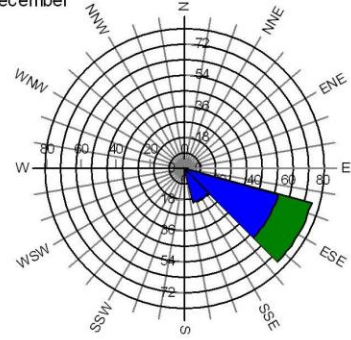
October



November



December



<5 m/s

5 - 10 m/s

10 - 15 m/s

15 - 20 m/s

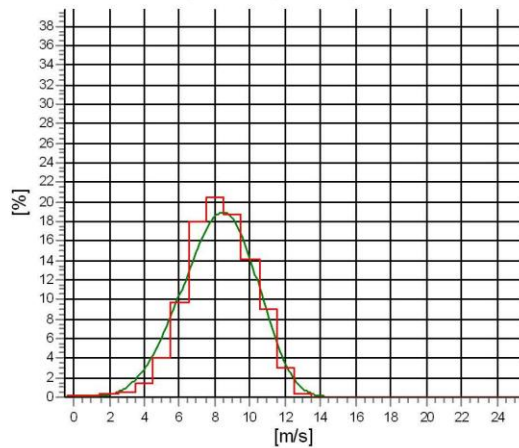
>20 m/s

## Meteo data report - Sector wise histogram/weibull graphs

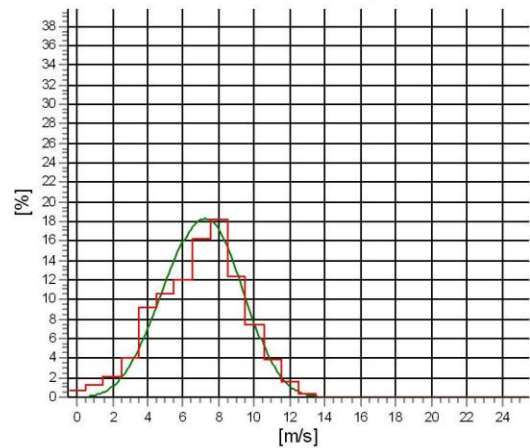
**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

**Height: 60,00m - 1 Subst**

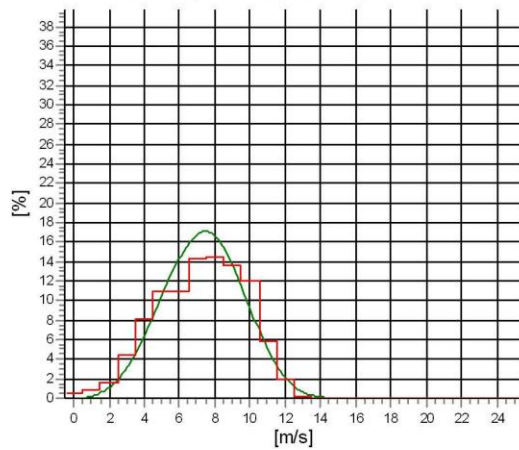
NA: 9,0 m/s k: 4,49 Vm: 8,2 m/s



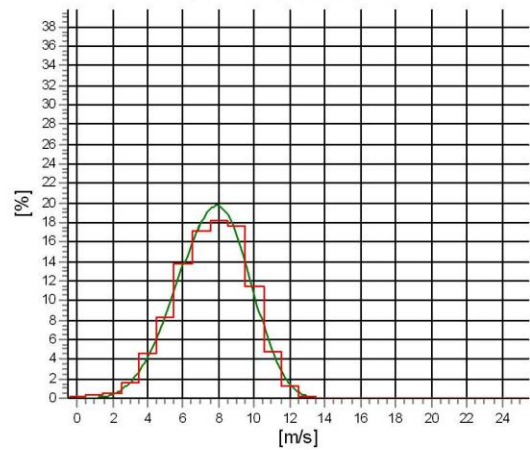
NNEA: 7,8 m/s k: 3,74 Vm: 7,1 m/s



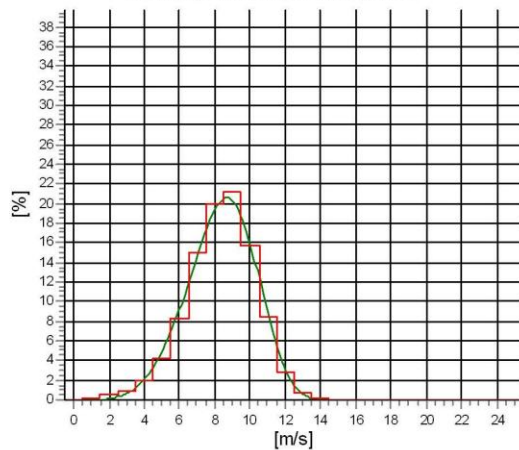
ENE A: 8,1 m/s k: 3,62 Vm: 7,3 m/s



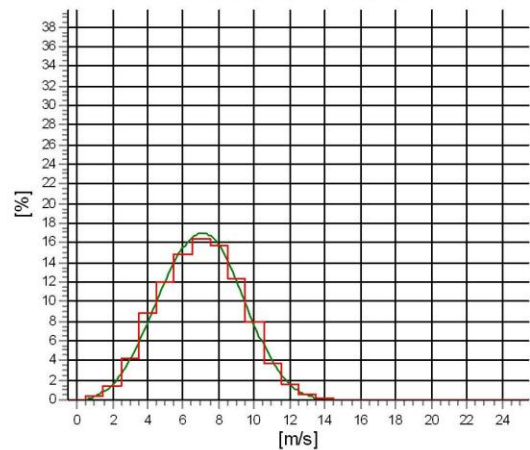
EA: 8,4 m/s k: 4,36 Vm: 7,6 m/s



ESE A: 9,1 m/s k: 4,98 Vm: 8,3 m/s



SSE A: 7,8 m/s k: 3,43 Vm: 7,0 m/s

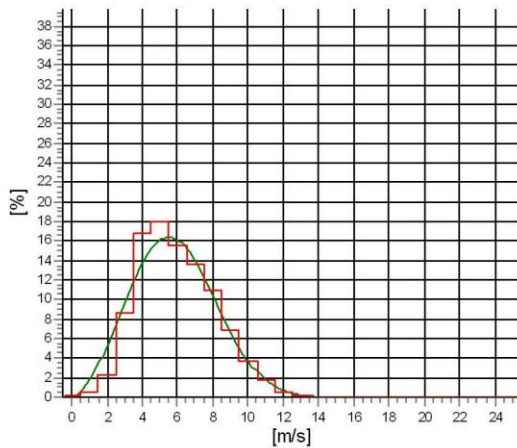


## Meteo data report - Sector wise histogram/weibull graphs

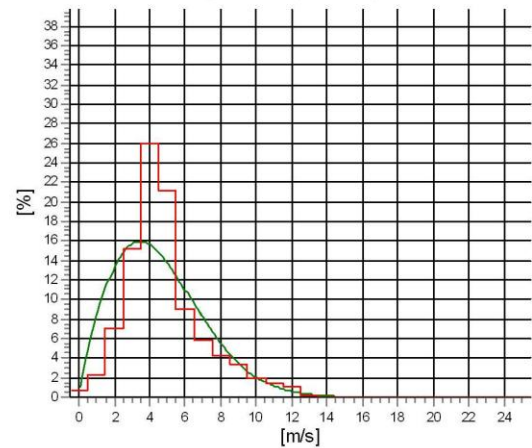
**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

