



## **Wind Measurement**

**Site: Lozenets, Bulgaria**

**On behalf of**

### **IWC GmbH**

Innovative Wind Concepts GmbH

Haus der Zukunftsenergien

Otto-Hahn Str. 12-16

D-25813 Husum/ Nordsee

Germany

### **Deutsche WindGuard Consulting GmbH**

Oldenburger Str. 65

26316 Varel

Germany

Project No.: VC09002

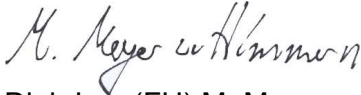
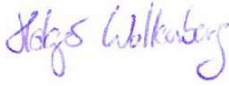
Report No.: MV14019

## Wind Measurement

### Lozenets, Bulgaria

Deutsche WindGuard Consulting GmbH  
Oldenburger Str. 65  
D-26316 Varel

Tel: +49(0)4451-9515-0  
Fax: +49(0)4451-9515-29  
e-mail: [info@windguard.de](mailto:info@windguard.de)

Client:	IWC GmbH Innovative Wind Concepts GmbH Haus der Zukunftsenergien Otto-Hahn Str. 12-16 D-25813 Husum/ Nordsee Germany
Contact:	Oliver Lütz
Project No.:	VC09002
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Date:	2014-07-16
Author:	 Dipl.-Ing. (FH) M. Meyer zu Himmerr
Approved by:	 Dipl.-Ing. (FH) H. Wollenberg

Deutsche WindGuard  
Consulting GmbH  
Oldenburger Straße 65  
D-26316 Varel  
Tel.: 04451 / 95 15 - 0 · Fax: 95 15 - 29



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## **1 Introduction**

On behalf of IWC GmbH, a wind measurement was performed by Deutsche WindGuard Consulting GmbH (DWG) at a planned wind farm site Lozenets, Bulgaria. A 100 m high met mast was used for the measurements. The mast design was carried out according to the terms of IEC 61400-12-1 [1].

Main subject was to determine the joint probability distribution of wind speeds and wind directions in the measurement period based on 10-minute-average values. Another object is the measurement of load relevant wind parameters according to IEC 61400-1, Edition 2 [2] and Edition 3 [3] as well as according to the MEASNET Guideline Evaluation of Site Specific Wind Conditions [4]. The results are intended for the purpose of wind farm site assessment. It is noted that the reported work covers only the measurement tasks according to the MEASNET Guideline Evaluation of Site Specific Wind Conditions [4] and not a full site assessment according to this guideline.

The presented results cover the following measurement period:

**2009-02-12 10:10 to 2013-10-10 13:00**

The results in this report are based upon generally acknowledged and state-of-the-art methods and have been neutrally conducted to the best of our knowledge and belief. No guarantee, however, is given and no responsibility is accepted by Deutsche WindGuard Consulting GmbH for the correctness of the derived results.

Deutsche WindGuard is accredited for wind measurements according to DIN EN ISO/IEC 17025:2005 and accepted by Measnet for wind measurements. The work presented in this report complies with the present day valid standards and guidelines and the corresponding quality management system of Deutsche WindGuard.

Any partial duplication of this measurement report is allowed only with written permission of Deutsche WindGuard Consulting GmbH. The results of the following report refer to the observed site and measurement period only.

This report covers 281 pages.

## 2 Measurement Site

### 2.1 Site Coordinates

System:	UTM
Datum:	WGS84
Zone:	35 T
Easting:	0559761
Northing:	4847264
Source:	GPS
Geodetic height:	213 m

### 2.2 Site Maps

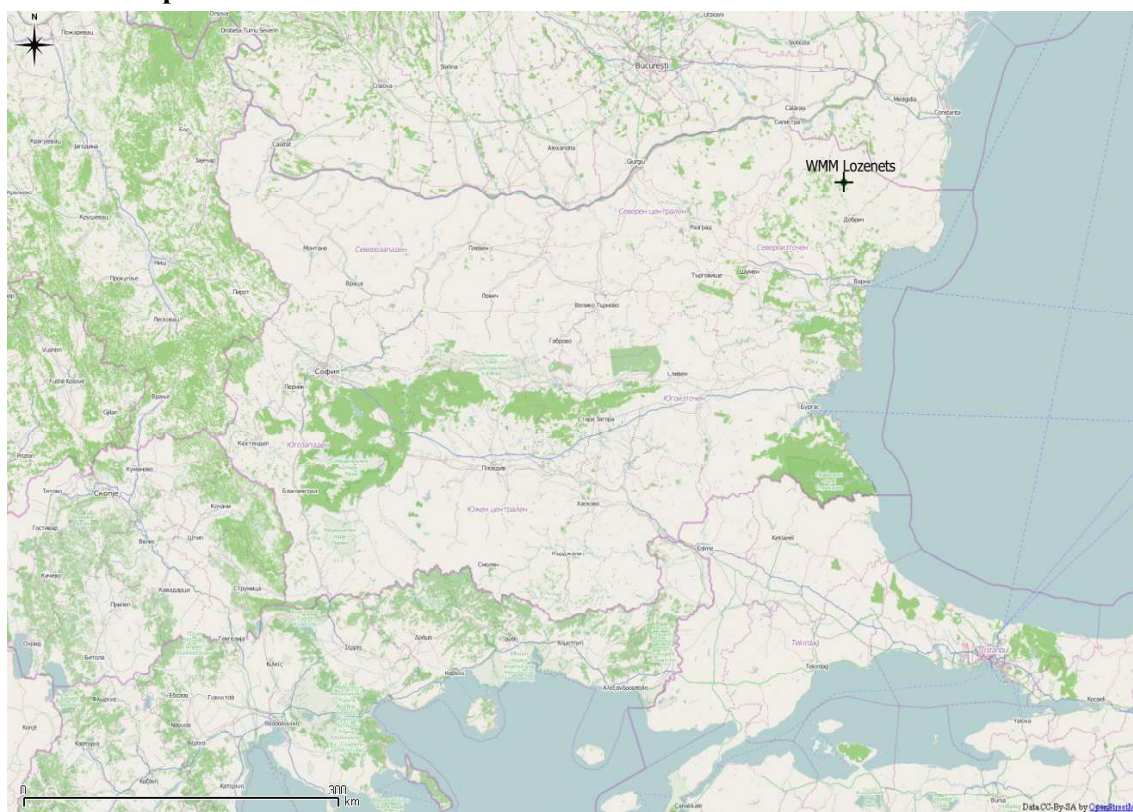


Figure 2.1: Large scale map of Ireland with the position of the met mast

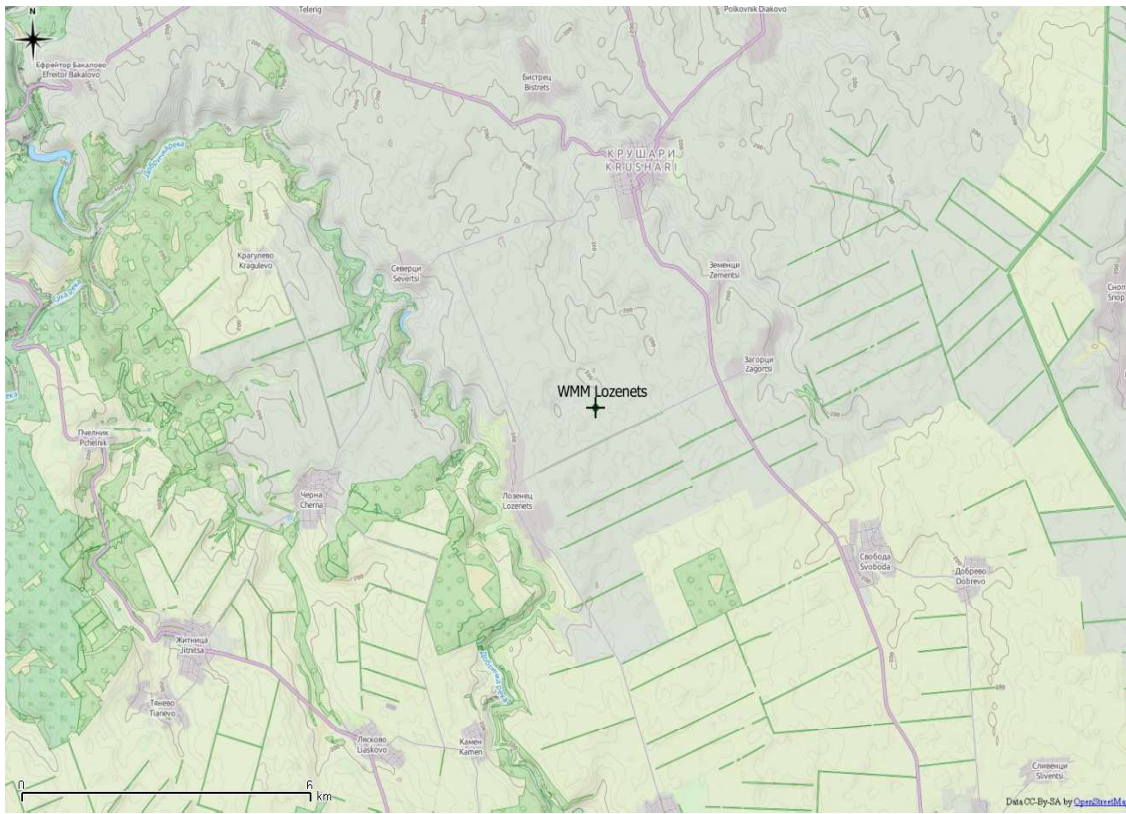


Figure 2.2: Small scale map of surroundings.

### 2.3 Site Description

The planned wind farm site is located in administrative district Dobrich, Bulgaria, about 1 km east of Lozenets, 6 km southwest of Krushari Municipality and about 66 km west from the Black Sea. The area around the met mast position is characterised by rather flat terrain. The terrain height at the met mast location is about 213 m above sea level and it varies within a radius of five kilometres from 153 m to 233 m.

The landscape is characterised by open farmland with rows of hedges and trees as natural boundaries, especially close to the met mast. A meandering river valley is situated in the west. The land consists of sparse villages and small towns. Thus, a medium terrain roughness was observed at the site

A panoramic view taken from the site is shown in chapter 2.5.

### 2.4 Obstacles

There are no objects in the surroundings of the met mast which have to be regarded as obstacles<sup>1</sup>.

<sup>1</sup> An object is defined as an obstacle if it is higher than one third of the measurement height and closer than 50 times the obstacle height to the met mast.



## 2.5 Panoramic View

0°



90°

90°



180°

180°

270°



270°

360°



Figure 2.3: Panoramic view of the site taken at the bottom of the met mast

### **3 Measurement Setup**

#### **3.1 General**

The wind measurement was set up by means of a 100 m metrological mast. The mast structure was tubular. Information regarding the sensor types is given in section 3.7. Details of all sensors like serial numbers and calibration protocols are listed in the appendix 9. Mast and boom dimensions and assembly of sensors is given in the installation protocol, 9.1. A photo of the entire met mast after erection is included (appendix 9.1.1).

#### **3.2 Wind Speed**

Wind speed was measured by means of cup anemometers at the heights 100.2 m, 97.9 m, 74.0 m, 40.0 m and 25.0 m above ground. The anemometer at 97.9 m height served as back-up anemometer for the top anemometer. The anemometer at 74.0 m, 40.0 m and 25.0 m height served for the determination of the vertical wind shear.

The anemometer at 100.2 m height was installed on top of the mast on a vertical tube that clearly exceeds the mast. The other anemometers were mounted on side booms (see appendix 9.1.1 for details).

The anemometers were all of type Thies First Class. This type of anemometer was classified as class 1.7A and class 3.4B anemometer according to reference [5]. An anemometer class was estimated for the site specific measurement conditions on the basis of the results of investigations of anemometers according to reference [5], [6], [7]. For all measurement heights, a class of 1.7S in accord to reference [1] was gained in case of the Thies First Class anemometers (see appendix 9.2).

All anemometers were calibrated before the measurements by Deutsche WindGuard Wind Tunnel Services according to terms of IEC 61400-12-1 [1], MEASNET [8] and DKD (for calibration certificates see appendix 9.2). According to the quality management system of Deutsche Windguard Consulting GmbH a complete anemometer replacement was performed on 2010-05-06, 2011-05-10 and 03-07-2012.

At the end of the measurement period and after every anemometer change, an in-situ test of all anemometers was performed in order to test the consistency of the calibrations during the measurement period. These in-situ tests proved that there were no significant changes of the calibrations for most of the used anemometers throughout the measurement period (see appendix 9.3). After the first anemometer change a post calibration for each anemometer was made, which was passed by all sensors (see appendix 9.3).

The only exception to the last paragraph was the measurement period between 13-02-2010 and 06-05-2010. Here the relation between the top anemometer and its back-up changes, see section 4.2 for a detailed discussion of this phenomenon.

The measured signals of the anemometers were transmitted and recorded as frequency. The frequency channels of the data logger were calibrated traceable to national standards before the measurement period. Heating of the anemometers was not applied.

#### **3.3 Wind Direction**

Wind direction was measured at 97.9 m and 40.0 m height by means of vanes of type Thies First Class 4.3150.00.212. Functional suitability was verified during installation. Northing of the vanes was performed via compass during installation according to Deutsche WindGuard's



quality management system. The angle of magnetic declination of 4°E has been taken into account for the data evaluation.

The vanes are of resistance type in 4-wire technique and have been recorded by analogue channels of the data logger.

### **3.4 Air Density**

Air density mainly depends on air temperature and atmospheric pressure. Only at hot temperatures it is also significantly influenced by the relative humidity.

Air temperature was measured by means of an air temperature sensor of type Galltec TPK 1/6-ME at 97.5 m height above ground. At 24.5 m height air temperature and relative humidity were measured by means of a combined air temperature and relative humidity sensor of type Galltec KPK 1/6-ME.

The air temperature measurements of both instruments are realised as Pt100 sensors. The air humidity sensor is a capacitive sensor. Both sensors provide active voltage signals of the measures, which are recorded by the data logger.

Atmospheric pressure was measured by a piezoelectric pressure sensor of type Ammonit AB 60 which was installed at height 5 m above ground level in a cabinet that houses also the data logger. The sensor provides a voltage signal, which is recorded by the data logger.

Air temperature sensors and the pressure sensor, including connecting cables and the data logger channels, were calibrated by Deutsche WindGuard traceable to national standards before the measurement period (see calibration certificates in appendix 9.4, also of reference sensors in appendix 9.6).

### **3.5 Radiation**

Solar radiation was measured by a Pyranometer of type Kipp & Zonen CMP 3. In the scope of this work the radiation data was recoded but not evaluated.

### **3.6 Data Recording**

Data was recorded by means of a data logger of type Ammonit Meteo 32X which is especially designed for meteorological measurements. Sampling frequency is 1 Hz. There are different channel types and several channels per type. Wind speeds are recorded as frequencies (counts of pulses per second). Wind directions, air temperature, atmospheric pressure and relative humidity are recorded by analogue voltage signals.

Mean values, extreme values and standard deviation are calculated and stored for 10-minute-intervals. All input channels were traceably calibrated.

Data was transmitted daily by means of GSM and regularly checked (weekly).

Conversion facilities of the logger were not used. Instead, conversion to physical measures was applied after the measurements by in-house designed software (see section 4).