**Height:** 60,00m - 1 Subst

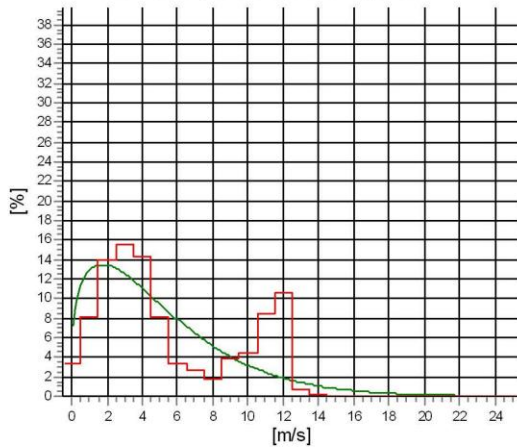
S A: 6,5 m/s k: 2,69 Vm: 5,8 m/s



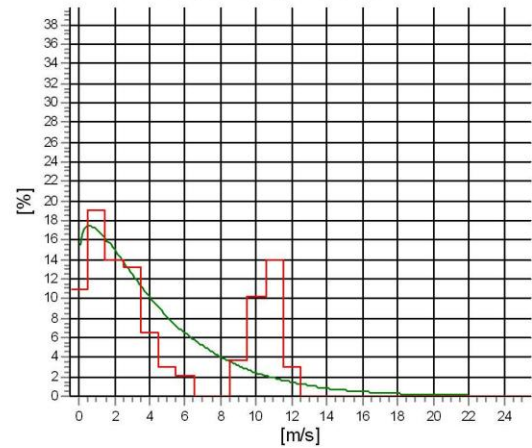
SSW A: 5,2 m/s k: 1,88 Vm: 4,6 m/s



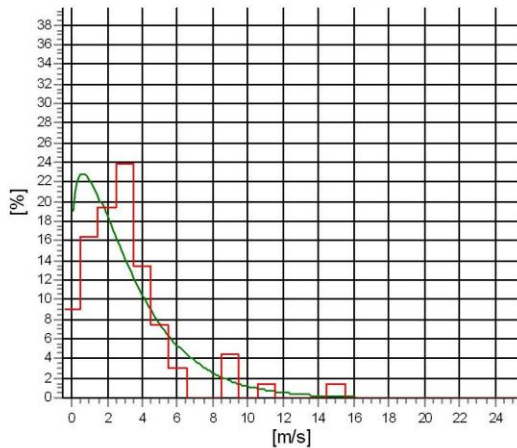
WSW A: 5,5 m/s k: 1,29 Vm: 5,0 m/s



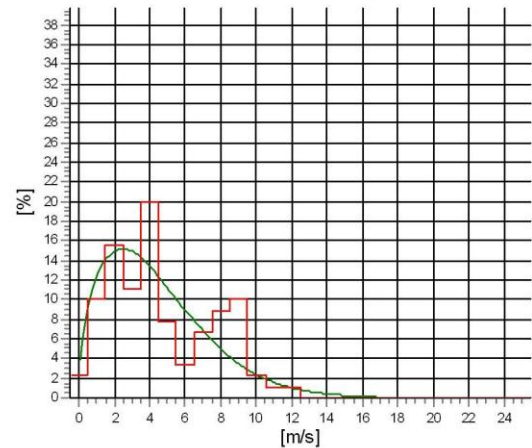
W A: 4,5 m/s k: 1,12 Vm: 4,4 m/s



WNW A: 3,4 m/s k: 1,17 Vm: 3,2 m/s



NNW A: 4,9 m/s k: 1,53 Vm: 4,4 m/s





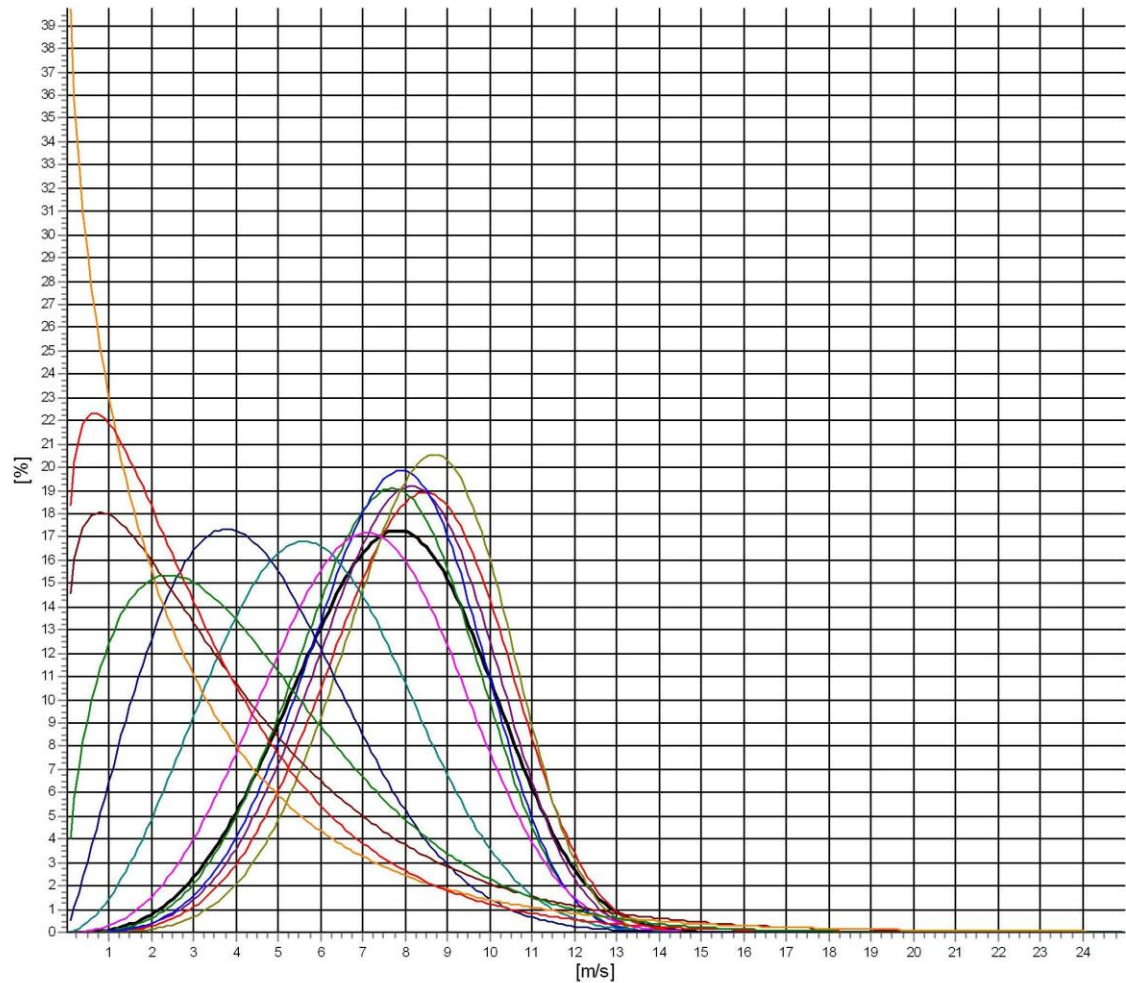
## Meteo data report - Weibull data overview

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

Height: **60,00m - 1**

### Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,96	4,486	2,98	8,18
1-NNE	8,23	4,137	2,21	7,47
2-ENE	8,65	4,388	2,51	7,88
3-E	8,39	4,403	14,57	7,65
4-ESE	9,09	4,972	46,78	8,35
5-SSE	7,81	3,484	20,03	7,02
6-S	6,58	2,793	9,42	5,86
7-SSW	5,13	2,113	1,16	4,55
8-WSW	4,24	1,167	0,18	4,02
9-W	3,03	0,903	0,07	3,18
10-WNW	3,42	1,173	0,04	3,24
11-NNW	4,88	1,526	0,05	4,39
<b>Mean</b>	<b>8,46</b>	<b>3,830</b>	<b>100,00</b>	<b>7,65</b>



— All A: 8,5 m/s k 3,83 Vm: 7,7 m/s	— N A: 9,0 m/s k 4,49 Vm: 8,2 m/s	— NNE A: 8,2 m/s k 4,14 Vm: 7,5 m/s	— ENE A: 8,6 m/s k 4,39 Vm: 7,9 m/s	— E A: 8,4 m/s k 4,40 Vm: 7,6 m/s
— ESE A: 9,1 m/s k 4,97 Vm: 8,3 m/s	— SSE A: 7,8 m/s k 3,48 Vm: 7,0 m/s	— S A: 6,6 m/s k 2,79 Vm: 5,9 m/s	— SSW A: 5,1 m/s k 2,11 Vm: 4,5 m/s	— WSW A: 4,2 m/s k 1,17 Vm: 4,0 m/s
— WA: 3,0 m/s k 0,90 Vm: 3,2 m/s	— WNW A: 3,4 m/s k 1,17 Vm: 3,2 m/s	— NNW A: 4,9 m/s k 1,53 Vm: 4,4 m/s		