### 3.7 List of Sensor Types

The following sensor types were used for the measurement. Type characteristics are given in the table below:

Table 3.1: Type characteristics of applied sensors

<b>Number</b>	1, 2, 3, 9, 10		
<b>Sensor</b>	Wind speed	<b>Range</b>	0-75 m/s
<b>Type</b>	Cup anemometer	<b>Resolution</b>	0.05 m/s
<b>Specification</b>	Thies 4.3350.X0.000 (First Class)	<b>Accuracy</b>	Class 1.7A, 3.4B, 1.7S (IEC 61400-12-1)
		<b>Distance constant</b>	2.3 m +/- 10%

<b>Number</b>	4, 5		
<b>Sensor</b>	Wind direction	<b>Range</b>	0 to 360°
<b>Type</b>	Wind vane	<b>Accuracy</b>	+/- 1°
<b>Specification</b>	Thies First class 4.3150.X0.212		

<b>Number</b>	6, 7		
<b>Sensor</b>	Air humidity (combined)	<b>Range</b>	0-100 % rH
<b>Type</b>	Capacitive	<b>Accuracy</b>	2% rH
<b>Sensor</b>	Air temperature (combined)	<b>Range</b>	-30° to +70°C
<b>Type</b>	PT100	<b>Accuracy</b>	0.5 K
<b>Specification</b>	Galltec KPK 1/6 - ME		

<b>Number</b>	8		
<b>Sensor</b>	Air pressure	<b>Range</b>	800-1100 hPa
<b>Type</b>	Piezoelectric	<b>Accuracy</b>	+/- 3.8 hPa
<b>Specification</b>	Ammonit AB60		

<b>Number</b>	11		
<b>Sensor</b>	Air temperature	<b>Range</b>	-30° to +70°C
<b>Type</b>	PT100	<b>Accuracy</b>	0.5 K
<b>Specification</b>	Galltec TPK 1/6 - ME		

<b>Number</b>	12		
<b>Device</b>	Solar radiation	<b>Range</b>	0 to 1400 W/m <sup>2</sup>
<b>Type</b>	Pyranometer	<b>Accuracy</b>	according specifications
<b>Specification</b>	Kipp&Zonen CMP 3		

<b>Device</b>	Data acquisition system	<b>Sample rate</b>	1 Hz
<b>Type</b>	Industrial data logger	<b>Average time</b>	10 min
<b>Specification</b>	Ammonit meteo32X		<b>Channel type</b>
			<b>Frequency</b>   <b>Analog</b>
		<b>Resolution</b>	16 bit   12 bit
		<b>Accuracy</b>	0.01%   0.10%

### 3.8 Logbook

Table 3.2: Logbook of the measurement. All times are given in CET (GMT+1h)

From	To	Event
2009-02-12 10:10	-	Begin of measurement after installation and
2009-02-12 10:10	2009-03-25 15:50	Malfunction of pressure sensor No. 8
2009-02-20 00:00	2009-02-22 12:40	Cup anemometers idle by icing
2009-03-25 15:50	2009-03-25 16:20	Repair of pressure sensor No. 8
2009-08-24 22:10	2009-08-24 22:10	Peak on cup anemometer No. 1
2009-12-15 20:20	2009-12-19 22:10	Cup anemometers idle by icing
2009-12-20 07:30	2009-12-22 05:40	Cup anemometers idle by icing
2010-01-04 02:10	2010-01-04 02:10	Peak on cup anemometers
2010-01-18 00:50	2010-01-20 21:00	Cup anemometer No. 9 idle by icing
2010-01-20 21:00	2010-01-26 09:00	Cup anemometers idle by icing
2010-02-13 00:00	2010-05-06 10:30	Implausible behavior of anemometers No. 1 & 2 refer to section 4.2
2010-02-20 18:10	2010-02-20 18:10	Peak on cup anemometer No. 3
2010-03-11 16:00	2010-03-12 07:10	Cup anemometers idle by icing
2010-05-06 10:30	2010-05-06 13:20	Change of cup anemometers
2010-06-05 17:00	2010-06-29 10:50	Implausible behavior anemometer No. 9
2010-06-29 10:50	2010-06-29 11:00	Change of defective cup anemometer No. 9
2010-10-29 13:30	2010-10-29 13:30	Peak on cup anemometer No. 1
2010-11-28 20:00	2011-01-19 12:00	Cup anemometer No.3 defective
2010-11-29 05:50	2010-11-29 06:50	Failure in sensors No. 6, 7, 8 and 11 due to weak supply
2010-12-02 01:00	2010-12-02 14:00	Cup anemometers idle by icing
2010-12-03 00:50	2010-12-03 10:20	Failure in sensors No. 6, 7, 8 and 11 due to weak supply
2010-12-04 05:50	2010-12-04 09:10	Failure in sensors No. 6, 7, 8 and 11 due to weak supply
2010-12-04 19:20	2010-12-05 07:20	Failure in sensors No. 6, 7, 8 and 11 due to weak supply
2010-12-05 08:50	2010-12-05 09:10	Failure in sensors No. 6, 7, 8 and 11 due to weak supply
2010-12-06 05:50	2010-12-06 06:40	Failure in sensors No. 6, 7, 8 and 11 due to weak supply
2010-12-27 03:20	2011-01-01 10:40	Cup anemometers and wind vanes idle by icing
2011-01-04 22:00	2011-01-07 12:00	Cup anemometers idle by icing
2011-01-19 10:40	2011-01-19 12:00	Change of cup anemometer No. 3 and maintenance
2011-01-22 20:40	2011-01-27 12:00	Cup anemometers idle by icing
2011-02-22 22:00	2011-03-03 11:00	Cup anemometers idle by icing
2011-05-10 09:20	2011-05-10 14:00	Change of cup anemometers
2011-08-23 05:50	2011-08-23 06:10	Failure in sensors No. 6, 7, 8 and 11 due to weak supply
2011-11-20 15:00	2011-11-23 19:00	Cup anemometers idle by icing
2011-12-08 01:00	2011-12-08 08:30	Cup anemometers idle by icing
2011-12-21 16:00	2011-12-22 07:30	Cup anemometers idle by icing
2011-12-30 04:00	2011-12-30 09:30	Cup anemometers idle by icing
2012-01-18 10:50	2012-01-18 11:20	Failure in sensors No. 6, 7, 8 and 11 due to weak supply
2012-02-05 09:30	2012-02-15 04:00	Cup anemometers idle by icing
2012-07-03 10:10	2012-07-03 13:00	Change of cup anemometers
2012-11-17 00:00	2012-11-17 02:30	Cup anemometers idle by icing
2012-11-20 23:20	2012-11-22 07:30	Failure in sensors No. 6, 7, 8 and 11 due to weak supply
2012-11-23 04:10	2012-11-23 07:40	Failure in sensors No. 6, 7, 8 and 11 due to weak supply
2012-11-24 20:10	2012-11-26 06:50	Failure in sensors No. 6, 7, 8 and 11 due to weak supply
2012-11-26 04:10	2012-11-26 07:00	Cup anemometers idle by icing
2012-11-29 10:30	2012-11-29 10:50	Failure in sensors No. 6, 7, 8 and 11 due to weak supply
2012-12-09 20:00	2012-12-11 20:30	Cup anemometers idle by icing
2012-12-16 14:30	2012-12-17 14:00	Cup anemometers idle by icing
2013-01-12 11:30	2013-01-13 10:10	Cup anemometers idle by icing
2013-02-09 03:10	2013-02-09 12:10	Cup anemometers idle by icing
2013-03-22 22:30	2013-03-23 10:30	Cup anemometers idle by icing
2013-10-08 10:50	2013-10-08 11:10	Implausible behavior anemometer No. 1
-	2013-10-10 13:00	End of evaluated data

## 4 Data Processing

### 4.1 Applied Software

Basic data processing and analysis was carried out by in-house designed computational software, KOMPASS, version 2.0.20.

This software was applied for conversion of raw data (*row*-files) to physical values (*kor*-files), for data corrections and for the calculation of combinations of different measurement channels like air density or turbulence intensity. Output files contain a header portion for particular channel declaration including the applied conversion values (slope and offset).

### 4.2 Filtering

According to Table 3.2, events were manually filtered out for the data evaluation. In case of all anemometers “idle by icing” all data of the corresponding time interval are sorted out. In the other cases only the data of the affected instrument was filtered out.

The data between 2010-02-13 00:00 and 2010-05-06 01:20 is not to be used for calculation due to the following reason. The anemometers No. 1 and 2 showed an additional deviation of 2.5% between each other during measurement (Figure 4.1) and in-situ tests failed in this period (see appendix 9.3.1.5). After sensor change a post calibration was performed and the results were compared with the calibrations before measurement. All anemometers passed the post calibration test (see appendix 9.3.1.3 ) and no defect aside slight mechanical wear of the ball bearings were found on the instruments. It seems that none of the anemometers can be considered as damaged before and after the measurement. Because a deviation was found during measurement and the top anemometer is the most important wind speed for the measurement, the complete measurement starting from February 13<sup>th</sup> 2010 till May 6<sup>th</sup> 2010 1:20 P.M. is not used for calculation.

With regard to the completeness criteria of the MEASNET Guideline [4] it has to be observed that the measurement worked for more than 40 consecutive months. Therefore no deviation to the guideline [4] occurred and thus no filling of this data gap was performed.

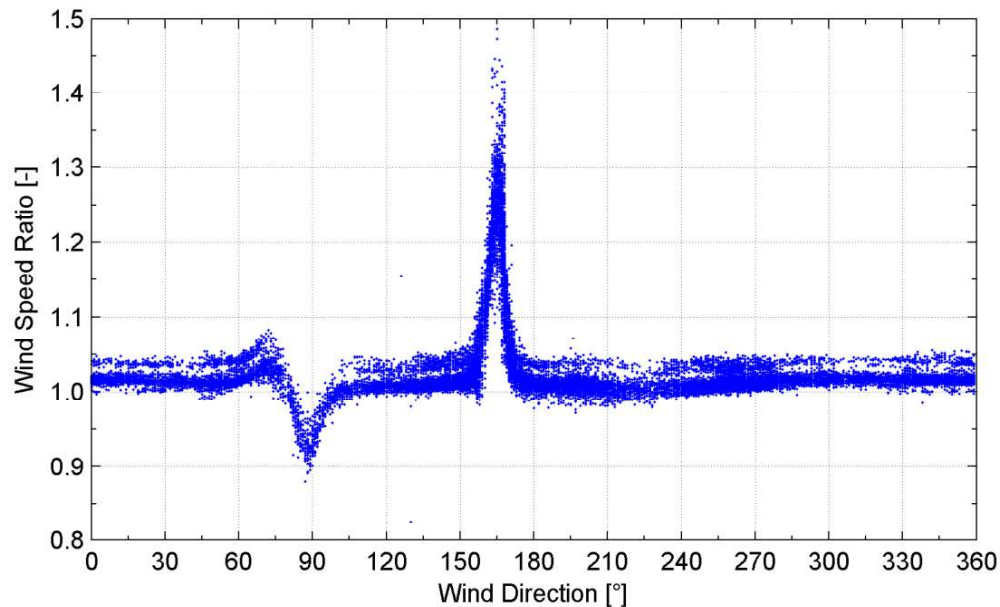


Figure 4.1: Ratio between the wind speeds measured by the top anemometer at 100.2 m and the back-up anemometer at 97.9 m over the wind direction at 97.9 m for wind speeds higher 8 m/s. A deviation of 2.5% of measured wind speed occurred from February 13<sup>th</sup> 2010 till the sensor change at May 6<sup>th</sup> 2010.

#### 4.3 Correction of Mast Effects

At wind directions, where the boom mounted anemometers are located downwind of the met mast, the anemometers are strongly influenced by the wake of the met mast. This effect can clearly be seen as a decrease of the ratios of wind speeds and as an increase of the ratios of turbulence intensities measured by the boom mounted anemometers and the top mounted anemometer (Figure 4.2, Figure 4.3, Figure 4.4 and Figure 4.5). In addition, the top anemometer is significantly influenced by the wake of the lightning rod (see in particular Figure 4.2). Wind direction dependent correction factors of these wake effects for wind speeds and turbulence intensities were gained by assuming that the true wind speed and turbulence ratios in the wake sectors (unaffected ratios) are the same than the ratios interpolated linearly between the borders of the wake.

Furthermore, a small decrease of wind speeds caused by the mast blockage occurs at the boom mounted anemometers at maximum at the wind direction opposite to the boom orientation. This effect is best noticeable from the ratios of wind speeds measured at 100.2 m and 97.9 m as function of the wind direction (Figure 4.2). The blockage effect caused by the met mast was corrected by assuming that the effect vanishes at wind directions about 45° to the boom orientation. For the directions between the maximum blockage and zero blockage a linear increase of the flow effect caused by the mast was assumed. The flow distortion of the mast causes a small flow acceleration at the position of the boom mounted anemometers if the angle between the wind direction and the boom orientation is larger than 45° and if the anemometers are not positioned in the wake of the mast. This flow acceleration effect is assumed to be at its maximum perpendicular to the boom orientation. The maximum flow acceleration effect is assumed to be of equal size than the maximum blockage effect. For wind directions between the direction of maximum flow acceleration and wind directions 45° to the

boom orientation a linear decrease of the flow acceleration effect caused by the mast was assumed.

The correction factors of wind speeds and turbulence intensities are shown in appendix 9.5. As the site evaluation according to the standard IEC 61400-1, Edition 3 [3] requires the evaluation of the standard deviation of the wind speed per 10-minute period, a corrected standard deviation of the wind speed was evaluated as product of the turbulence intensity corrected for mast effects times the wind speed corrected for mast effects.

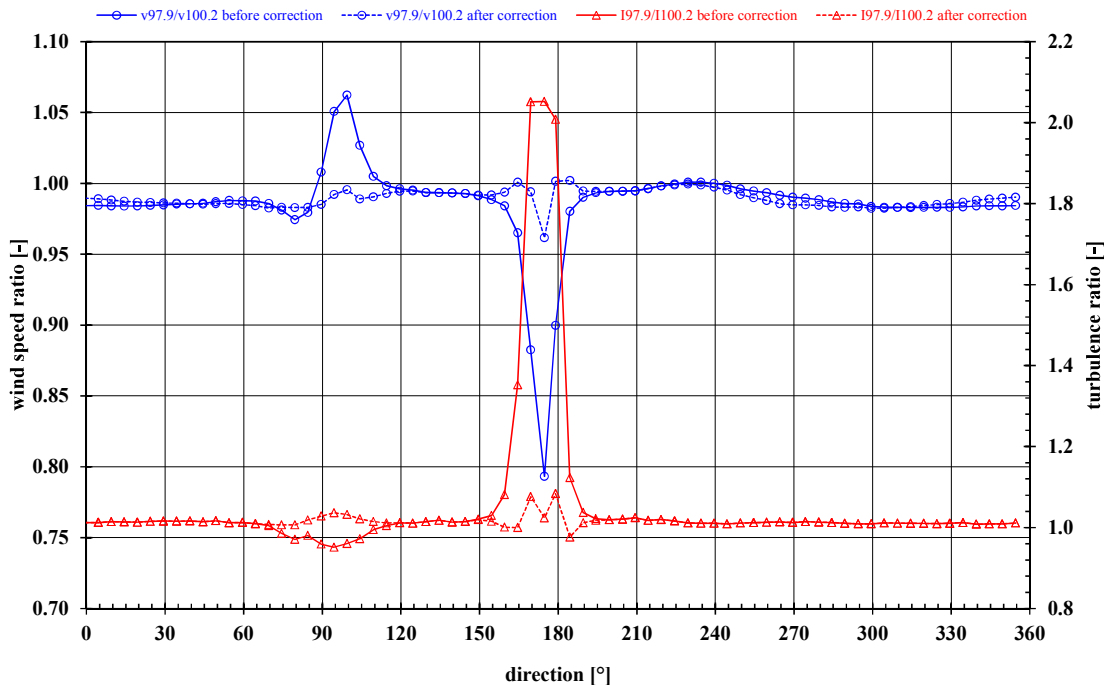


Figure 4.2: Ratios of wind speeds and turbulence intensities measured at 100.2 m and 97.9 m as function of the wind direction. The wind speed ratios and turbulence ratios are bin averaged against the wind direction at wind speeds larger than 4 m/s. The wake influence of the met mast on the anemometer in 97.9 m measurement height is clearly seen in the sector 160°- 190°. At wind directions around 355° appears the maximum mast blockage effect on the anemometer at 97.9 m height (decrease of measured wind speed at opposite direction of boom orientation), and at wind directions perpendicular to the maximum blockage effect appear acceleration effects caused by the mast. In addition, the wake influence of the lightning rod on the anemometer at the mast top (100.2 m) is clearly seen in the sector 60°- 105°.