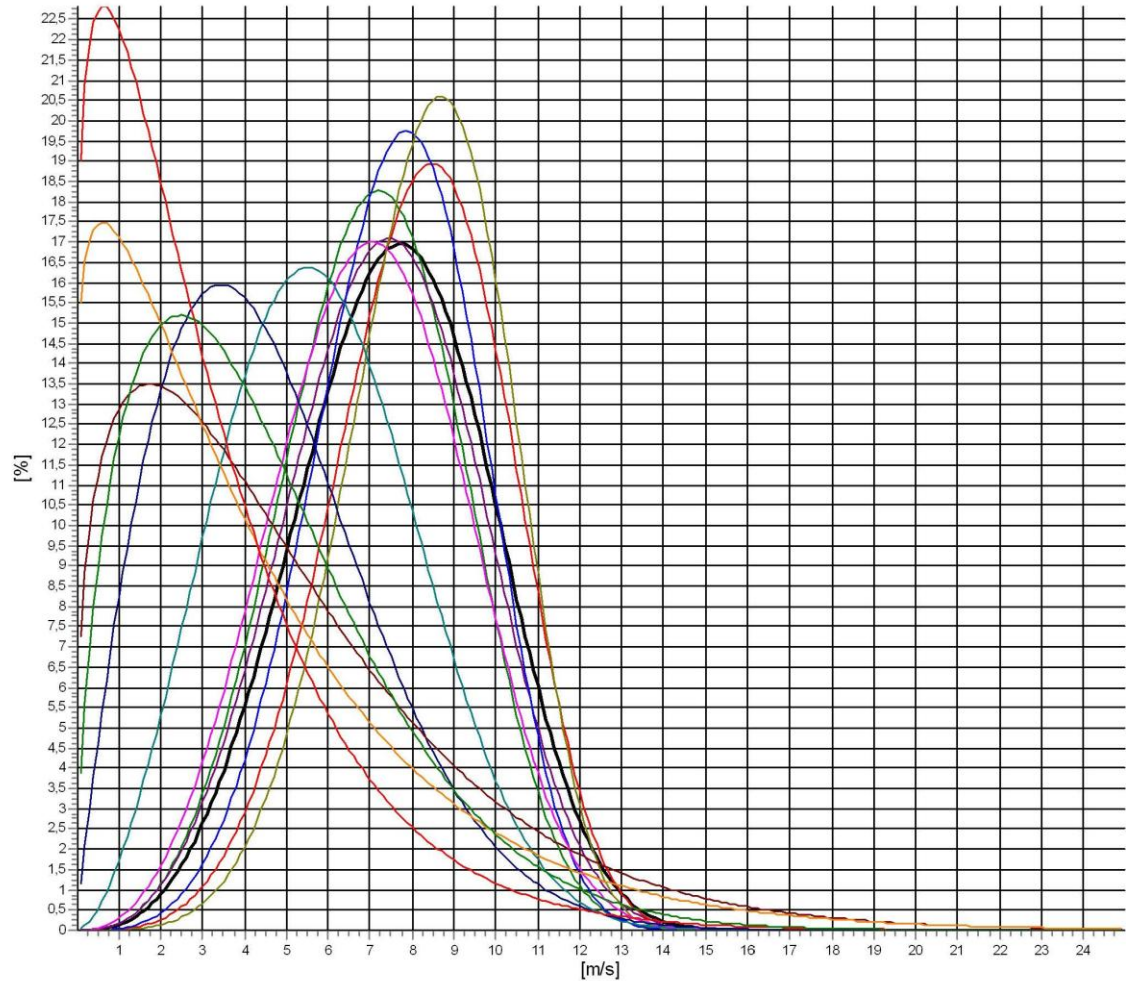
## Meteo data report - Weibull data overview

**Mast:** TP\_2839\_Iparana; TP\_2839\_Iparana ALL; TP\_2839 **Period:** Full period: 03/06/2009 - 17/12/2012 (42,5 months)

Height: **60,00m** - **1 Subst**

### Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,96	4,494	2,76	8,18
1-NNE	7,82	3,738	2,86	7,06
2-ENE	8,14	3,624	3,31	7,34
3-E	8,36	4,362	13,85	7,62
4-ESE	9,09	4,980	45,25	8,34
5-SSE	7,79	3,435	20,15	7,00
6-S	6,55	2,692	10,05	5,82
7-SSW	5,17	1,877	1,40	4,59
8-WSW	5,46	1,295	0,22	5,04
9-W	4,54	1,117	0,08	4,36
10-WNW	3,35	1,168	0,04	3,18
11-NNW	4,93	1,531	0,05	4,44
<b>Mean</b>	<b>8,40</b>	<b>3,719</b>	<b>100,00</b>	<b>7,58</b>

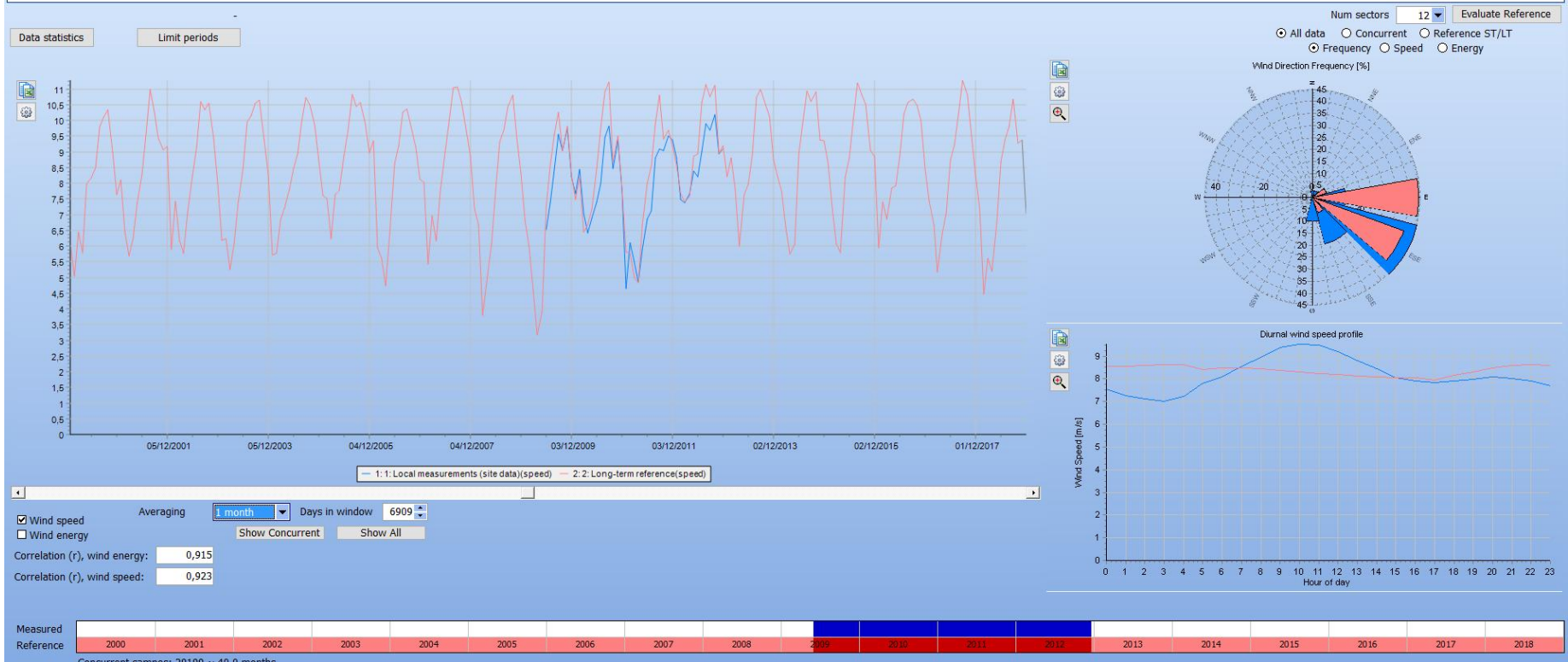


— All A: 8,4 m/s k 3,72 Vm: 7,6 m/s	— N A: 9,0 m/s k 4,49 Vm: 8,2 m/s	— NNE A: 7,8 m/s k 3,74 Vm: 7,1 m/s	— ENE A: 8,1 m/s k 3,62 Vm: 7,3 m/s	— E A: 8,4 m/s k 4,36 Vm: 7,6 m/s
— ESE A: 9,1 m/s k 4,98 Vm: 8,3 m/s	— SSE A: 7,8 m/s k 3,43 Vm: 7,0 m/s	— S A: 6,5 m/s k 2,69 Vm: 5,8 m/s	— SSW A: 5,2 m/s k 1,88 Vm: 4,6 m/s	— WSW A: 5,5 m/s k 1,29 Vm: 5,0 m/s
— W A: 4,5 m/s k 1,12 Vm: 4,4 m/s	— WNW A: 3,4 m/s k 1,17 Vm: 3,2 m/s	— NNW A: 4,9 m/s k 1,53 Vm: 4,4 m/s		