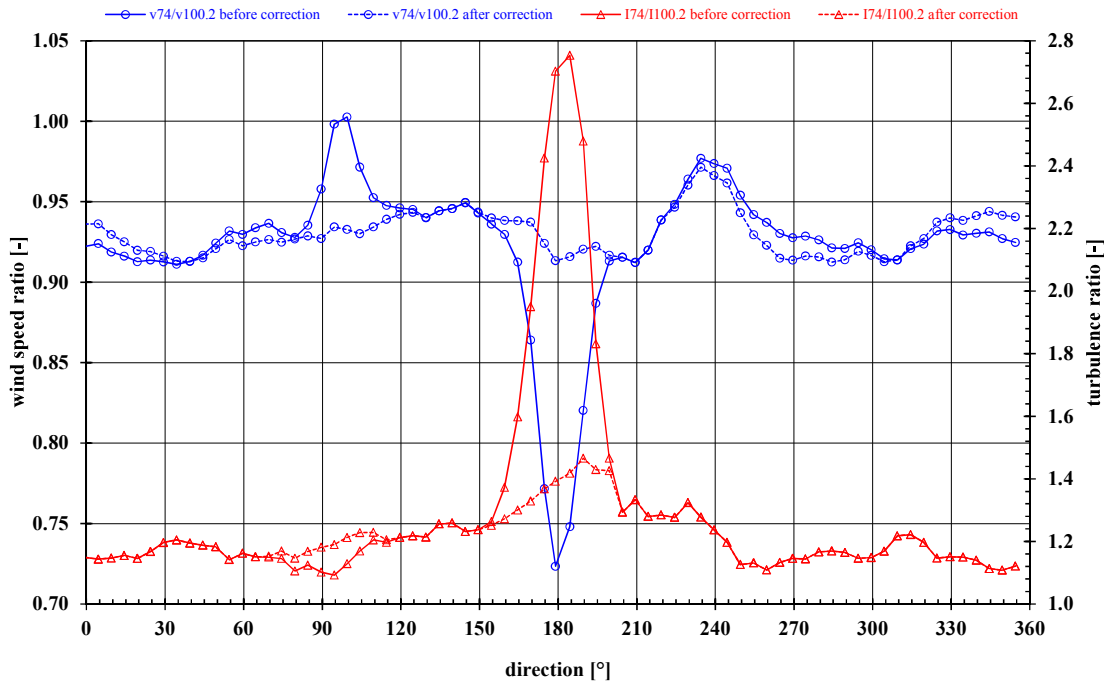


Figure 4.3: Ratios of wind speeds and turbulence intensities measured at 100.2 m and 74.0 m as function of the wind direction. The wind speed ratios and turbulence ratios are bin averaged against the wind direction at wind speeds larger than 4 m/s. The wake influence of the met mast on the anemometer in 74.0 m measurement height is clearly seen in the sector 150°- 220°. At wind directions around 5° appears the maximum mast blockage effect on the anemometer at 74.0 m height (decrease of measured wind speed at opposite direction of boom orientation), and at wind directions perpendicular to the maximum blockage effect appear acceleration effects caused by the mast. In addition, the wake influence of the lightning rod on the anemometer at the mast top (100.2 m) is clearly seen in the sector 60°-105°.



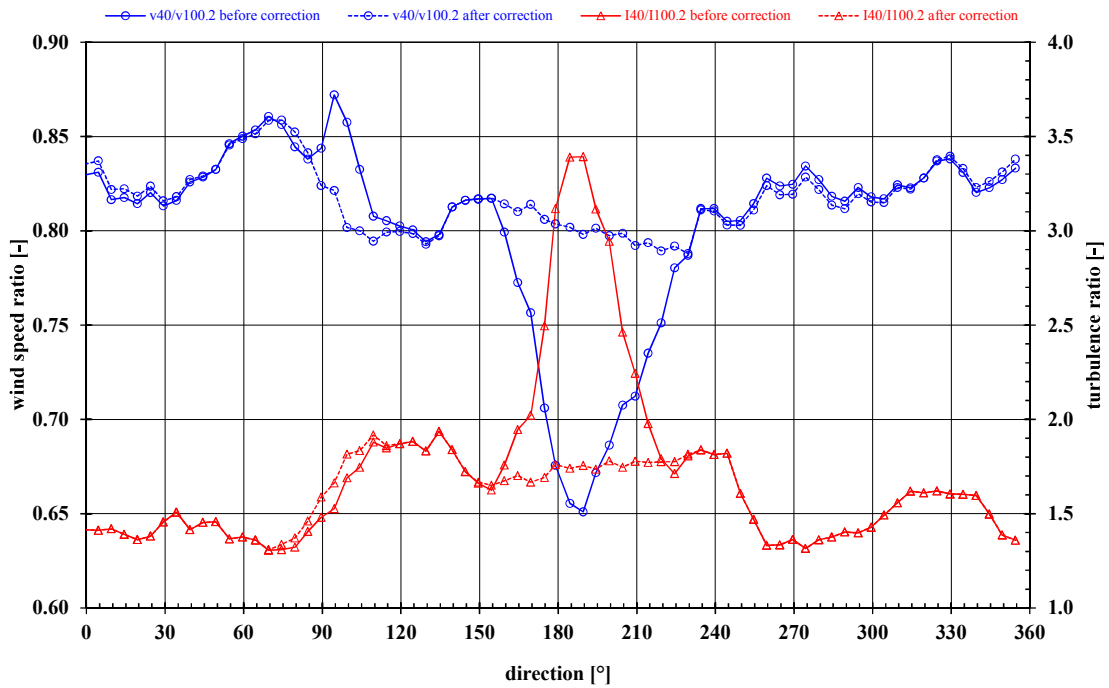


Figure 4.4: Ratios of wind speeds and turbulence intensities measured at 100.2 m and 40.0 m as function of the wind direction. The wind speed ratios and turbulence ratios are bin averaged against the wind direction at wind speeds larger than 4 m/s. The wake influence of the met mast on the anemometer in 40.0 m measurement height is clearly seen in the sector 150°- 240°. At wind directions around 15° appears the maximum mast blockage effect on the anemometer at 40.0 m height (decrease of measured wind speed at opposite direction of boom orientation), and at wind directions perpendicular to the maximum blockage effect appear acceleration effects caused by the mast. In addition, the wake influence of the lightning rod on the anemometer at the mast top (100.2 m) is seen in the sector 60°-105°.



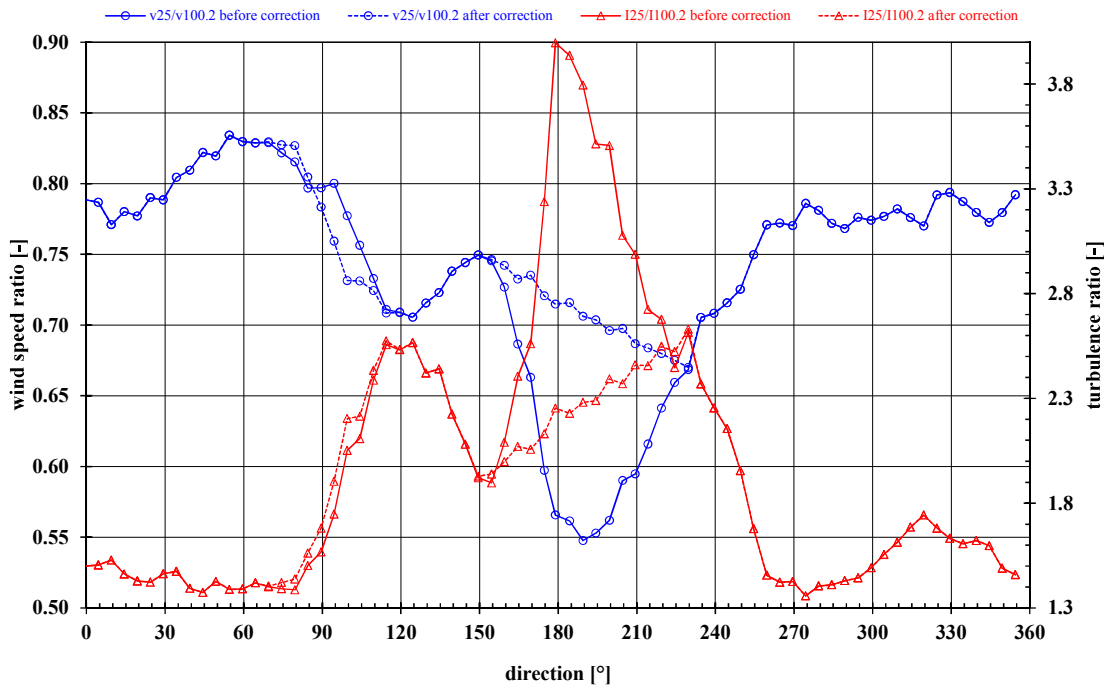


Figure 4.5: Ratios of wind speeds and turbulence intensities measured at 100.2 m and 25.0 m as function of the wind direction. The wind speed ratios and turbulence ratios are bin averaged against the wind direction at wind speeds larger than 4 m/s. The wake influence of the met mast on the anemometer in 25.0 m measurement height is clearly seen in the sector 150°- 240°. At wind directions around 15° appears the maximum mast blockage effect on the anemometer at 25.0 m height (decrease of measured wind speed at opposite direction of boom orientation), and at wind directions perpendicular to the maximum blockage effect appear acceleration effects caused by the mast. In addition, the wake influence of the lightning rod on the anemometer at the mast top (100.2 m) is seen in the sector 60°-105°.

#### **4.4 Filling of Data Gaps**

Data sets with non-plausible values were filtered according to predefined rules (see section 4.2 and Table 3.2). The resulting data gaps do not result in a violation of the completeness rules of the MEASNET guideline. Consequently, none of these gaps have been filled.

Implausible data sets were filtered out manually according to section 4.2 and Table 3.2. The resulting data gaps are negligibly small. Consequently, none of these gaps have been filled.

#### **4.5 Evaluation of Turbulence Intensity**

The turbulence intensity was evaluated as ratio of standard deviation of wind speed per 10-minute period and average wind speed. The turbulence intensity was corrected for wake effects of the met mast. The measured standard deviation of the wind speeds was corrected for the pre-averaging of the measurement data over 1-second intervals by a factor of 1.05454 according to reference [9].

Apart of the measured turbulence intensity, the following turbulence information was evaluated:

- Standard deviation of the turbulence intensity per wind speed and wind direction bin,
- Characteristic ambient turbulence intensity according to IEC 61400-1, Edition 2 [2] per wind speed and wind direction bin, evaluated as sum of the measured turbulence intensity and the standard deviation of the turbulence intensity,
- Characteristic ambient turbulence intensity at 15 m/s according to IEC 61400-1, Edition 2 [2] evaluated as sum of the mean measured turbulence intensity at wind speeds above 10 m/s and the standard deviation of turbulence intensities above 10 m/s,
- Standard deviation of the wind speed per wind speed and wind direction bin according to IEC 61400-1, Edition 3 [3],
- Standard deviation of standard deviation of the wind speed per wind speed and wind direction bin according to IEC 61400-1, Edition 3 [3],
- Representative ambient turbulence intensity according to IEC 61400-1, Edition 3 [3] per wind speed and wind direction bin as sum of the standard deviation of the wind speed and 1.28 times the standard deviation of the standard deviation of the wind speed, divided by the mean wind speed per bin.

#### **4.6 Evaluation of Wind Shear**

The wind shear was calculated as the power law exponent (wind shear exponent) between two successive heights. For this calculation wind speeds corrected for mast effects were used.

#### **4.7 Evaluation of Air Density**

The air density was calculated for each 10-minute period on the basis of the measurement of the air temperature and air pressure according to the standard IEC 61400-12-1 [1]. Height correction was applied according to the terms of ISO 2533 [12] such that the evaluated air density refers to a height of 97.5 m above ground.

#### 4.8 Data Description

The time series of the measurement data are provided on a CD attached to this report. This data is stored in space separated ASCII-file in tables. Columns correspond to data channels and rows to contiguous time steps.

The 10 minute statistics generated from 1 Hz samples as stored by the data logger are given “row” (raw data). The statistic to every sensor consists in most cases of average, maximum, minimum and standard deviation. The data format is described in Table 4.1.

The data file MV14019\_Lozenets.kor is covering the entire measurement period in a single file. All data are converted to physical measures as used for the data evaluation. The calibration of the sensors and data logger was applied to all signals given. In this file also corrected data or calculated measures, like wind speeds corrected for mast effects and air density, are included. Data rows with measurement errors (i.e. icing events) are filtered out of the file MV14019\_Lozenets.kor. The data format is described in Table 4.2.

The time stamp in the head of every row is given in CET (GMT+1) and has the format <dd-mm-yyyy HH:MM:SS> for raw data files and <yyyy-mm-dd HH:MM:SS> for corrected data files.

Table 4.1: Column number of data channels of the raw data file (yyyy\_mm.row)

measured variable	measurement height above ground	unit	column number				Remark
			avg	min	max	std	
time	dd-mm-yyyy	HH:MM:SS	1	-	-	-	
wind speed	100.2 m	[0.1 Hz]	2	3	4	5	
wind speed	97.9 m	[0.1 Hz]	6	7	8	9	
wind speed	74.0 m	[0.1 Hz]	10	11	12	13	
wind direction	97.9 m	[deg]	14	15	16	17	offset not corrected
wind direction	40.0 m	[deg]	18	19	20	21	offset not corrected
humidity	24.5 m	[0.1 mV]	22	23	24	25	
air temperature	24.5 m	[0.1 mV]	26	27	28	29	
atmospheric pressure	5 m	[0.1 mV]	30	31	32	33	not height corrected
radiation	9 m	[0.1 mV]	34	35	36	37	
wind speed	40.0 m	[0.1 Hz]	38	39	40	41	
air temperature	97.5 m	[0.1 mV]	42	43	44	45	
wind speed	25.0 m	[0.1 Hz]	46	47	48	49	
internal temperature logger	5 m	[° C]	50	-	-	-	
voltage external supply	5 m	[0.1 V]	51	-	-	-	
battery left	5 m	[0.1 V]	52	-	-	-	
battery right	5 m	[0.1 V]	53	-	-	-	

Table 4.2: Column number of data channels of the file MV14019\_Lozenets.kor

measured variable	height above ground	unit	column number			
			avg	min	max	std
time		yyyy-mm-dd HH:MM:SS	0	-	-	-
wind speed, not corrected	100.2 m	[m/s]	1	2	3	4
wind speed, not corrected	97.9 m	[m/s]	5	6	7	8
wind speed, not corrected	74.0 m	[m/s]	9	10	11	12
wind direction	97.9 m	[deg]	13	14	15	16
wind direction	40.0 m	[deg]	17	18	19	20
humidity	24.5 m	[°C]	21	22	23	24
air temperature	24.5 m	[°C]	25	26	27	28
atmospheric pressure	5 m	[hPa]	29	30	31	32
radiation	9 m	[W/m <sup>2</sup> ]	33	34	35	36
wind speed, not corrected	40.0 m	[m/s]	37	38	39	40
air temperature	97.5 m	[°C]	41	42	43	44
wind speed, not corrected	25.0 m	[m/s]	45	46	47	48
internal temperature logger	5 m	[°C]	49	-	-	-
voltage external supply	5 m	[V]	50	-	-	-
battery left	5 m	[V]	51	-	-	-
battery right	5 m	[V]	52	-	-	-
air density	97.5 m	[kg/m <sup>3</sup> ]	53	-	-	-
turbulence intensity, not corrected	100.2 m	[-]	54	-	-	-
turbulence intensity, not corrected	97.9 m	[-]	55	-	-	-
turbulence intensity, not corrected	74.0 m	[-]	56	-	-	-
turbulence intensity, not corrected	40.0 m	[-]	57	-	-	-
turbulence intensity, not corrected	25.0 m	[-]	58	-	-	-
wind speed, corrected for mast effects	100.2 m	[m/s]	59	-	-	-
turbulence intensity, corrected for mast effects	100.2 m	[-]	60	-	-	-
standart deviation wind speed, corrected for mast effects	100.2 m	[m/s]	61	-	-	-
wind speed, corrected for mast effects	97.9 m	[m/s]	62	-	-	-
turbulence intensity, corrected for mast effects	97.9 m	[-]	63	-	-	-
standart deviation wind speed, corrected for mast effects	97.9 m	[m/s]	64	-	-	-
wind speed, corrected for mast effects	74.0 m	[m/s]	65	-	-	-
turbulence intensity, corrected for mast effects	74.0 m	[-]	66	-	-	-
standart deviation wind speed, corrected for mast effects	74.0 m	[m/s]	67	-	-	-
wind speed, corrected for mast effects	40.0 m	[m/s]	68	-	-	-
turbulence intensity, corrected for mast effects	40.0 m	[-]	69	-	-	-
standart deviation wind speed, corrected for mast effects	40.0 m	[m/s]	70	-	-	-
wind speed, corrected for mast effects	25.0 m	[m/s]	71	-	-	-
turbulence intensity, corrected for mast effects	25.0 m	[-]	72	-	-	-
standart deviation wind speed, corrected for mast effects	25.0 m	[m/s]	73	-	-	-

## 5 Results

### 5.1 Availability

The availability of the measurements evaluated as percentage of the measurement period covered by the filtered data of the highest anemometer and the total measurement period is shown in Table 5.1. Detailed data availability is shown in Table 5.2.

Table 5.1: Basic Data Information

Start of Data	2009-02-12 10:10
End of Data	2013-10-10 13:00
Total Number of Data	225285
Data Availability	92%

Table 5.2: Listed data sets per day (continued)

day	02.09	03.09	04.09	05.09	06.09	07.09	08.09	09.09	10.09	11.09	12.09
1	0	144	144	144	144	144	144	144	144	144	144
2	0	144	144	144	144	144	144	144	144	144	144
3	0	144	144	144	144	144	144	144	144	144	144
4	0	144	144	144	144	144	144	144	144	144	144
5	0	144	144	144	144	144	144	144	144	144	144
6	0	144	144	144	144	144	144	144	144	144	144
7	0	144	144	144	144	144	144	144	144	144	144
8	0	144	144	144	144	144	144	144	144	144	144
9	0	144	144	144	144	144	144	144	144	144	144
10	0	144	144	144	144	144	144	144	144	144	144
11	0	144	144	144	144	144	144	144	144	144	144
12	83	144	144	144	144	144	144	144	144	144	144
13	144	144	144	144	144	144	144	144	144	144	144
14	144	144	144	144	144	144	144	144	144	144	144
15	144	144	144	144	144	144	144	144	144	144	122
16	144	144	144	144	144	144	144	144	144	144	0
17	144	144	144	144	144	144	144	144	144	144	0
18	144	144	144	144	144	144	144	144	144	144	0
19	144	144	144	144	144	144	144	144	144	144	10
20	0	144	144	144	144	144	144	144	144	144	45
21	0	144	144	144	144	144	144	144	144	144	0
22	67	144	144	144	144	144	144	144	144	144	109
23	144	144	144	144	144	144	144	144	144	144	144
24	144	144	144	144	144	144	143	144	144	144	144
25	144	140	144	144	144	144	144	144	144	144	144
26	144	144	144	144	144	144	144	144	144	144	144
27	144	144	144	144	144	144	144	144	144	144	144
28	144	144	144	144	144	144	144	144	144	144	144
29	0	144	144	144	144	144	144	144	144	144	144
30	0	144	144	144	144	144	144	144	144	144	144
31	0	144	0	144	0	144	144	0	144	0	144
%	84.7%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	80.6%

Table 5.2: Listed data sets per day (continued)

day	01.10	02.10	03.10	04.10	05.10	06.10	07.10	08.10	09.10	10.10	11.10	12.10
1	144	144	0	0	0	144	144	144	144	144	144	144
2	144	144	0	0	0	144	144	144	144	144	144	65
3	144	144	0	0	0	144	144	144	144	144	144	144
4	143	144	0	0	0	144	144	144	144	144	144	144
5	144	144	0	0	0	144	144	144	144	144	144	144
6	144	144	0	0	70	144	144	144	144	144	144	144
7	144	144	0	0	144	144	144	144	144	144	144	144
8	144	144	0	0	144	144	144	144	144	144	144	144
9	144	144	0	0	144	144	144	144	144	144	144	144
10	144	144	0	0	144	144	144	144	144	144	144	144
11	144	144	0	0	144	144	144	144	144	144	144	144
12	144	144	0	0	144	144	144	144	144	144	144	144
13	144	0	0	0	144	144	144	144	144	144	144	144
14	144	0	0	0	144	144	144	144	144	144	144	144
15	144	0	0	0	144	144	144	144	144	144	144	144
16	144	0	0	0	144	144	144	144	144	144	144	144
17	144	0	0	0	144	144	144	144	144	144	144	144
18	144	0	0	0	144	144	144	144	144	144	144	144
19	144	0	0	0	144	144	144	144	144	144	144	144
20	126	0	0	0	144	144	144	144	144	144	144	144
21	0	0	0	0	144	144	144	144	144	144	144	144
22	0	0	0	0	144	144	0	144	144	144	144	144
23	0	0	0	0	144	144	144	144	144	144	144	144
24	0	0	0	0	144	144	144	144	144	144	144	144
25	0	0	0	0	144	144	144	144	144	144	144	144
26	89	0	0	0	144	144	144	144	144	144	144	144
27	144	0	0	0	144	144	144	144	144	144	144	20
28	144	0	0	0	144	144	144	144	144	144	144	0
29	144	0	0	0	144	140	144	144	144	143	144	0
30	144	0	0	0	144	144	144	144	144	144	144	0
31	144	0	0	0	144	0	144	144	0	144	0	0
%	82.2%	42.9%	0.0%	0.0%	82.2%	99.9%	96.8%	100.0%	100.0%	100.0%	100.0%	82.5%

Table 5.2: Listed data sets per day (continued)

day	01.11	02.11	03.11	04.11	05.11	06.11	07.11	08.11	09.11	10.11	11.11	12.11
1	79	144	0	144	144	144	144	144	144	144	144	144
2	144	144	0	144	144	144	144	144	144	144	144	144
3	144	144	77	144	144	144	144	144	144	144	144	144
4	144	144	144	144	144	144	144	144	144	144	144	144
5	144	144	144	144	144	144	144	144	144	144	144	144
6	144	144	144	144	144	144	144	144	144	144	144	144
7	144	144	144	144	144	144	144	144	144	144	144	144
8	144	144	144	36	144	144	144	144	144	144	144	98
9	144	144	144	144	144	144	144	144	144	144	144	144
10	144	144	144	144	115	144	144	144	144	144	144	144
11	144	144	144	144	144	144	144	144	144	144	144	144
12	144	144	144	144	144	144	144	144	144	144	144	144
13	144	144	144	144	144	144	144	144	144	144	144	144
14	144	144	144	144	144	144	144	144	144	144	144	144
15	144	144	144	144	144	144	144	144	144	144	144	144
16	144	144	144	144	144	144	144	144	144	144	144	144
17	144	144	144	144	144	144	144	144	144	144	144	144
18	144	144	144	144	144	144	144	144	144	144	144	144
19	143	144	144	144	144	144	144	144	144	144	144	144
20	144	144	144	144	144	144	144	144	144	144	90	144
21	144	144	144	144	144	144	144	144	144	144	0	96
22	124	132	144	144	144	144	144	144	144	144	0	98
23	0	0	144	144	144	144	144	144	144	144	29	144
24	0	0	144	144	144	144	144	144	144	144	144	144
25	0	0	144	144	144	144	144	144	144	144	144	144
26	0	0	144	144	144	144	144	144	144	144	144	144
27	71	0	144	144	144	144	144	144	144	144	144	144
28	144	0	144	144	144	144	144	144	144	144	144	144
29	144	0	144	144	144	144	144	144	144	144	144	144
30	144	0	144	144	144	144	144	144	144	144	144	110
31	144	0	144	0	144	0	144	144	0	144	0	144
%	83.5%	78.3%	92.0%	97.5%	99.4%	100.0%	100.0%	100.0%	100.0%	100.0%	89.4%	96.1%

Table 5.2: Listed data sets per day (continued)

day	01.12	02.12	03.12	04.12	05.12	06.12	07.12	08.12	09.12	10.12	11.12	12.12
1	144	144	144	144	144	144	144	144	144	144	144	144
2	144	144	144	144	144	144	144	144	144	144	144	144
3	144	144	144	144	144	144	126	144	144	144	144	144
4	144	144	144	144	144	144	144	144	142	144	144	144
5	144	57	144	144	144	144	144	144	144	144	144	144
6	144	0	144	144	144	144	144	144	144	144	144	144
7	144	0	144	144	144	144	144	144	144	144	144	144
8	144	0	144	144	144	144	144	144	144	144	144	144
9	144	0	144	144	144	144	144	144	144	144	144	120
10	144	0	144	144	144	144	144	144	144	144	144	0
11	144	0	144	144	144	144	144	144	144	144	144	20
12	144	0	144	144	144	144	144	144	144	144	144	144
13	144	0	144	144	144	144	144	144	144	144	144	144
14	144	0	144	144	144	144	144	144	144	144	144	144
15	144	119	144	144	144	144	144	144	144	144	144	144
16	144	144	144	144	144	144	144	144	144	144	144	87
17	144	144	144	144	144	144	144	144	144	144	128	59
18	144	144	144	144	144	144	144	144	144	144	144	144
19	144	144	144	144	144	144	144	144	144	144	144	144
20	144	144	144	144	144	144	144	144	144	144	144	144
21	144	144	144	144	144	144	144	144	144	144	144	144
22	144	144	144	144	144	144	144	144	144	144	144	144
23	144	144	144	144	144	144	144	144	144	144	144	144
24	144	144	144	144	144	144	144	144	144	144	144	144
25	144	144	144	144	144	144	144	144	144	144	144	144
26	144	144	144	144	144	144	144	144	144	144	126	144
27	144	144	144	144	144	144	144	144	144	144	144	144
28	144	144	144	144	144	144	144	144	144	144	144	144
29	144	144	144	144	144	144	144	144	144	144	144	144
30	144	0	144	144	144	144	144	144	144	144	144	144
31	144	0	144	0	144	0	144	144	0	144	0	144
%	100.0%	66.3%	100.0%	100.0%	100.0%	100.0%	99.6%	100.0%	100.0%	100.0%	99.2%	90.3%



Table 5.2: Listed data sets per day (end)

day	01.13	02.13	03.13	04.13	05.13	06.13	07.13	08.13	09.13	10.13
1	144	144	144	144	144	144	144	144	144	144
2	144	144	144	144	144	144	144	144	144	144
3	144	144	144	144	144	144	144	144	144	144
4	144	144	144	144	144	144	144	144	144	144
5	144	144	144	144	144	144	144	144	144	144
6	144	144	144	144	144	144	144	144	144	144
7	144	144	144	144	144	144	144	144	144	144
8	144	144	144	144	144	144	144	144	144	141
9	144	89	144	144	144	144	144	144	144	144
10	144	144	144	144	144	144	144	144	144	79
11	144	144	144	144	144	144	144	144	144	0
12	69	144	144	144	144	144	144	144	144	0
13	82	144	144	144	144	144	144	144	144	0
14	144	144	144	144	144	144	144	144	144	0
15	144	144	144	144	144	144	144	144	144	0
16	144	144	144	144	144	144	144	144	144	0
17	144	144	144	144	144	144	144	144	144	0
18	144	144	144	144	144	144	144	144	144	0
19	144	144	144	144	144	144	144	144	144	0
20	144	144	144	144	144	144	144	144	144	0
21	144	144	144	144	144	144	144	144	144	0
22	144	144	135	144	144	144	144	144	144	0
23	144	144	80	144	144	144	144	144	144	0
24	144	144	144	144	144	144	144	144	144	0
25	144	144	144	144	144	144	144	144	144	0
26	144	144	144	144	144	144	144	144	144	0
27	144	144	144	144	144	144	144	144	144	0
28	144	144	144	144	144	144	144	144	144	0
29	144	0	144	144	144	144	144	144	144	0
30	144	0	144	144	144	144	144	144	144	0
31	144	0	144	0	144	0	144	144	0	0
%	96.9%	98.6%	98.4%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.8%

## 5.2 Graphical Overview of Measurements

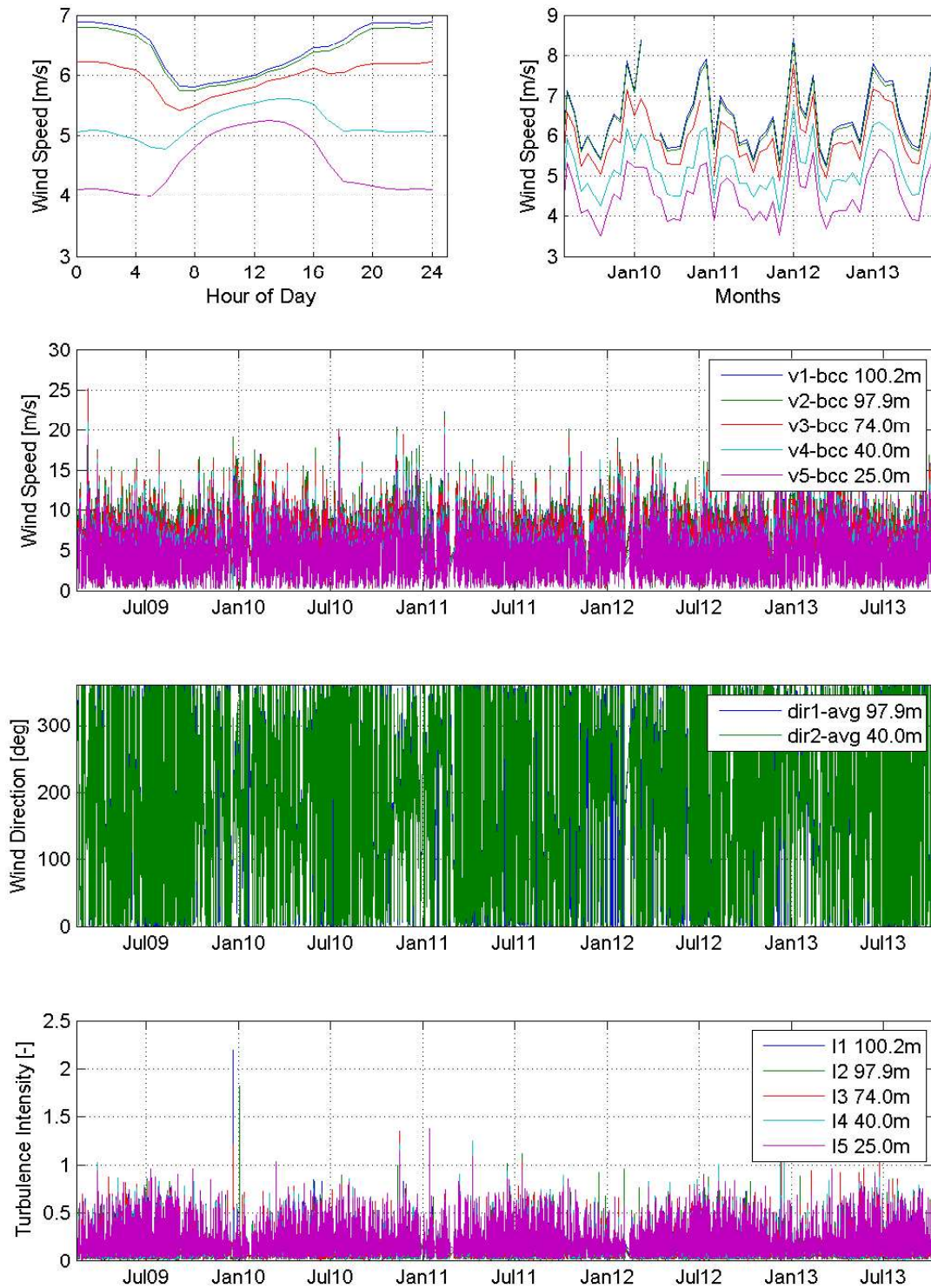


Figure 5.1: Diurnal distribution, monthly averages and time series, all measurement heights

### 5.3 Measurement Height 100.2 m

#### 5.3.1 Averages of Wind Speed and Time Series at 100.2 m

Table 5.3: Monthly averages at measurement height 100.2 m

Monthly mean values of wind speed in m/s							
Month	2009	2010	2011	2012	2013	mean	mean of months
January		7.10	5.72	8.43	7.79	7.37	7.26
February	6.03	8.38	6.99	6.74	7.52	7.13	7.13
March	7.13		6.67	6.51	7.34	6.91	6.91
April	6.59		6.53	7.50	7.37	7.00	7.00
May	5.63	6.06	5.80	5.69	6.49	5.93	5.93
June	6.00	5.67	5.89	5.27	6.03	5.77	5.77
July	5.68	5.69	5.41	6.12	5.77	5.73	5.73
August	5.42	5.72	5.94	6.24	5.68	5.80	5.80
September	6.11	6.46	6.09	6.28	6.78	6.34	6.34
October	6.55	6.81	6.49	6.33	7.79	6.63	6.79
November	6.38	7.65	5.36	5.84		6.33	6.31
December	7.86	7.91	6.68	6.86		7.28	7.33
mean, all data	6.29	6.62	6.12	6.48	6.77	6.44	
mean of months	6.31	6.74	6.13	6.48	6.86		6.53