# MCP

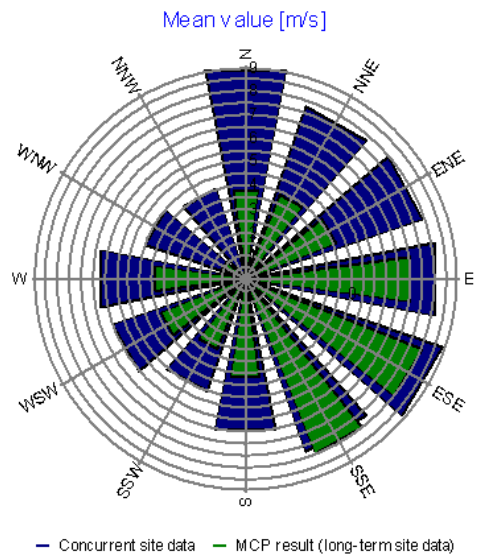
## Detalhes MCP

Data	Meteo object and height	First date	Last date	Time step [min]	Mean wind speed
1: Local measurements (site data)	TP_2839_Iparana.90,00m - F Synth	03/06/2009	17/12/2012	10	8,2 m/s
2: Long-term reference	ERA5_S03.512879_W038.53125.100,00m -	01/01/2000	31/12/2018	60	8,7 m/s

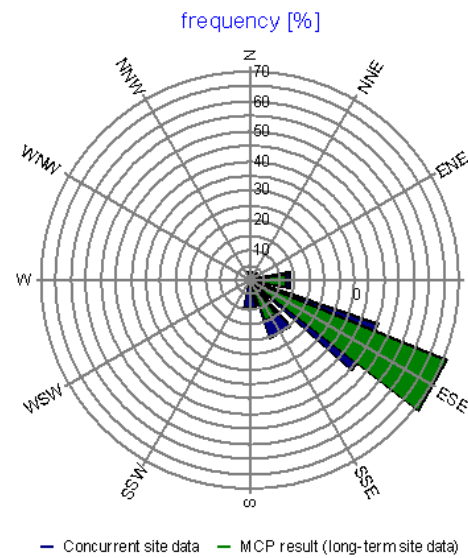
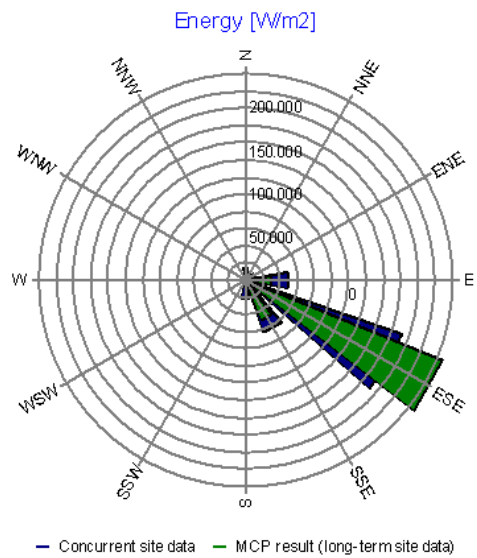
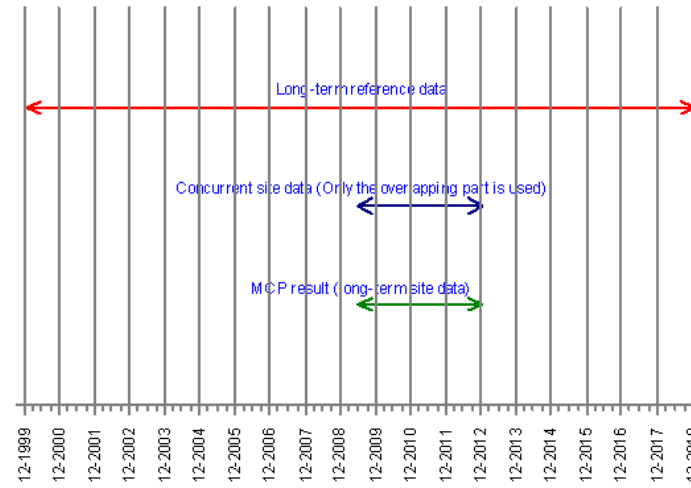








Timelines of MCP source data and result  
Only the overlapping and enabled parts of the concurrent data are used





## MCP - Main report Regression MCP

**1: Local measurements (site data)** TP\_2839\_Iparana  
**Height** 90,00 m  
**Period** 03/06/2009 to 17/12/2012 3,5 years  
**Mean wind speed** 8,18 m/s  
**Filters used** (Averaging)

**2: Long-term reference** ERA5\_S03.512879\_W038.53125  
**Height** 100,00 m  
**Period** 01/01/2000 to 31/12/2018 19,0 years  
**Mean wind speed** 8,43 m/s  
**Filters used** Not Filtered

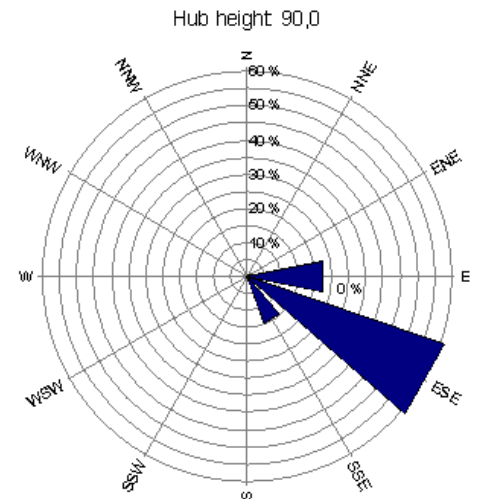
### Calculation setup

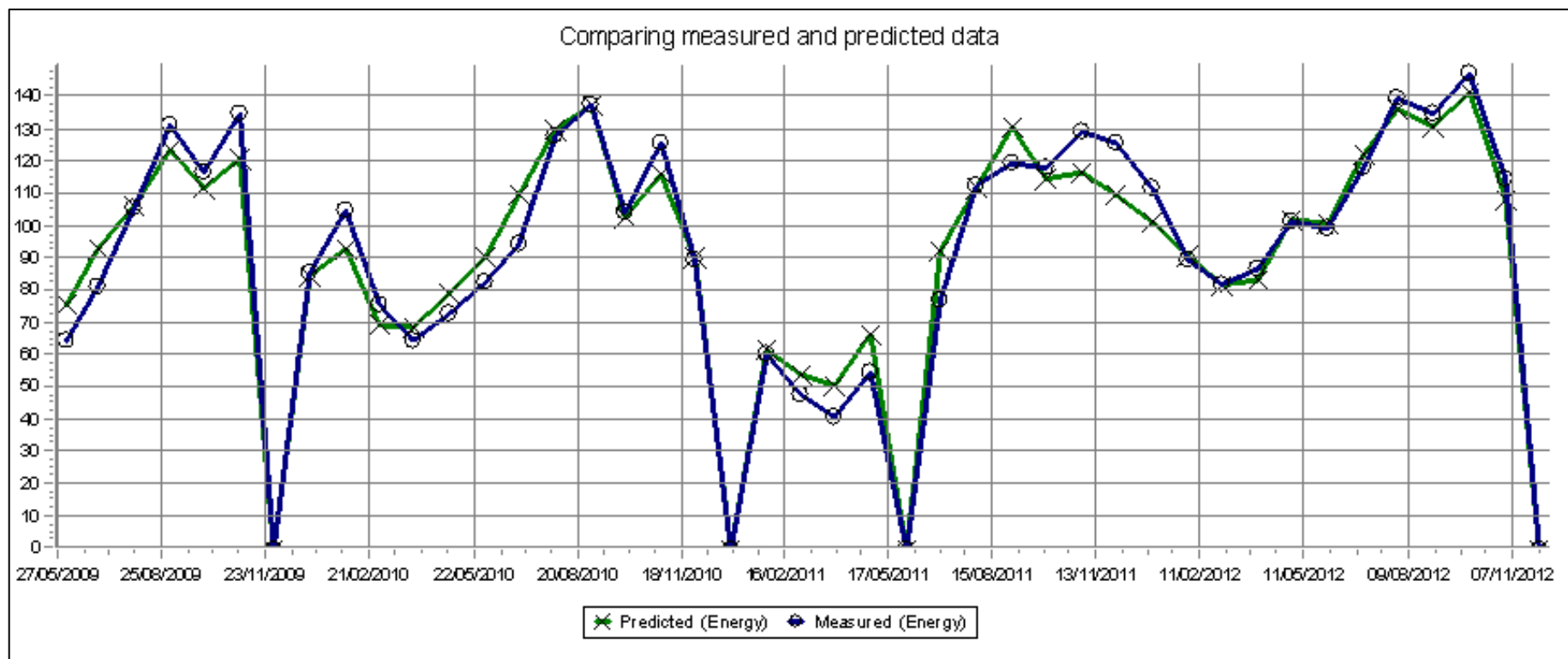
<b>Method</b>	Find transfer function for each sector
<b>Number of sectors</b>	12
<b>Skip angle differences larger than</b>	360,00
<b>Skip wind speeds less than</b>	2,00
<b>Regression model (wind speed)</b>	Linear (1st order polynomial)
<b>Regression model (wind direction)</b>	Constant (0th order polynomial)
<b>Wind speed model - use residual resampling</b>	Advanced Gaussian: Mean and std.dev. conditioned on wind speed modelled as polynomials (Of order: 1)
<b>Wind direction model - use residual resampling</b>	No model