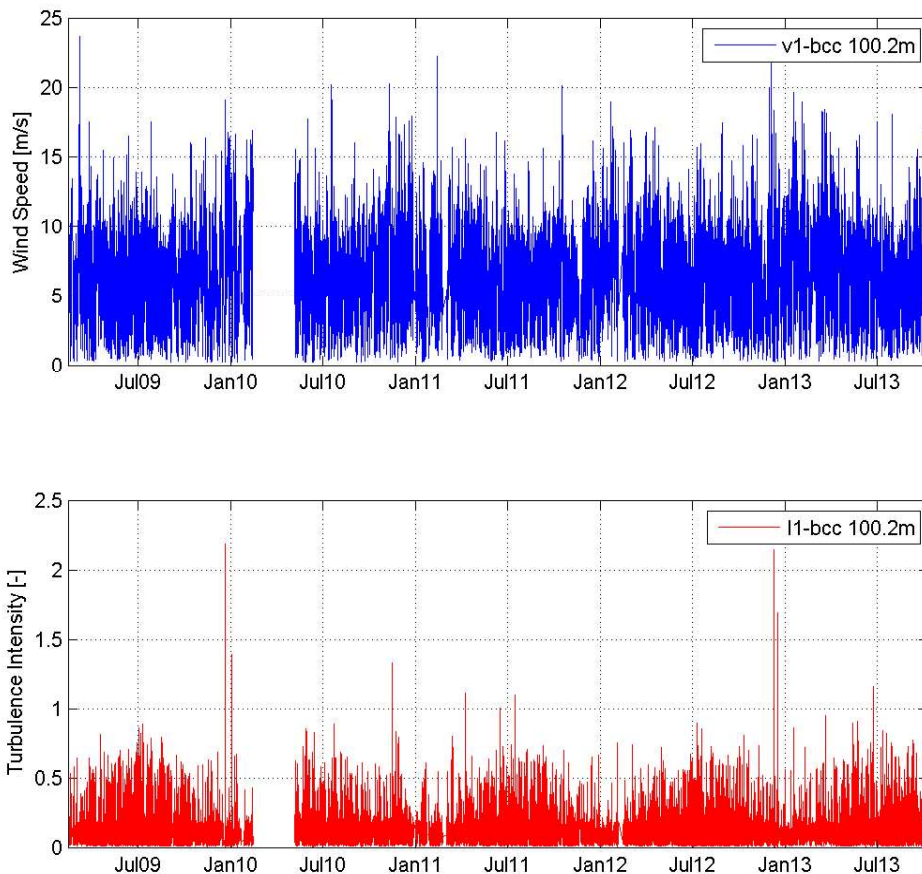


Figure 5.2: Wind speed, turbulence intensity and time series at measurement height 100.2 m

### 5.3.2 Joint Probability Distribution of Wind Speeds at 100.2 m and Wind Directions at 97.9 m

Table 5.4: Number of datasets per wind speed bin and per sector at 100.2 m

Wind Speed	Sum	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	649	45	34	26	56	29	25	22	29	29	116	128	110
0.5 - 1.49	4901	466	437	361	325	330	356	380	422	413	448	479	484
1.5 - 2.49	11722	1271	1089	978	780	613	720	777	854	942	1048	1224	1426
2.5 - 3.49	18765	2479	1996	1545	1167	993	913	1173	1183	1260	1669	2029	2358
3.5 - 4.49	24925	3467	2510	1988	1588	1354	1249	1437	1497	1465	2308	2882	3180
4.5 - 5.49	28425	3887	2631	2116	2180	1522	1886	2111	1351	1420	2717	3160	3444
5.5 - 6.49	29603	3828	2538	2070	2314	1784	2414	2363	1401	1420	2933	3329	3209
6.5 - 7.49	28600	3459	2348	1580	2023	1678	2613	2726	1591	1421	3199	3007	2955
7.5 - 8.49	25654	2976	1835	1397	1565	1412	2502	3161	1731	1314	3343	2317	2101
8.5 - 9.49	20020	2318	1223	906	907	953	1914	3387	1886	1009	2873	1354	1290
9.5 - 10.49	13620	1641	659	467	506	410	1171	3056	1484	668	2094	737	727
10.5 - 11.49	8046	1044	350	248	259	149	573	2150	968	296	1197	381	431
11.5 - 12.49	4604	609	233	154	142	79	347	1207	522	113	666	214	318
12.5 - 13.49	2745	353	104	84	111	73	223	741	292	40	439	96	189
13.5 - 14.49	1468	189	40	40	55	84	116	381	192	17	200	63	91
14.5 - 15.49	754	76	33	43	33	32	59	176	144	5	93	21	39
15.5 - 16.49	424	74	18	32	22	29	17	64	70	1	65	17	15
16.5 - 17.49	199	46	14	8	6	9	10	27	40	1	28	6	4
17.5 - 18.49	79	27	1	0	1	1	13	7	18	1	9	0	1
18.5 - 19.49	44	16	1	1	0	0	2	4	10	1	9	0	0
19.5 - 20.49	22	2	0	1	0	0	0	6	2	0	11	0	0
20.5 - 21.49	11	0	0	0	0	0	0	2	0	1	8	0	0
21.5 - 22.49	1	0	0	0	0	0	0	0	0	0	1	0	0
22.5 - 23.49	3	0	0	0	0	0	0	2	0	1	0	0	0
23.5 - 24.49	1	0	0	0	0	0	0	1	0	0	0	0	0
24.5 - 25.49	0	0	0	0	0	0	0	0	0	0	0	0	0
25.5 - 26.49	0	0	0	0	0	0	0	0	0	0	0	0	0
26.5 - 27.49	0	0	0	0	0	0	0	0	0	0	0	0	0
27.5 - 28.49	0	0	0	0	0	0	0	0	0	0	0	0	0
28.5 - 29.49	0	0	0	0	0	0	0	0	0	0	0	0	0
29.5 - 30.49	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	225285	28273	18094	14045	14040	11534	17123	25361	15687	11838	25474	21444	22372

### 5.3.3 Wind Speed Distribution at 100.2 m, Wind Direction Distribution at 97.9 m, Weibull Fit at 100.2 m

Table 5.5: Weibull parameters, average wind speeds at 100.2 m per sector

Sector	A-Parameter	Mean Wind Speed	k-Parameter	Frequency
	[m/s]	[m/s]	[-]	[%]
N	7.27	6.44	2.36	12.55
NNE	6.57	5.82	2.38	8.03
ENE	6.47	5.73	2.29	6.23
E	6.76	6.00	2.50	6.23
ESE	6.83	6.06	2.47	5.12
SSE	7.70	6.85	2.74	7.60
S	8.80	7.85	2.85	11.26
SSW	8.03	7.11	2.33	6.96
WSW	6.61	5.86	2.34	5.25
W	7.84	6.96	2.54	11.31
WNW	6.57	5.83	2.50	9.52
NNW	6.52	5.78	2.35	9.93
mean	7.26	6.44	2.39	100.00

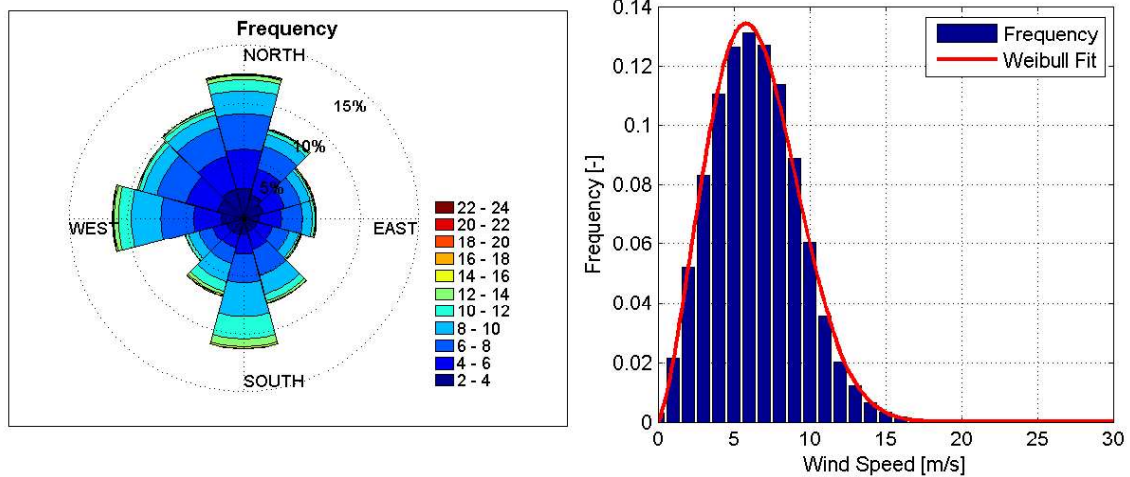


Figure 5.3: Frequency distribution of wind speeds at 100.2 m and of wind direction at 97.9 m

### 5.3.4 Turbulence Intensity at 100.2 m

Table 5.6: Turbulence intensity per wind speed bin and per sector at 100.2 m

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.116	0.126	0.169	0.201	0.100	0.195	0.256	0.309	0.227	0.282	0.050	0.054	0.065
0.5 - 1.49	0.244	0.242	0.243	0.255	0.215	0.260	0.249	0.238	0.245	0.238	0.245	0.236	0.261
1.5 - 2.49	0.185	0.198	0.182	0.180	0.175	0.198	0.195	0.168	0.178	0.177	0.181	0.188	0.189
2.5 - 3.49	0.146	0.149	0.153	0.149	0.145	0.143	0.157	0.137	0.143	0.143	0.138	0.151	0.142
3.5 - 4.49	0.121	0.123	0.130	0.131	0.123	0.126	0.130	0.118	0.112	0.105	0.112	0.119	0.116
4.5 - 5.49	0.103	0.111	0.112	0.112	0.112	0.103	0.104	0.092	0.088	0.090	0.099	0.101	0.101
5.5 - 6.49	0.091	0.102	0.098	0.103	0.098	0.082	0.093	0.076	0.076	0.077	0.090	0.088	0.091
6.5 - 7.49	0.080	0.093	0.092	0.088	0.089	0.073	0.083	0.065	0.059	0.066	0.083	0.076	0.079
7.5 - 8.49	0.074	0.091	0.090	0.083	0.083	0.062	0.075	0.058	0.051	0.060	0.079	0.074	0.077
8.5 - 9.49	0.071	0.092	0.090	0.081	0.080	0.058	0.076	0.050	0.044	0.062	0.081	0.076	0.079
9.5 - 10.49	0.071	0.096	0.097	0.088	0.085	0.056	0.076	0.047	0.045	0.060	0.084	0.081	0.087
10.5 - 11.49	0.077	0.101	0.103	0.100	0.084	0.066	0.077	0.052	0.052	0.069	0.097	0.094	0.096
11.5 - 12.49	0.084	0.105	0.104	0.097	0.089	0.073	0.082	0.058	0.065	0.075	0.106	0.111	0.100
12.5 - 13.49	0.088	0.104	0.107	0.094	0.093	0.080	0.083	0.061	0.086	0.092	0.109	0.106	0.104
13.5 - 14.49	0.093	0.105	0.104	0.103	0.099	0.072	0.081	0.068	0.110	0.124	0.111	0.108	0.103
14.5 - 15.49	0.097	0.105	0.104	0.094	0.096	0.067	0.084	0.079	0.108	0.098	0.113	0.122	0.105
15.5 - 16.49	0.099	0.104	0.107	0.094	0.102	0.056	0.086	0.080	0.112	0.110	0.111	0.121	0.117
16.5 - 17.49	0.105	0.108	0.110	0.092	0.095	0.050	0.094	0.105	0.106	0.120	0.105	0.163	0.122
17.5 - 18.49	0.103	0.107	0.132		0.096	0.072	0.077	0.094	0.111	0.112	0.117		0.123
18.5 - 19.49	0.112	0.105	0.120	0.155			0.097	0.106	0.110	0.117	0.129		
19.5 - 20.49	0.116	0.107		0.155				0.118	0.134		0.110		
20.5 - 21.49	0.122							0.108		0.144	0.122		
21.5 - 22.49	0.114										0.114		
22.5 - 23.49	0.111							0.109		0.116			
23.5 - 24.49	0.129							0.129					
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.102	0.113	0.117	0.117	0.109	0.100	0.100	0.074	0.084	0.098	0.100	0.105	0.108
Measured Turbulence Intensity above 10 m/s: 0.081													

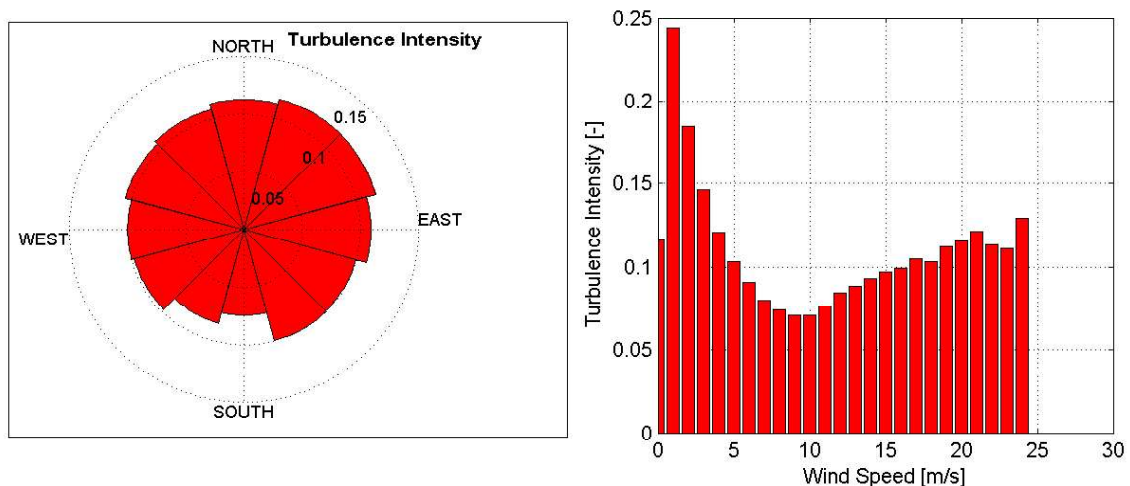


Figure 5.4: Sector dependent turbulence intensity at 100.2 m



### 5.3.5 Standard Deviation of Turbulence Intensity at 100.2 m

Table 5.7: Standard deviation of turbulence intensity at 100.2 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.185	0.160	0.166	0.189	0.164	0.133	0.137	0.127	0.106	0.112	0.118	0.212	0.195
0.5 - 1.49	0.150	0.147	0.147	0.161	0.138	0.146	0.148	0.160	0.163	0.149	0.144	0.148	0.142
1.5 - 2.49	0.133	0.140	0.136	0.128	0.120	0.158	0.142	0.129	0.137	0.129	0.123	0.126	0.128
2.5 - 3.49	0.101	0.099	0.101	0.102	0.102	0.106	0.117	0.105	0.104	0.105	0.097	0.095	0.096
3.5 - 4.49	0.082	0.079	0.088	0.083	0.084	0.091	0.091	0.088	0.081	0.080	0.073	0.077	0.076
4.5 - 5.49	0.069	0.064	0.067	0.073	0.074	0.073	0.076	0.071	0.069	0.072	0.066	0.065	0.066
5.5 - 6.49	0.058	0.055	0.061	0.065	0.058	0.060	0.061	0.053	0.057	0.059	0.053	0.056	0.056
6.5 - 7.49	0.050	0.048	0.052	0.053	0.047	0.048	0.056	0.047	0.045	0.050	0.046	0.048	0.048
7.5 - 8.49	0.045	0.042	0.046	0.046	0.043	0.040	0.046	0.042	0.039	0.043	0.044	0.046	0.044
8.5 - 9.49	0.043	0.037	0.039	0.042	0.040	0.035	0.041	0.037	0.035	0.041	0.042	0.044	0.044
9.5 - 10.49	0.042	0.033	0.036	0.038	0.037	0.032	0.038	0.035	0.036	0.041	0.040	0.047	0.036
10.5 - 11.49	0.041	0.031	0.038	0.030	0.027	0.038	0.036	0.034	0.038	0.042	0.037	0.043	0.029
11.5 - 12.49	0.039	0.025	0.030	0.028	0.028	0.029	0.030	0.035	0.041	0.044	0.034	0.039	0.029
12.5 - 13.49	0.036	0.019	0.026	0.027	0.022	0.021	0.028	0.034	0.042	0.050	0.030	0.042	0.026
13.5 - 14.49	0.035	0.019	0.017	0.045	0.020	0.018	0.025	0.034	0.033	0.034	0.028	0.045	0.030
14.5 - 15.49	0.029	0.024	0.025	0.011	0.013	0.017	0.025	0.031	0.028	0.019	0.022	0.035	0.025
15.5 - 16.49	0.029	0.018	0.047	0.012	0.013	0.014	0.014	0.037	0.019	0.000	0.021	0.032	0.027
16.5 - 17.49	0.035	0.020	0.022	0.011	0.011	0.014	0.026	0.050	0.019	0.000	0.027	0.105	0.037
17.5 - 18.49	0.022	0.014	0.000		0.000	0.000	0.017	0.022	0.021	0.000	0.027		0.000
18.5 - 19.49	0.020	0.013	0.000	0.000			0.007	0.007	0.025	0.000	0.019		
19.5 - 20.49	0.027	0.005		0.000				0.045	0.039		0.011		
20.5 - 21.49	0.016							0.000		0.000	0.016		
21.5 - 22.49	0.000										0.000		
22.5 - 23.49	0.018							0.025		0.000			
23.5 - 24.49	0.000							0.000					
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.080	0.074	0.083	0.086	0.077	0.089	0.080	0.070	0.083	0.089	0.070	0.081	0.081
Measured Standard Deviation of Turbulence Intensity above 10 m/s: 0.040													

### 5.3.6 Standard Deviation of Wind Speed at 100.2 m

Table 5.8: Standard deviation of wind speed at 100.2 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]
0 - 0.49	0.048	0.052	0.069	0.083	0.042	0.076	0.102	0.121	0.091	0.118	0.022	0.023	0.026
0.5 - 1.49	0.267	0.270	0.268	0.275	0.236	0.281	0.267	0.262	0.260	0.266	0.266	0.255	0.296
1.5 - 2.49	0.375	0.407	0.371	0.370	0.352	0.405	0.394	0.339	0.360	0.359	0.366	0.381	0.386
2.5 - 3.49	0.440	0.450	0.462	0.447	0.435	0.430	0.474	0.412	0.430	0.425	0.415	0.456	0.429
3.5 - 4.49	0.482	0.494	0.521	0.522	0.497	0.505	0.521	0.473	0.448	0.420	0.450	0.475	0.462
4.5 - 5.49	0.517	0.555	0.558	0.560	0.563	0.516	0.524	0.460	0.436	0.449	0.494	0.503	0.506
5.5 - 6.49	0.545	0.612	0.586	0.617	0.588	0.490	0.559	0.456	0.458	0.457	0.539	0.527	0.542
6.5 - 7.49	0.559	0.645	0.642	0.616	0.621	0.509	0.579	0.454	0.414	0.461	0.584	0.531	0.554
7.5 - 8.49	0.593	0.726	0.720	0.660	0.662	0.498	0.601	0.462	0.407	0.479	0.636	0.590	0.610
8.5 - 9.49	0.637	0.828	0.803	0.721	0.720	0.518	0.677	0.450	0.397	0.551	0.725	0.683	0.707
9.5 - 10.49	0.709	0.961	0.968	0.877	0.849	0.554	0.760	0.470	0.449	0.600	0.840	0.805	0.863
10.5 - 11.49	0.840	1.103	1.134	1.096	0.917	0.719	0.845	0.569	0.566	0.752	1.058	1.026	1.057
11.5 - 12.49	1.010	1.263	1.247	1.154	1.062	0.878	0.984	0.689	0.779	0.889	1.273	1.321	1.201
12.5 - 13.49	1.144	1.341	1.379	1.220	1.206	1.043	1.078	0.790	1.119	1.184	1.417	1.382	1.355
13.5 - 14.49	1.297	1.454	1.445	1.429	1.387	1.005	1.134	0.945	1.547	1.705	1.547	1.511	1.434
14.5 - 15.49	1.446	1.569	1.559	1.411	1.454	1.005	1.244	1.183	1.613	1.476	1.693	1.821	1.579
15.5 - 16.49	1.578	1.652	1.687	1.512	1.619	0.887	1.367	1.268	1.784	1.725	1.772	1.923	1.853
16.5 - 17.49	1.772	1.830	1.857	1.538	1.580	0.843	1.618	1.785	1.804	1.982	1.784	2.719	2.078
17.5 - 18.49	1.854	1.937	2.436		1.776	1.258	1.387	1.691	1.982	2.006	2.101		2.269
18.5 - 19.49	2.134	1.993	2.260	2.956			1.856	2.013	2.090	2.173	2.441		
19.5 - 20.49	2.307	2.137		3.114				2.325	2.701		2.182		
20.5 - 21.49	2.551							2.284		3.022	2.558		
21.5 - 22.49	2.530										2.530		
22.5 - 23.49	2.535							2.483		2.638			
23.5 - 24.49	3.061							3.061					
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.574	0.670	0.617	0.594	0.592	0.502	0.604	0.498	0.489	0.469	0.646	0.546	0.556



### 5.3.7 Standard Deviation of Standard Deviation of Wind Speed at 100.2 m

Table 5.9: Standard deviation of standard deviation of wind speed at 100.2 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]
0 - 0.49	0.080	0.069	0.071	0.082	0.073	0.058	0.063	0.057	0.046	0.053	0.053	0.099	0.078
0.5 - 1.49	0.176	0.174	0.168	0.181	0.163	0.171	0.168	0.189	0.188	0.183	0.177	0.167	0.174
1.5 - 2.49	0.268	0.286	0.273	0.267	0.241	0.309	0.289	0.262	0.277	0.256	0.252	0.254	0.258
2.5 - 3.49	0.303	0.298	0.304	0.301	0.305	0.318	0.358	0.310	0.310	0.305	0.289	0.286	0.291
3.5 - 4.49	0.327	0.314	0.348	0.333	0.340	0.365	0.365	0.350	0.322	0.323	0.293	0.307	0.302
4.5 - 5.49	0.345	0.319	0.333	0.365	0.372	0.364	0.381	0.353	0.343	0.362	0.329	0.319	0.329
5.5 - 6.49	0.347	0.331	0.365	0.386	0.348	0.358	0.366	0.319	0.341	0.348	0.319	0.333	0.331
6.5 - 7.49	0.349	0.335	0.367	0.367	0.331	0.334	0.389	0.328	0.312	0.348	0.324	0.333	0.336
7.5 - 8.49	0.361	0.337	0.366	0.366	0.344	0.314	0.366	0.334	0.314	0.345	0.351	0.370	0.351
8.5 - 9.49	0.383	0.333	0.351	0.374	0.356	0.315	0.370	0.331	0.314	0.370	0.377	0.396	0.401
9.5 - 10.49	0.419	0.327	0.358	0.373	0.366	0.321	0.380	0.348	0.362	0.404	0.397	0.474	0.362
10.5 - 11.49	0.455	0.346	0.421	0.327	0.293	0.422	0.389	0.376	0.421	0.470	0.414	0.468	0.323
11.5 - 12.49	0.472	0.296	0.367	0.328	0.338	0.349	0.358	0.421	0.487	0.519	0.411	0.462	0.345
12.5 - 13.49	0.471	0.251	0.343	0.356	0.291	0.275	0.359	0.436	0.541	0.654	0.387	0.540	0.348
13.5 - 14.49	0.490	0.262	0.241	0.608	0.289	0.245	0.353	0.482	0.467	0.471	0.389	0.619	0.418
14.5 - 15.49	0.437	0.359	0.374	0.170	0.188	0.252	0.366	0.456	0.415	0.316	0.324	0.533	0.377
15.5 - 16.49	0.466	0.295	0.743	0.201	0.207	0.221	0.214	0.581	0.298	0.000	0.334	0.526	0.455
16.5 - 17.49	0.592	0.341	0.382	0.198	0.170	0.243	0.462	0.857	0.307	0.000	0.463	1.739	0.597
17.5 - 18.49	0.410	0.260	0.000		0.000	0.000	0.298	0.385	0.374	0.000	0.508		0.000
18.5 - 19.49	0.384	0.251	0.000	0.000			0.135	0.149	0.489	0.000	0.366		
19.5 - 20.49	0.542	0.067		0.000				0.878	0.761		0.231		
20.5 - 21.49	0.329							0.043		0.000	0.320		
21.5 - 22.49	0.000										0.000		
22.5 - 23.49	0.440							0.610		0.000			
23.5 - 24.49	0.000							0.000					
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.396	0.400	0.396	0.390	0.374	0.349	0.396	0.375	0.419	0.364	0.431	0.381	0.375

### 5.3.8 Ambient Characteristic Turbulence Intensity According to IEC 61400-1, Edition 2 at 100.2 m

Table 5.10: Ambient characteristic turbulence intensity at 100.2 m as function of wind speed according to IEC 61400-1; Edition 2

Wind Speed	I1	Class A	Class B	Frequency
[m/s]	[-]	[-]	[-]	[-]
0 - 0.49	0.301	2.907	1.978	649
0.5 - 1.49	0.394	0.925	0.657	4901
1.5 - 2.49	0.317	0.558	0.412	11722
2.5 - 3.49	0.247	0.417	0.318	18765
3.5 - 4.49	0.202	0.344	0.269	24925
4.5 - 5.49	0.173	0.300	0.240	28425
5.5 - 6.49	0.149	0.270	0.220	29603
6.5 - 7.49	0.130	0.249	0.206	28600
7.5 - 8.49	0.119	0.233	0.195	25654
8.5 - 9.49	0.114	0.220	0.187	20020
9.5 - 10.49	0.113	0.210	0.180	13620
10.5 - 11.49	0.118	0.202	0.175	8046
11.5 - 12.49	0.124	0.195	0.170	4604
12.5 - 13.49	0.125	0.189	0.166	2745
13.5 - 14.49	0.128	0.185	0.163	1468
14.5 - 15.49	0.126	0.180	0.160	754
15.5 - 16.49	0.128	0.176	0.158	424
16.5 - 17.49	0.140	0.173	0.155	199
17.5 - 18.49	0.125	0.170	0.153	79
18.5 - 19.49	0.132	0.167	0.152	44
19.5 - 20.49	0.143	0.165	0.150	22
20.5 - 21.49	0.138	0.163	0.149	11
21.5 - 22.49	0.114	0.160	0.147	1
22.5 - 23.49	0.129	0.159	0.146	3
23.5 - 24.49	0.129	0.158	0.145	1
24.5 - 25.49				0
25.5 - 26.49				0
26.5 - 27.49				0
27.5 - 28.49				0
28.5 - 29.49				0
29.5 - 30.49				0
Ambient Characteristic turbulence intensity at 15 m/s determined from measurement above 10 m/s (I 15): 0.121				

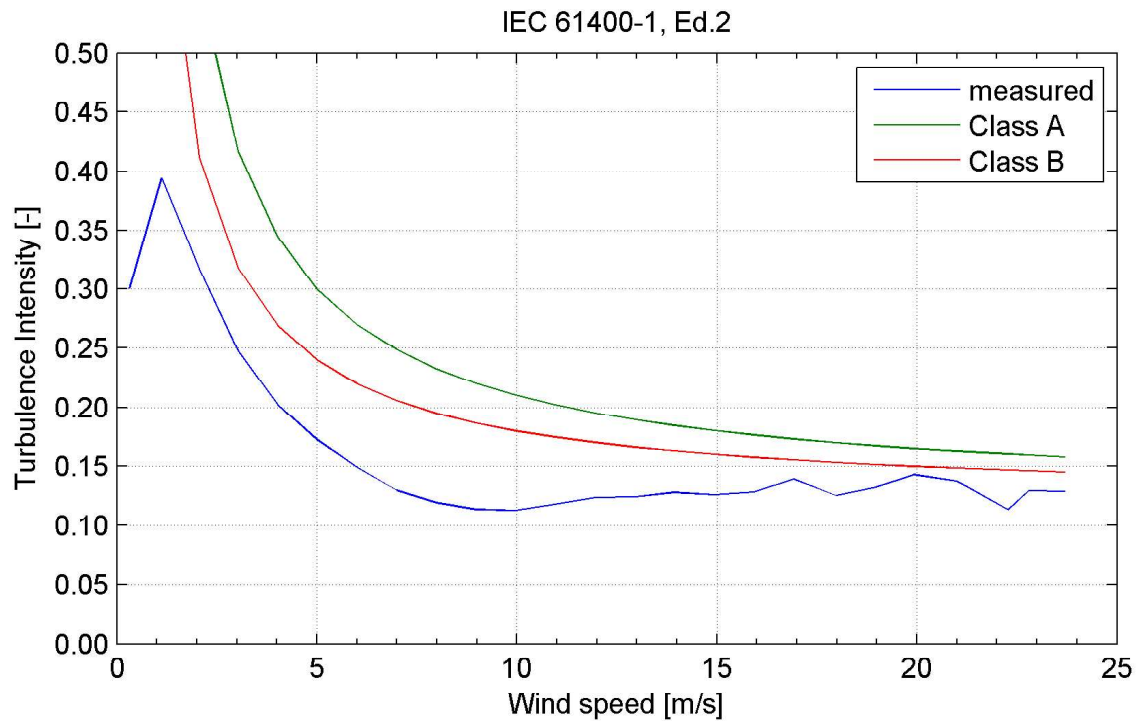


Figure 5.5: Ambient characteristic turbulence intensity at 100.2 m according to IEC 61400-1, Edition 2

### 5.3.9 Ambient Representative Turbulence Intensity According to IEC 61400-1, Edition 3 at 100.2 m

Table 5.11: Ambient representative turbulence intensity at 100.2 m as function of wind speed according to IEC 61400-1; Edition 3

Wind Speed	I1	Class A	Class B	Class C	Frequency
[m/s]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.464	2.894	2.533	2.171	649
0.5 - 1.49	0.441	0.922	0.807	0.691	4901
1.5 - 2.49	0.350	0.556	0.487	0.417	11722
2.5 - 3.49	0.273	0.416	0.364	0.312	18765
3.5 - 4.49	0.224	0.343	0.300	0.257	24925
4.5 - 5.49	0.191	0.299	0.262	0.224	28425
5.5 - 6.49	0.165	0.269	0.236	0.202	29603
6.5 - 7.49	0.144	0.248	0.217	0.186	28600
7.5 - 8.49	0.132	0.232	0.203	0.174	25654
8.5 - 9.49	0.126	0.220	0.192	0.165	20020
9.5 - 10.49	0.125	0.210	0.184	0.157	13620
10.5 - 11.49	0.130	0.202	0.177	0.151	8046
11.5 - 12.49	0.135	0.195	0.171	0.146	4604
12.5 - 13.49	0.135	0.189	0.165	0.142	2745
13.5 - 14.49	0.138	0.184	0.161	0.138	1468
14.5 - 15.49	0.134	0.180	0.157	0.135	754
15.5 - 16.49	0.137	0.176	0.154	0.132	424
16.5 - 17.49	0.150	0.173	0.151	0.130	199
17.5 - 18.49	0.132	0.170	0.149	0.127	79
18.5 - 19.49	0.138	0.167	0.146	0.125	44
19.5 - 20.49	0.151	0.165	0.144	0.124	22
20.5 - 21.49	0.142	0.163	0.142	0.122	11
21.5 - 22.49	0.114	0.160	0.140	0.120	1
22.5 - 23.49	0.136	0.159	0.139	0.119	3
23.5 - 24.49	0.129	0.158	0.138	0.118	1
24.5 - 25.49					0
25.5 - 26.49					0
26.5 - 27.49					0
27.5 - 28.49					0
28.5 - 29.49					0
29.5 - 30.49					0