### Results

<b>Measure height a.g.l.</b>	90,0 m
<b>Mean wind in measure height</b>	7,86 m/s
<b>Key height a.g.l.</b>	90,0 m
<b>Mean wind in key height</b>	7,93 m/s
<b>Wind energy</b>	59,8
<b>WTG energy</b>	92,2
<b>r - wind speed</b>	0,4278
<b>s - wind speed</b>	2,0095 m/s
<b>r - wind index</b>	0,9625
<b>s - wind index</b>	6,5525 %
<b>Time of calculation</b>	24/06/2019 11:40

Expected long-term WTG energy direction distribution AT SITE

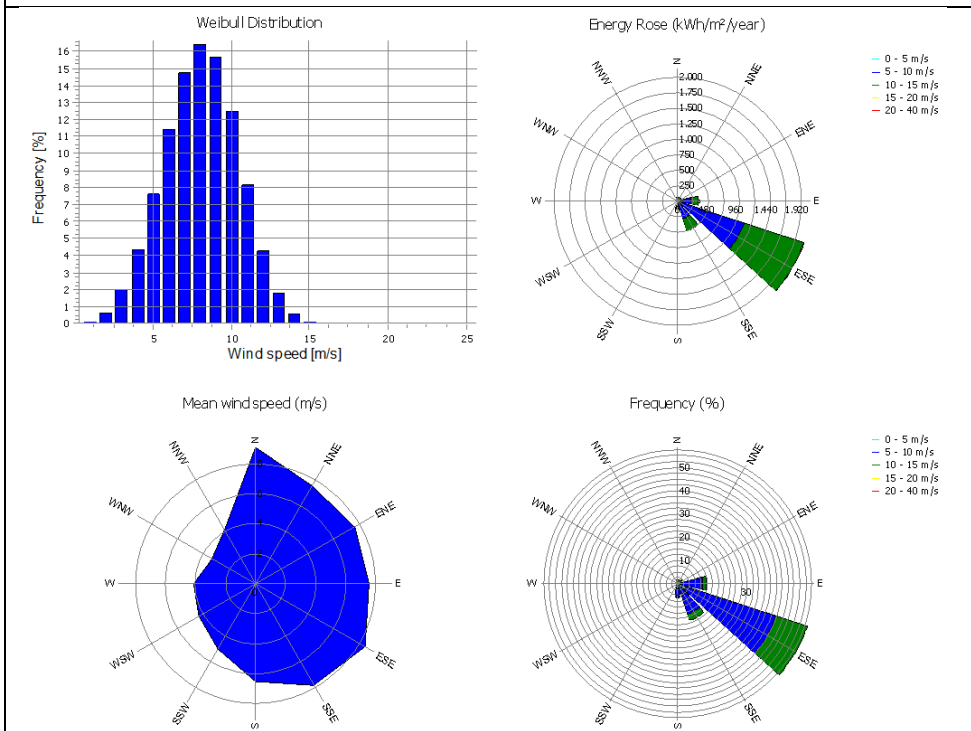




	Sinal	Média Weibull do Período [m/s]	Média Weibull a Longo Prazo - MCP ERA5 [m/s]	Ks Fator de Correção Histórico	Supra- Estimativa do Período
90,0m	Velocidade média do vento	8,18	8,03	0,9817	1,87%

TP\_2839 - velocidade média do vento a longo prazo, relatórios de gráfico direcional para 90 m de altura: distribuição de frequência, velocidade média do vento e energia aumentada. Distribuições weibull setoriais

	Sinal	Unidade	Contagem	Do Período	Média	Std dev	Min	Max	Weibull Médio	Weibull A par	Weibull k par
90,00m - LT ERA5	Velocidade média do vento, tudo	m/s	312564	31,3%	7,99		0	23,4	8,03	8,88	3,8279
90,00m - LT ERA5	Direção do vento, todos	Graus	312564	31,3%	121,4		0	356			
90,00m - LT ERA5	Intensidade de turbulência, ativada		162472	16,3%	0,0741	0,062	0	0,6763			



### Weibull Data

Sector	A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	9,96	9,07	4,346	1,6
1 NNE	8,36	7,52	3,506	1,7
2 ENE	8,50	7,61	3,215	2,0
3 E	8,33	7,50	3,607	12,4
4 ESE	9,25	8,44	4,514	58,6
5 SSE	8,60	7,77	3,732	16,6
6 S	7,31	6,50	2,722	5,8
7 SSW	5,63	5,00	1,830	0,8
8 WSW	4,63	4,37	1,191	0,2
9 W	4,39	4,07	1,275	0,2
10 WNW	3,54	3,33	1,204	0,0
11 NNW	4,65	4,16	1,625	0,1
All	8,88	8,03	3,828	100,0

	Sinal	Média Weibull do Período [m/s]	Média Weibull a Longo Prazo - MCP ERA5 [m/s]	Ks Fator de Correção Histórico	Supra- Estimativa do Período
90,0m	Velocidade média do vento	8,18	8,03	0,9817	1,87%



## Entrada de Estatística de Vento para Simulação

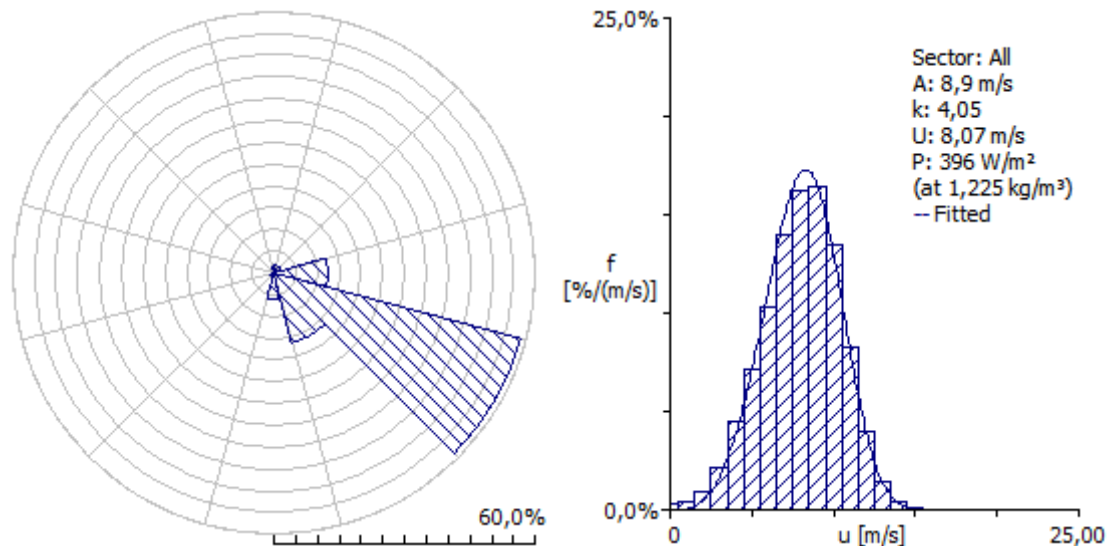
Com base em todo o procedimento descrito, segue o detalhamento da estatística de vento representativo de longo prazo (19 anos), utilizada para as simulações, obtida utilizando as medidas da estação TP\_2839 no período de 3,5 anos, de junho de 2009 a dezembro de 2012 correlacionada com o conjunto de dados de mesoescala ERA5 (19 anos de janeiro de 2000 a dezembro de 2018).

A metodologia de correlação mostrou que o período de medição de 3,5 anos está ligeiramente acima da média histórica de longo prazo, em detalhes a correção de longo prazo consiste em uma redução de 1,87% na velocidade média com um fator de correção igual a 0,9817.