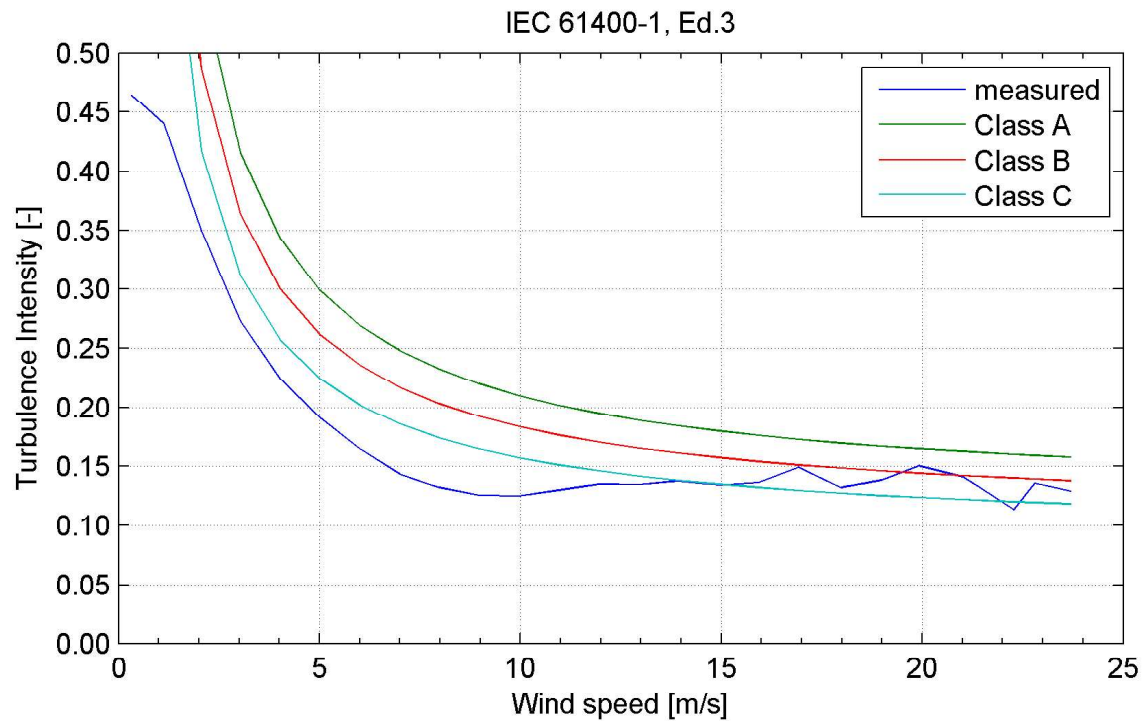


Figure 5.6: Ambient representative turbulence intensity at 100.2 m according to IEC 61400-1, Edition 3

### 5.3.10 Extreme Values of Wind Speed at 100.2 m

Table 5.12: Monthly averages and extreme values of wind speed at 100.2 m (continued)

month	n	v-average	v-max 10 minutes	v-max 1 second
[-]	[-]	[m/s]	[m/s]	[m/s]
02.09	2022	6.03	15.2	18.5
03.09	4460	7.13	23.7	32.1
04.09	4320	6.59	15.4	18.4
05.09	4464	5.63	14.9	16.4
06.09	4320	6.00	16.5	21.6
07.09	4464	5.68	17.5	20.7
08.09	4463	5.42	13.5	23.4
09.09	4320	6.11	13.8	17.4
10.09	4464	6.55	16.1	23.3
11.09	4320	6.38	16.4	20.1
12.09	3598	7.86	19.1	23.8
01.10	3670	7.10	16.7	21.5
02.10	1728	8.38	16.9	19.4
03.10	0	0.00	0.0	0.0
04.10	0	0.00	0.0	0.0
05.10	3670	6.06	15.5	19.1
06.10	4316	5.67	17.7	23.8
07.10	4320	5.69	20.1	26.4
08.10	4464	5.72	13.0	17.1
09.10	4320	6.46	16.0	20.7
10.10	4463	6.81	14.1	18.9
11.10	4320	7.65	20.3	25.8
12.10	3685	7.91	17.9	23.1
01.11	3356	5.72	14.6	17.2
02.11	3156	6.99	22.3	28.1
03.11	4109	6.67	15.7	18.1
04.11	4212	6.53	16.3	22.9
05.11	4435	5.80	14.4	18.7
06.11	4320	5.89	16.8	24.1
07.11	4464	5.41	13.7	18.0
08.11	4464	5.94	14.6	18.9
09.11	4320	6.09	15.6	18.9
10.11	4464	6.49	20.1	25.9
11.11	3863	5.36	12.0	13.2
12.11	4290	6.68	16.2	20.7



Table 5.12: Monthly averages and extreme values of wind speed at 100.2 m (end)

month	n	v-average	v-max 10 minutes	v-max 1 second
[-]	[-]	[m/s]	[m/s]	[m/s]
01.12	4464	8.43	19.0	23.2
02.12	2768	6.74	16.0	21.0
03.12	4464	6.51	16.9	20.8
04.12	4320	7.50	17.1	22.3
05.12	4464	5.69	13.5	17.5
06.12	4320	5.27	14.1	20.8
07.12	4446	6.12	16.0	24.2
08.12	4464	6.24	17.5	22.5
09.12	4318	6.28	14.7	18.0
10.12	4464	6.33	16.6	21.3
11.12	4286	5.84	20.0	24.8
12.12	4464	6.86	22.7	28.6
01.13	4327	7.79	19.6	24.2
02.13	3977	7.52	19.0	23.9
03.13	4391	7.34	18.4	28.4
04.13	4320	7.37	15.6	19.3
05.13	4464	6.49	16.6	22.6
06.13	4320	6.03	14.1	18.5
07.13	4464	5.77	18.1	22.2
08.13	4464	5.68	11.8	16.2
09.13	4320	6.78	16.4	21.4
10.13	1372	7.79	16.9	21.4
complete period	225285	6.44	23.7	32.1

## 5.4 Measurement Height 97.9 m

### 5.4.1 Averages of Wind Speed and Time Series at 97.9 m

Table 5.13: Monthly averages at measurement height 97.9 m

Monthly mean values of wind speed in m/s							
Month	2009	2010	2011	2012	2013	mean	mean of months
January		7.08	5.63	8.34	7.68	7.29	7.18
February	5.96	8.32	6.88	6.68	7.42	7.04	7.05
March	7.08		6.61	6.43	7.24	6.84	6.84
April	6.55		6.47	7.44	7.27	6.94	6.93
May	5.60	6.01	5.74	5.61	6.41	5.87	5.87
June	5.96	5.62	5.80	5.21	5.94	5.71	5.71
July	5.64	5.62	5.34	6.05	5.69	5.67	5.67
August	5.39	5.66	5.85	6.17	5.61	5.74	5.74
September	6.06	6.38	6.01	6.19	6.70	6.27	6.27
October	6.50	6.71	6.38	6.26	7.69	6.55	6.71
November	6.33	7.55	5.27	5.76		6.25	6.23
December	7.80	7.82	6.60	6.69		7.17	7.23
mean, all data	6.25	6.55	6.04	6.40	6.68	6.37	
mean of months	6.26	6.68	6.05	6.40	6.77		6.45

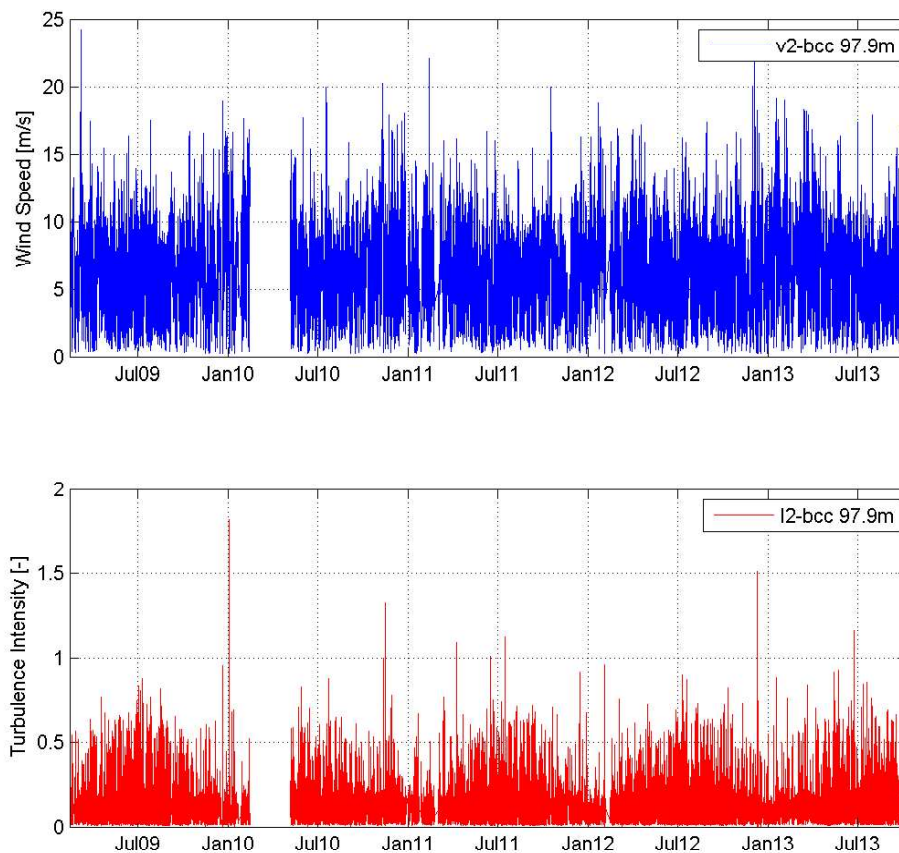


Figure 5.7: Wind speed, turbulence intensity and time series at measurement height 97.9 m

### 5.4.2 Joint Probability Distribution of Wind Speeds at 97.9 m and Wind Directions at 97.9 m

Table 5.14: Number of datasets per wind speed bin and per sector at 97.9 m

Wind Speed	Sum	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	685	45	34	29	83	26	27	21	34	27	115	129	115
0.5 - 1.49	5000	479	444	375	346	333	372	366	433	409	461	493	489
1.5 - 2.49	12073	1301	1124	1026	815	623	736	853	845	941	1065	1256	1488
2.5 - 3.49	19281	2574	2087	1588	1189	1008	936	1195	1196	1260	1719	2119	2410
3.5 - 4.49	25447	3512	2555	2022	1635	1348	1265	1565	1498	1477	2379	2943	3248
4.5 - 5.49	28960	3962	2670	2141	2201	1555	1909	2165	1359	1440	2786	3267	3505
5.5 - 6.49	29987	3848	2533	2085	2350	1802	2447	2439	1408	1427	3006	3373	3269
6.5 - 7.49	28772	3464	2342	1598	2005	1685	2614	2793	1573	1448	3280	3058	2912
7.5 - 8.49	25589	2979	1819	1388	1525	1430	2500	3229	1776	1321	3380	2217	2025
8.5 - 9.49	19232	2196	1150	799	830	918	1856	3252	1925	1018	2871	1217	1200
9.5 - 10.49	12812	1619	600	422	475	374	1120	2786	1472	633	1927	684	700
10.5 - 11.49	7495	968	327	244	238	136	586	2010	941	269	1066	311	399
11.5 - 12.49	4478	589	219	139	136	74	342	1250	481	108	634	189	317
12.5 - 13.49	2612	341	89	71	110	82	211	712	281	33	411	98	173
13.5 - 14.49	1384	167	40	42	41	71	117	403	190	16	176	49	72
14.5 - 15.49	737	73	31	39	28	37	48	200	138	5	80	25	33
15.5 - 16.49	405	75	16	33	23	26	16	66	66	1	56	13	14
16.5 - 17.49	182	39	12	2	9	7	10	29	40	1	27	3	3
17.5 - 18.49	75	25	1	0	0	0	12	10	18	1	7	0	1
18.5 - 19.49	48	15	1	1	1	0	2	4	11	1	12	0	0
19.5 - 20.49	19	2	0	1	0	0	0	6	2	0	8	0	0
20.5 - 21.49	10	0	0	0	0	0	0	2	0	1	7	0	0
21.5 - 22.49	3	0	0	0	0	0	0	2	0	0	1	0	0
22.5 - 23.49	3	0	0	0	0	0	0	2	0	1	0	0	0
23.5 - 24.49	1	0	0	0	0	0	0	1	0	0	0	0	0
24.5 - 25.49	0	0	0	0	0	0	0	0	0	0	0	0	0
25.5 - 26.49	0	0	0	0	0	0	0	0	0	0	0	0	0
26.5 - 27.49	0	0	0	0	0	0	0	0	0	0	0	0	0
27.5 - 28.49	0	0	0	0	0	0	0	0	0	0	0	0	0
28.5 - 29.49	0	0	0	0	0	0	0	0	0	0	0	0	0
29.5 - 30.49	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	225290	28273	18094	14045	14040	11535	17126	25361	15687	11838	25474	21444	22373

### 5.4.3 Wind Speed Distribution at 97.9 m, Wind Direction Distribution at 97.9 m, Weibull Fit at 97.9 m

Table 5.15: Weibull parameters, average wind speeds at 97.9 m per sector.

Sector	A-Parameter	Mean Wind Speed	k-Parameter	Frequency
	[m/s]	[m/s]	[-]	[%]
N	7.19	6.37	2.36	12.55
NNE	6.48	5.75	2.38	8.03
ENE	6.37	5.64	2.28	6.23
E	6.66	5.90	2.47	6.23
ESE	6.78	6.01	2.47	5.12
SSE	7.65	6.80	2.72	7.60
S	8.73	7.77	2.78	11.26
SSW	7.99	7.08	2.33	6.96
WSW	6.58	5.83	2.35	5.25
W	7.73	6.86	2.54	11.31
WNW	6.46	5.73	2.50	9.52
NNW	6.43	5.70	2.34	9.93
mean	7.18	6.37	2.38	100.00

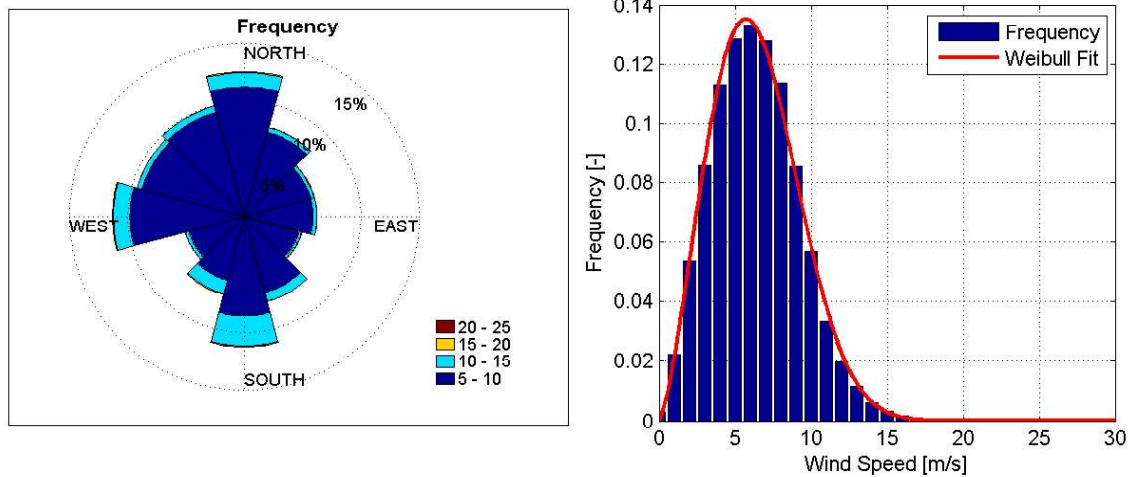


Figure 5.8: Frequency distribution of wind speeds at 97.9 m and of wind direction at 97.9 m