### TP\_2839\_LT\_ERA5 90m 'Simulação de entrada – Resumo

O anemômetro está localizado nas coordenadas -3,69 ° N -38,61 ° E Altura 90 m

Parâmetro	Medido	Emergente	Discrepância
Velocidade Média do Vento	8,03	8,03	0.0 %
Densidade de potência média	397,5	396	0.4 %



### Vento

	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
A [m/s]	10,0	8,4	8,5	8,3	9,2	8,6	7,3	5,6	4,6	4,4	3,5	4,6
k	4,36	3,49	3,21	3,62	4,51	3,72	2,72	1,83	1,19	1,28	1,20	1,62

U [m/s]	9,08	7,52	7,61	7,51	8,44	7,76	6,50	5,00	4,37	4,07	3,33	4,16
P [W/m <sup>2</sup> ]	549	339	365	332	437	363	250	161	206	147	90	107
f [%]	1,6	1,7	2,0	12,4	58,6	16,6	5,8	0,8	0,2	0,2	0,0	0,1





## Wind statistics - Overview

File: \\192.168.1.5\Med-Tp\WPROjects\ESTERO\BRASILE\CAUCAIA\BR\_TP\_2839\_Iparana - LT ERA5 90 WP -60+50+5.wws

### Name

TP\_2839\_Iparana - LT ERA5 90 WP -60+50+5

### Source

USER

### Country

Brazil

### Site coordinates

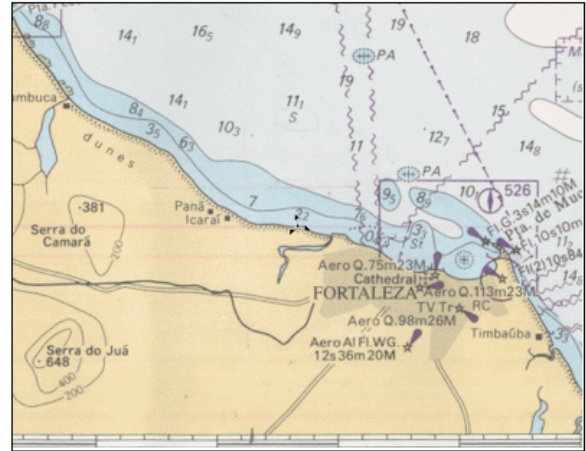
UTM WGS84 S Zone: 24 East: 543.279 North: 9.592.142

### WASP version

WASP 11 Version 11.06.0028

### Interval used

01/01/2000 - 31/12/2018



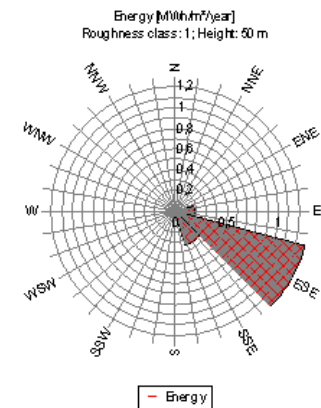
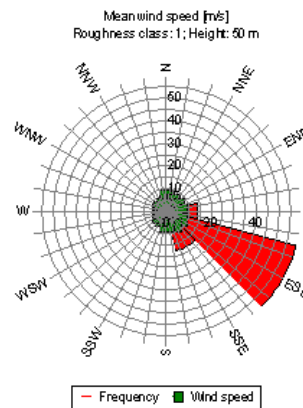
Scale 1:500.000

### Mean wind speed [m/s]

Height [m]	Roughness class/Length			
	0	1	2	3
0,00 m	0,03 m	0,10 m	0,40 m	1,50 m
10,0	7,0	4,7	4,1	3,2
25,0	7,6	5,7	5,1	4,2
50,0	8,2	6,6	6,0	5,1
100,0	8,8	7,9	7,2	6,3
200,0	9,5	9,8	8,9	7,8

### Wind energy [kWh/m<sup>2</sup>/year]

Height [m]	Roughness class/Length			
	0	1	2	3
0,00 m	0,03 m	0,10 m	0,40 m	1,50 m
10,0	2.377	787	507	238
25,0	3.082	1.326	940	540
50,0	3.757	2.013	1.494	942
100,0	4.651	3.319	2.500	1.654
200,0	5.872	6.128	4.608	3.110



### WTG energy [kWh/m<sup>2</sup>/year]

Normal rated WTG (0.45 kW/m<sup>2</sup>)

Height [m]	Roughness class/Length			
	0	1	2	3
0,00 m	0,03 m	0,10 m	0,40 m	1,50 m
10,0	1.075	388	213	56
25,0	1.274	669	483	246
50,0	1.435	961	758	499
100,0	1.608	1.363	1.142	846
200,0	1.797	1.860	1.634	1.319

High wind rated WTG (0.55 kW/m<sup>2</sup>)

Height [m]	Roughness class/Length			
	0	1	2	3
0,00 m	0,03 m	0,10 m	0,40 m	1,50 m
10,0	1.154	394	206	50
25,0	1.405	692	495	242
50,0	1.603	1.022	788	511
100,0	1.806	1.516	1.238	890
200,0	2.032	2.108	1.837	1.461

Low wind rated WTG (0.35 kW/m<sup>2</sup>)

Height [m]	Roughness class/Length			
	0	1	2	3
0,00 m	0,03 m	0,10 m	0,40 m	1,50 m
10,0	985	388	236	66
25,0	1.153	631	470	265
50,0	1.278	886	708	484
100,0	1.382	1.228	1.042	785
200,0	1.547	1.610	1.398	1.191

Características Aerogeradores



SG 6.0-170



## Technical Specifications

### Rotor

Type .....	3-bladed, horizontal axis
Position .....	Upwind
Diameter.....	170 m
Swept area .....	22,698 m <sup>2</sup>
Power regulation .....	Pitch & torque regulation with variable speed
Rotor tilt.....	6 degrees

### Blade

Type .....	Self-supporting
Blade length .....	83 m
Max chord .....	4.5 m
Aerodynamic profile .....	Siemens Gamesa proprietary airfoils
Material .....	GRE (Glassfiber Reinforced Epoxy) – CRP (Carbon Reinforced Plastic)
Surface gloss .....	Semi-gloss, < 30 / ISO2813
Surface color .....	Light grey, RAL 7035 or White, RAL 9018

### Aerodynamic Brake

Type .....	Full span pitching
Activation.....	Active, hydraulic

### Load-Supporting Parts

Hub.....	Nodular cast iron
Main shaft.....	Forged steel
Nacelle bed frame.....	Nodular cast iron

### Mechanical Brake

Type .....	Hydraulic disc brake
Position .....	Gearbox rear end

### Nacelle Cover

Type .....	Totally enclosed
Surface gloss .....	Semi-gloss, <30 / ISO2813
Color.....	Light Grey, RAL 7035 or White, RAL 9018

### Generator

Type.....	Asynchronous, DFIG
-----------	--------------------

### Grid Terminals (LV)

Baseline nominal power ..	6.0 MW
Voltage .....	690 V
Frequency.....	50 Hz or 60 Hz

### Yaw System

Type.....	Active
Yaw bearing.....	Externally geared
Yaw drive.....	Electric gear motors
Yaw brake.....	Active friction brake

### Controller

Type .....	Siemens Integrated Control System (SICS)
SCADA system .....	SGRE SCADA System

### Tower

Type .....	Tubular steel / Hybrid
Hub height .....	100m to 165 m, site-specific
Corrosion protection .....	Painted
Surface gloss .....	Semi-gloss, <30 / ISO-2813
Color .....	Light grey, RAL 7035 or White, RAL 9018

### Operational Data

Cut-in wind speed .....	3 m/s
Rated wind speed .....	10.0 m/s (steady wind without turbulence, as defined by IEC61400-1)
Cut-out wind speed .....	25 m/s
Restart wind speed.....	22 m/s

### Weight

Modular approach.....	All modules weight lower than 80 t for transport
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V162-5.6 MW 50/60 Hz



Generator	
Type	Permanent Magnet Synchronous generator
Rated Power [ $P_N$ ]	Up to 5850 kW (depending on turbine variant)
Frequency range [ $f_N$ ]	0-138 Hz
Voltage, Stator [ $U_{Ns}$ ]	3 x 800 V (at rated speed)
Number of Poles	36
Winding Type	Form with Vacuum Pressurized Impregnation
Winding Connection	Star
Operational speed range	0-460 rpm
Overspeed Limit (2 minutes)	TBD
Temperature Sensors, Stator	PT100 sensors placed in the stator hot spots.
Insulation Class	H
Enclosure	IP54

Rotor	V150	V162
Diameter	150 m	162 m
Swept Area	17671 m <sup>2</sup>	20611 m <sup>2</sup>
Speed, Dynamic Operation Range	4.9 - 12.6 rpm	4.3 - 12.1 rpm
Rotational Direction	Clockwise (front view)	
Orientation	Upwind	
Tilt	6°	
Hub Coning	6°	
No. of Blades	3	
Aerodynamic Brakes	Full feathering	

Blades	V150	V162
Blade Length	73.65 m	79.35 m
Maximum Chord	4.2 m	4.3 m
Chord at 90% blade radius	1.4 m	1.57 m]
Type Description	Structural airfoil shell	
Material	Fibreglass reinforced epoxy, carbon fibres and Solid Metal Tip (SMT)	
Blade Connection	Steel roots inserted	
Airfoils	High-lift profile	



## Detalhes da curva de potência de SG 170 6 MW

**Calculation:** SG 170 6 MWWTG: 26 - Siemens SG 6.0-170 6000 170.0 !OI, Hub height: 122,5 m

**Name:** Mode Std.

**Source:** Manufacturer

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type	Generator type	Specific power kW/m <sup>2</sup>
08/09/2017	USER	03/05/2017	08/05/2019	27,0	Pitch	User defined	Variable	0,26

Power Curve Rev. 0.

Siemens Wind Power and its affiliates reserve the right to change the above specifications without prior notice.

### HP curve comparison - Note: For standard air density

Vmean [m/s]	5	6	7	8	9	10
HP value Pitch, variable speed (2013) [MWh]	11.225	16.735	21.905	26.405	30.135	33.074
Siemens SG 6.0-170 6000 170.0 !OI Mode Std. [MWh]	11.459	17.007	22.177	26.648	30.335	33.239
Check value [%]	-2	-2	-1	-1	-1	0

The table shows comparison between annual energy production calculated on basis of simplified "HP-curves" which assume that all WTGs performs quite similar - only specific power loading (kW/m<sup>2</sup>) and single/dual speed or stall/pitch decides the calculated values. Productions are without wake losses.

For further details, ask at the Danish Energy Agency for project report J.nr. 51171/00-0016 or see windPRO manual chapter 3.5.2.

The method is refined in EMD report "20 Detailed Case Studies comparing Project Design Calculations and actual Energy Productions for Wind Energy Projects worldwide", Jan 2003.

Use the table to evaluate if the given power curve is reasonable - if the check value are lower than -5%, the power curve probably is too optimistic due to uncertainty in power curve measurement.

### Power curve

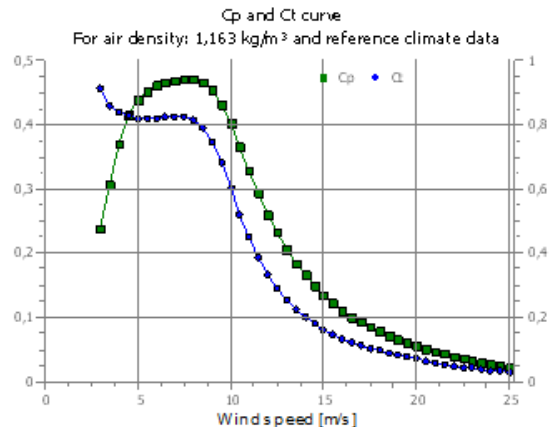
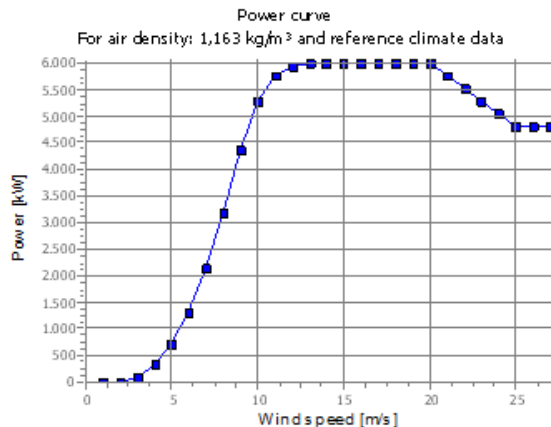
Original data, Air density: 1,225 kg/m<sup>3</sup>

Wind speed [m/s]	Power [kW]	Cp	Wind speed [m/s]	Ct
3,0	94,0	0,25	3,0	0,91
3,5	194,0	0,21	3,5	0,85
4,0	324,0	0,28	4,0	0,84
4,5	528,0	0,42	4,5	0,83
5,0	764,0	0,44	5,0	0,82
5,5	1.047,0	0,45	5,5	0,82
6,0	1.383,0	0,46	6,0	0,82
6,5	1.778,0	0,47	6,5	0,82
7,0	2.238,0	0,47	7,0	0,82
7,5	2.763,0	0,47	7,5	0,82
8,0	3.348,0	0,47	8,0	0,81
8,5	3.990,0	0,46	8,5	0,79
9,0	4.570,0	0,45	9,0	0,74
9,5	5.083,0	0,43	9,5	0,68
10,0	5.454,0	0,39	10,0	0,60
10,5	5.712,0	0,35	10,5	0,52
11,0	5.855,0	0,32	11,0	0,45
11,5	5.931,0	0,28	11,5	0,39
12,0	5.959,0	0,25	12,0	0,33
12,5	5.960,0	0,22	12,5	0,29
13,0	5.964,0	0,20	13,0	0,26
13,5	5.967,0	0,18	13,5	0,23
14,0	5.969,0	0,16	14,0	0,20
14,5	5.969,0	0,14	14,5	0,18
15,0	6.000,0	0,13	15,0	0,16
15,5	6.000,0	0,12	15,5	0,15
16,0	6.000,0	0,11	16,0	0,13
16,5	6.000,0	0,10	16,5	0,12
17,0	6.000,0	0,09	17,0	0,11
17,5	6.000,0	0,08	17,5	0,10
18,0	6.000,0	0,07	18,0	0,10
18,5	6.000,0	0,07	18,5	0,09
19,0	6.000,0	0,06	19,0	0,08
19,5	6.000,0	0,06	19,5	0,08
20,0	6.000,0	0,05	20,0	0,07
20,5	5.980,0	0,05	20,5	0,06
21,0	5.760,0	0,04	21,0	0,05
21,5	5.040,0	0,04	21,5	0,05
22,0	5.220,0	0,04	22,0	0,05
22,5	5.400,0	0,03	22,5	0,04
23,0	5.280,0	0,03	23,0	0,04
23,5	5.160,0	0,03	23,5	0,04
24,0	5.040,0	0,03	24,0	0,04
24,5	4.920,0	0,02	24,5	0,03
25,0	4.800,0	0,02	25,0	0,03

### Power, Efficiency and energy vs. wind speed

Data used in calculation, Air density: 1,163 kg/m<sup>3</sup> New windPRO method (adjusted IEC method, improved to match turbine control) <RECOMMENDED>

Wind speed [m/s]	Power [kW]	Cp	Interval [m/s]	Energy [MWh]	Acc.Energy [MWh]	Relative [%]
1,0	0,0	0,00	0,50-1,50	0,0	0,0	0,0
2,0	0,0	0,00	1,50-2,50	0,0	0,0	0,0
3,0	84,4	0,24	2,50-3,50	17,9	17,9	0,1
4,0	312,7	0,37	3,50-4,50	109,2	127,1	0,4
5,0	722,1	0,44	4,50-5,50	379,8	506,8	1,6
6,0	1.311,4	0,46	5,50-6,50	992,6	1.499,4	4,8
7,0	2.123,8	0,47	6,50-7,50	2.122,5	3.621,9	11,5
8,0	3.180,4	0,47	7,50-8,50	3.777,4	7.399,4	23,6
9,0	4.362,1	0,45	8,50-9,50	5.452,9	12.852,3	41,0
10,0	5.296,0	0,40	9,50-10,50	6.171,6	19.023,9	60,6
11,0	5.772,9	0,33	10,50-11,50	5.425,0	24.448,8	77,9
12,0	5.941,5	0,26	11,50-12,50	3.736,2	28.185,0	89,8
13,0	5.987,4	0,21	12,50-13,50	2.018,2	30.203,2	96,2
14,0	5.997,2	0,17	13,50-14,50	841,8	31.045,0	98,9
15,0	5.999,0	0,13	14,50-15,50	264,6	31.309,6	99,8
16,0	6.000,0	0,11	15,50-16,50	61,0	31.370,6	100,0
17,0	6.000,0	0,09	16,50-17,50	10,0	31.380,6	100,0
18,0	6.000,0	0,08	17,50-18,50	1,1	31.381,7	100,0
19,0	6.000,0	0,07	18,50-19,50	0,1	31.381,8	100,0
20,0	6.000,0	0,06	19,50-20,50	0,0	31.381,8	100,0
21,0	5.760,0	0,05	20,50-21,50	0,0	31.381,8	100,0
22,0	5.520,0	0,04	21,50-22,50	0,0	31.381,8	100,0
23,0	5.280,0	0,03	22,50-23,50	0,0	31.381,8	100,0
24,0	5.040,0	0,03	23,50-24,50	0,0	31.381,8	100,0
25,0	4.800,0	0,02	24,50-25,50	0,0	31.381,8	100,0
26,0	4.800,0	0,02	25,50-26,50	0,0	31.381,8	100,0
27,0	4.800,0	0,02	26,50-27,50	0,0	31.381,8	100,0



## Detalhes da curva de potência do Vestas V162 5,6 MW

**Calculation:** Vestas V162 5.6WTG: 26 - VESTAS V162-5.6 5600 162.0 IOI, Hub height: 125,0 m

**Name:** Level 0 - Calculated - Power Curves, Mode 0 - 24-10-2018

**Source:** Manufacturer

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type	Generator type	Specific power kW/m <sup>2</sup>
24/10/2018	USER	10/08/2017	14/01/2019	24,0	Pitch	User defined	Variable	0,27

Document no.: 0079-5337 V00

Date: 2018-10-24

Document owner: Platform Management

Type: T05 - General Description

### HP curve comparison - Note: For standard air density

Vmean	[m/s]	5	6	7	8	9	10
HP value Pitch, variable speed (2013)	[MWh]	10.249	15.343	20.152	24.357	27.855	30.619
VESTAS V162-5.6 5600 162.0 IOI Level 0 - Calculated - Power Curves, Mode 0 - 24-10-2018	[MWh]	10.446	15.650	20.507	24.652	27.934	30.319
Check value	[%]	-2	-2	-2	-1	0	1

The table shows comparison between annual energy production calculated on basis of simplified "HP-curves" which assume that all WTGs performs quite similar - only specific power loading (kW/m<sup>2</sup>) and single/dual speed or stall/pitch decides the calculated values. Productions are without wake losses.

For further details, ask at the Danish Energy Agency for project report J.nr. 51171/00-0016 or see windPRO manual chapter 3.5.2.

The method is refined in EMD report "20 Detailed Case Studies comparing Project Design Calculations and actual Energy Productions for Wind Energy Projects worldwide", jan 2003.

Use the table to evaluate if the given power curve is reasonable - if the check value are lower than -5%, the power curve probably is too optimistic due to uncertainty in power curve measurement.

### Power curve

Original data, Air density: 1,225 kg/m<sup>3</sup>

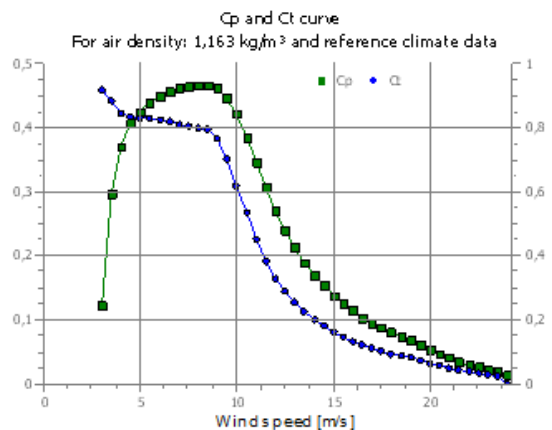
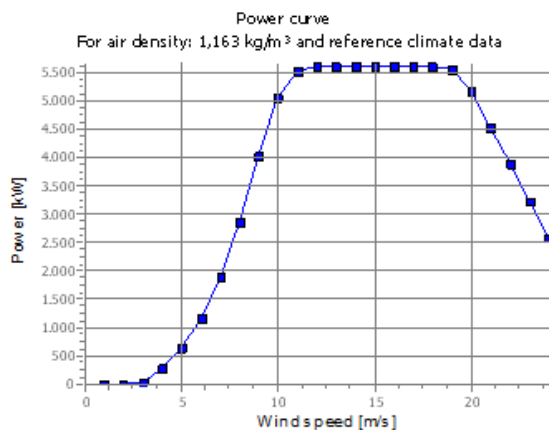
Wind speed Power Cp Wind speed2 ctm

[m/s]	[kW]	[m/s]	[m/s]	
3,0	22,0	0,15	3,0	0,92
3,5	166,0	0,31	3,5	0,88
4,0	304,0	0,38	4,0	0,85
4,5	470,0	0,44	4,5	0,83
5,0	672,0	0,43	5,0	0,83
5,5	922,0	0,44	5,5	0,83
6,0	1.224,0	0,45	6,0	0,82
6,5	1.579,0	0,46	6,5	0,82
7,0	1.986,0	0,46	7,0	0,81
7,5	2.472,0	0,46	7,5	0,81
8,0	3.012,0	0,47	8,0	0,80
8,5	3.614,0	0,47	8,5	0,79
9,0	4.245,0	0,46	9,0	0,78
9,5	4.812,0	0,44	9,5	0,78
10,0	5.238,0	0,41	10,0	0,62
10,5	5.472,0	0,37	10,5	0,53
11,0	5.574,0	0,33	11,0	0,45
11,5	5.597,0	0,29	11,5	0,38
12,0	5.600,0	0,25	12,0	0,33
12,5	5.600,0	0,23	12,5	0,29
13,0	5.600,0	0,20	13,0	0,25
13,5	5.600,0	0,18	13,5	0,22
14,0	5.600,0	0,16	14,0	0,20
14,5	5.600,0	0,15	14,5	0,18
15,0	5.600,0	0,13	15,0	0,16
15,5	5.600,0	0,12	15,5	0,15
16,0	5.600,0	0,11	16,0	0,13
16,5	5.600,0	0,10	16,5	0,12
17,0	5.600,0	0,09	17,0	0,11
17,5	5.600,0	0,08	17,5	0,10
18,0	5.600,0	0,08	18,0	0,09
18,5	5.600,0	0,07	18,5	0,09
19,0	5.558,0	0,06	19,0	0,08
19,5	5.499,0	0,05	19,5	0,07
20,0	5.147,0	0,05	20,0	0,06
20,5	4.821,0	0,04	20,5	0,06
21,0	4.514,0	0,04	21,0	0,05
21,5	4.195,0	0,03	21,5	0,04
22,0	3.870,0	0,03	22,0	0,04
22,5	3.529,0	0,03	22,5	0,03
23,0	3.225,0	0,03	23,0	0,03
23,5	2.899,0	0,02	23,5	0,03
24,0	2.584,0	0,01	24,0	0,02

### Power, Efficiency and energy vs. wind speed

Data used in calculation, Air density: 1,163 kg/m<sup>3</sup> New windPRO method (adjusted IEC method, improved to match turbine control) <RECOMMENDED>

Wind speed [m/s]	Power [kW]	Cp	Interval [m/s]	Energy [MWh]	Acc.Energy [MWh]	Relative [%]
1,0	0,0	0,00	0,50-1,50	0,0	0,0	0,0
2,0	0,0	0,00	1,50-2,50	0,0	0,0	0,0
3,0	39,8	0,12	2,50-3,50	15,6	15,6	0,1
4,0	284,3	0,37	3,50-4,50	96,6	112,2	0,4
5,0	636,0	0,42	4,50-5,50	333,3	445,6	1,5
6,0	1.159,3	0,45	5,50-6,50	873,0	1.318,6	4,5
7,0	1.891,8	0,46	6,50-7,50	1.881,7	3.200,2	10,9
8,0	2.856,6	0,47	7,50-8,50	3.394,3	6.594,6	22,4
9,0	4.025,7	0,46	8,50-9,50	5.042,2	11.636,8	39,5
10,0	5.049,8	0,42	9,50-10,50	5.874,2	17.511,0	59,5
11,0	5.515,2	0,35	10,50-11,50	5.222,8	22.733,8	77,3
12,0	5.997,8	0,27	11,50-12,50	3.991,9	26.325,7	89,5
13,0	5.600,0	0,21	12,50-13,50	1.945,3	28.271,0	96,1
14,0	5.600,0	0,17	13,50-14,50	820,9	29.092,0	98,9
15,0	5.600,0	0,14	14,50-15,50	262,4	29.354,4	99,8
16,0	5.600,0	0,11	15,50-16,50	61,8	29.416,2	100,0
17,0	5.600,0	0,10	16,50-17,50	10,4	29.426,5	100,0
18,0	5.600,0	0,08	17,50-18,50	1,2	29.427,7	100,0
19,0	5.558,0	0,07	18,50-19,50	0,1	29.427,8	100,0
20,0	5.147,0	0,05	19,50-20,50	0,0	29.427,8	100,0
21,0	4.514,0	0,04	20,50-21,50	0,0	29.427,8	100,0
22,0	3.870,0	0,03	21,50-22,50	0,0	29.427,8	100,0
23,0	3.225,0	0,02	22,50-23,50	0,0	29.427,8	100,0
24,0	2.584,0	0,02	23,50-24,50	0,0	29.427,8	100,0



## Detalhes da curva de potência da GE 116 2 MW