#### 5.4.4 Turbulence Intensity at 97.9 m

Table 5.16: Turbulence intensity per wind speed bin and per sector at 97.9 m

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.108	0.129	0.169	0.237	0.079	0.209	0.229	0.197	0.228	0.271	0.046	0.042	0.065
0.5 - 1.49	0.236	0.241	0.236	0.242	0.223	0.257	0.238	0.182	0.243	0.238	0.238	0.232	0.257
1.5 - 2.49	0.181	0.196	0.181	0.176	0.179	0.195	0.195	0.141	0.179	0.178	0.179	0.185	0.187
2.5 - 3.49	0.145	0.148	0.152	0.151	0.153	0.143	0.157	0.119	0.145	0.142	0.136	0.149	0.140
3.5 - 4.49	0.119	0.123	0.130	0.130	0.124	0.127	0.130	0.099	0.114	0.106	0.112	0.119	0.115
4.5 - 5.49	0.103	0.111	0.111	0.111	0.116	0.104	0.106	0.082	0.088	0.090	0.098	0.100	0.102
5.5 - 6.49	0.090	0.102	0.098	0.103	0.100	0.082	0.093	0.069	0.077	0.076	0.090	0.087	0.090
6.5 - 7.49	0.080	0.093	0.093	0.087	0.091	0.073	0.082	0.060	0.061	0.067	0.083	0.076	0.079
7.5 - 8.49	0.074	0.092	0.090	0.082	0.083	0.063	0.075	0.053	0.051	0.061	0.080	0.075	0.077
8.5 - 9.49	0.071	0.093	0.092	0.083	0.084	0.059	0.075	0.047	0.044	0.060	0.082	0.078	0.081
9.5 - 10.49	0.072	0.098	0.101	0.093	0.087	0.057	0.076	0.043	0.047	0.063	0.088	0.084	0.089
10.5 - 11.49	0.076	0.104	0.106	0.101	0.085	0.068	0.074	0.045	0.054	0.071	0.101	0.101	0.099
11.5 - 12.49	0.082	0.106	0.107	0.097	0.092	0.074	0.080	0.048	0.067	0.077	0.109	0.112	0.101
12.5 - 13.49	0.088	0.105	0.108	0.098	0.097	0.080	0.082	0.056	0.091	0.096	0.110	0.109	0.106
13.5 - 14.49	0.091	0.105	0.103	0.097	0.100	0.073	0.082	0.061	0.112	0.129	0.114	0.111	0.106
14.5 - 15.49	0.093	0.107	0.107	0.095	0.108	0.066	0.082	0.066	0.111	0.099	0.114	0.120	0.104
15.5 - 16.49	0.100	0.107	0.110	0.096	0.108	0.056	0.084	0.071	0.114	0.112	0.113	0.144	0.122
16.5 - 17.49	0.104	0.109	0.111	0.099	0.102	0.056	0.091	0.094	0.109	0.121	0.109	0.145	0.107
17.5 - 18.49	0.101	0.110	0.133				0.075	0.063	0.113	0.112	0.130		0.126
18.5 - 19.49	0.109	0.104	0.120	0.156	0.099		0.097	0.076	0.110	0.120	0.121		
19.5 - 20.49	0.102	0.109		0.156				0.061	0.137		0.116		
20.5 - 21.49	0.110							0.058		0.146	0.120		
21.5 - 22.49	0.079							0.062			0.115		
22.5 - 23.49	0.090							0.076		0.119			
23.5 - 24.49	0.091							0.091					
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.102	0.114	0.118	0.117	0.112	0.100	0.100	0.066	0.085	0.098	0.101	0.106	0.108
Measured Turbulence Intensity above 10 m/s: 0.080													

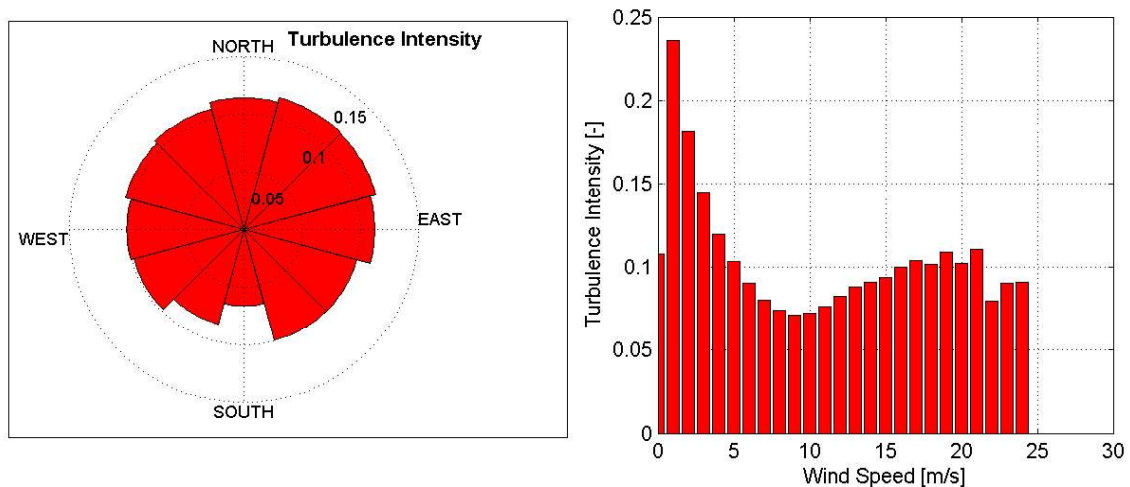


Figure 5.9: Sector dependent turbulence intensity at 97.9 m

### 5.4.5 Standard Deviation of Turbulence Intensity at 97.9 m

Table 5.17: Standard deviation of turbulence intensity at 97.9 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.154	0.160	0.154	0.198	0.148	0.145	0.182	0.118	0.107	0.126	0.113	0.108	0.138
0.5 - 1.49	0.147	0.160	0.144	0.152	0.146	0.148	0.137	0.113	0.162	0.146	0.138	0.156	0.141
1.5 - 2.49	0.127	0.133	0.133	0.126	0.125	0.138	0.137	0.096	0.134	0.128	0.121	0.123	0.126
2.5 - 3.49	0.099	0.097	0.102	0.100	0.106	0.107	0.113	0.079	0.104	0.104	0.096	0.094	0.094
3.5 - 4.49	0.080	0.077	0.085	0.081	0.087	0.093	0.089	0.063	0.082	0.080	0.074	0.076	0.076
4.5 - 5.49	0.068	0.064	0.066	0.072	0.076	0.077	0.077	0.052	0.069	0.071	0.065	0.064	0.066
5.5 - 6.49	0.057	0.054	0.060	0.063	0.062	0.059	0.058	0.040	0.057	0.061	0.053	0.055	0.055
6.5 - 7.49	0.049	0.048	0.052	0.052	0.049	0.048	0.052	0.036	0.046	0.050	0.046	0.048	0.048
7.5 - 8.49	0.044	0.042	0.045	0.045	0.046	0.040	0.044	0.031	0.039	0.044	0.044	0.047	0.044
8.5 - 9.49	0.042	0.036	0.039	0.042	0.041	0.035	0.041	0.029	0.035	0.042	0.042	0.044	0.044
9.5 - 10.49	0.042	0.032	0.034	0.035	0.037	0.033	0.037	0.026	0.037	0.041	0.040	0.049	0.035
10.5 - 11.49	0.042	0.030	0.038	0.030	0.028	0.039	0.035	0.028	0.040	0.045	0.038	0.038	0.029
11.5 - 12.49	0.040	0.024	0.031	0.029	0.030	0.028	0.029	0.029	0.041	0.043	0.031	0.039	0.028
12.5 - 13.49	0.038	0.019	0.025	0.040	0.024	0.020	0.027	0.031	0.040	0.058	0.029	0.045	0.029
13.5 - 14.49	0.036	0.018	0.017	0.022	0.021	0.018	0.025	0.031	0.035	0.032	0.028	0.041	0.027
14.5 - 15.49	0.033	0.024	0.024	0.010	0.020	0.017	0.025	0.030	0.027	0.020	0.022	0.031	0.025
15.5 - 16.49	0.033	0.019	0.050	0.012	0.015	0.013	0.013	0.030	0.020	0.000	0.021	0.078	0.032
16.5 - 17.49	0.031	0.021	0.023	0.006	0.010	0.017	0.026	0.055	0.018	0.000	0.026	0.030	0.017
17.5 - 18.49	0.029	0.015	0.000				0.019	0.025	0.020	0.000	0.025		0.000
18.5 - 19.49	0.022	0.012	0.000	0.000	0.000		0.005	0.024	0.024	0.000	0.021		
19.5 - 20.49	0.034	0.004		0.000				0.005	0.042		0.014		
20.5 - 21.49	0.031							0.003		0.000	0.014		
21.5 - 22.49	0.031							0.001			0.000		
22.5 - 23.49	0.029							0.022		0.000			
23.5 - 24.49	0.000							0.000					
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.079	0.074	0.082	0.085	0.082	0.088	0.078	0.053	0.083	0.089	0.069	0.080	0.080
Measured Standard Deviation of Turbulence Intensity above 10 m/s: 0.041													



### 5.4.6 Standard Deviation of Wind Speed at 97.9 m

Table 5.18: Standard deviation of wind speed at 97.9 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]
0 - 0.49	0.044	0.055	0.068	0.097	0.033	0.082	0.089	0.077	0.089	0.108	0.020	0.017	0.026
0.5 - 1.49	0.259	0.266	0.257	0.265	0.244	0.274	0.256	0.203	0.263	0.263	0.259	0.252	0.292
1.5 - 2.49	0.368	0.402	0.367	0.361	0.360	0.398	0.394	0.281	0.362	0.360	0.362	0.375	0.381
2.5 - 3.49	0.437	0.448	0.459	0.454	0.458	0.429	0.476	0.357	0.434	0.423	0.411	0.452	0.424
3.5 - 4.49	0.478	0.492	0.521	0.519	0.500	0.509	0.520	0.398	0.455	0.425	0.448	0.475	0.459
4.5 - 5.49	0.514	0.557	0.555	0.555	0.580	0.519	0.533	0.411	0.439	0.448	0.492	0.500	0.508
5.5 - 6.49	0.541	0.612	0.587	0.612	0.596	0.491	0.558	0.414	0.461	0.457	0.541	0.521	0.538
6.5 - 7.49	0.557	0.648	0.649	0.608	0.633	0.511	0.578	0.420	0.422	0.468	0.582	0.531	0.554
7.5 - 8.49	0.590	0.735	0.721	0.656	0.660	0.499	0.595	0.427	0.407	0.486	0.642	0.600	0.613
8.5 - 9.49	0.636	0.836	0.820	0.739	0.753	0.528	0.669	0.419	0.396	0.542	0.736	0.699	0.725
9.5 - 10.49	0.721	0.982	1.010	0.925	0.863	0.569	0.762	0.434	0.465	0.628	0.877	0.834	0.885
10.5 - 11.49	0.836	1.134	1.164	1.103	0.936	0.749	0.808	0.493	0.593	0.781	1.112	1.109	1.085
11.5 - 12.49	0.983	1.271	1.275	1.162	1.094	0.883	0.960	0.576	0.801	0.916	1.308	1.328	1.214
12.5 - 13.49	1.138	1.362	1.392	1.275	1.251	1.047	1.058	0.719	1.184	1.242	1.425	1.411	1.377
13.5 - 14.49	1.268	1.455	1.435	1.350	1.387	1.009	1.137	0.855	1.573	1.781	1.599	1.549	1.484
14.5 - 15.49	1.399	1.604	1.600	1.434	1.633	0.985	1.225	0.987	1.663	1.489	1.701	1.804	1.564
15.5 - 16.49	1.590	1.708	1.739	1.530	1.707	0.899	1.338	1.126	1.815	1.759	1.792	2.305	1.950
16.5 - 17.49	1.756	1.838	1.861	1.670	1.693	0.940	1.564	1.594	1.847	2.007	1.850	2.414	1.830
17.5 - 18.49	1.820	1.985	2.443				1.343	1.124	2.022	2.010	2.336		2.301
18.5 - 19.49	2.057	1.967	2.245	2.926	1.839		1.842	1.442	2.095	2.229	2.290		
19.5 - 20.49	2.039	2.148		3.117				1.208	2.749		2.324		
20.5 - 21.49	2.303							1.233		3.054	2.501		
21.5 - 22.49	1.740							1.344			2.532		
22.5 - 23.49	2.087							1.774		2.712			
23.5 - 24.49	2.191							2.191					
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.567	0.669	0.614	0.588	0.598	0.504	0.598	0.446	0.495	0.471	0.644	0.542	0.553

#### 5.4.7 Standard Deviation of Standard Deviation of Wind Speed at 97.9 m

Table 5.19: Standard deviation of standard deviation of wind speed at 97.9 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]
0 - 0.49	0.065	0.071	0.065	0.086	0.064	0.065	0.085	0.054	0.047	0.057	0.050	0.044	0.057
0.5 - 1.49	0.173	0.179	0.162	0.177	0.174	0.168	0.158	0.136	0.189	0.179	0.171	0.183	0.170
1.5 - 2.49	0.259	0.277	0.265	0.265	0.255	0.284	0.277	0.190	0.273	0.254	0.248	0.246	0.254
2.5 - 3.49	0.298	0.295	0.308	0.300	0.319	0.316	0.344	0.234	0.311	0.303	0.286	0.284	0.285
3.5 - 4.49	0.320	0.309	0.339	0.326	0.352	0.371	0.356	0.247	0.328	0.322	0.295	0.304	0.299
4.5 - 5.49	0.340	0.320	0.328	0.360	0.381	0.382	0.385	0.257	0.345	0.355	0.322	0.316	0.327
5.5 - 6.49	0.341	0.324	0.360	0.377	0.368	0.352	0.351	0.239	0.343	0.359	0.319	0.328	0.330
6.5 - 7.49	0.341	0.336	0.363	0.361	0.341	0.333	0.363	0.250	0.316	0.345	0.323	0.335	0.334
7.5 - 8.49	0.354	0.333	0.363	0.359	0.363	0.313	0.353	0.251	0.313	0.350	0.351	0.373	0.352
8.5 - 9.49	0.379	0.329	0.349	0.377	0.364	0.318	0.363	0.263	0.317	0.371	0.377	0.401	0.399
9.5 - 10.49	0.415	0.321	0.340	0.352	0.369	0.327	0.373	0.260	0.369	0.408	0.400	0.489	0.351
10.5 - 11.49	0.463	0.336	0.422	0.328	0.310	0.435	0.387	0.303	0.437	0.494	0.421	0.423	0.323
11.5 - 12.49	0.479	0.293	0.379	0.339	0.358	0.332	0.353	0.343	0.495	0.508	0.374	0.462	0.337
12.5 - 13.49	0.488	0.252	0.331	0.539	0.307	0.262	0.350	0.396	0.528	0.748	0.375	0.587	0.378
13.5 - 14.49	0.503	0.255	0.239	0.306	0.302	0.252	0.350	0.443	0.490	0.442	0.389	0.564	0.379
14.5 - 15.49	0.489	0.357	0.355	0.157	0.302	0.255	0.371	0.453	0.398	0.342	0.332	0.452	0.379
15.5 - 16.49	0.530	0.308	0.783	0.208	0.247	0.205	0.216	0.470	0.306	0.000	0.324	1.270	0.530
16.5 - 17.49	0.528	0.349	0.397	0.115	0.154	0.296	0.450	0.932	0.296	0.000	0.438	0.494	0.334
17.5 - 18.49	0.522	0.280	0.000				0.336	0.455	0.369	0.000	0.472		0.000
18.5 - 19.49	0.426	0.238	0.000	0.000	0.000		0.100	0.459	0.474	0.000	0.382		
19.5 - 20.49	0.683	0.061		0.000				0.100	0.833		0.306		
20.5 - 21.49	0.636							0.095		0.000	0.290		
21.5 - 22.49	0.686							0.006			0.000		
22.5 - 23.49	0.651							0.511		0.000			
23.5 - 24.49	0.000							0.000					
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.389	0.399	0.394	0.386	0.388	0.350	0.383	0.297	0.425	0.366	0.431	0.379	0.373

### 5.4.8 Ambient Characteristic Turbulence Intensity According to IEC 61400-1, Edition 2 at 97.9 m

Table 5.20: Ambient characteristic turbulence intensity at 97.9 m as function of wind speed according to IEC 61400-1; Edition 2

Wind Speed	I1	Class A	Class B	Frequency
[m/s]	[-]	[-]	[-]	[-]
0 - 0.49	0.262	3.006	2.044	685
0.5 - 1.49	0.383	0.925	0.657	5000
1.5 - 2.49	0.309	0.559	0.412	12073
2.5 - 3.49	0.244	0.417	0.318	19281
3.5 - 4.49	0.199	0.344	0.269	25447
4.5 - 5.49	0.171	0.300	0.240	28960
5.5 - 6.49	0.148	0.270	0.220	29987
6.5 - 7.49	0.129	0.249	0.206	28772
7.5 - 8.49	0.118	0.233	0.195	25589
8.5 - 9.49	0.113	0.220	0.187	19232
9.5 - 10.49	0.114	0.210	0.180	12812
10.5 - 11.49	0.118	0.202	0.175	7495
11.5 - 12.49	0.122	0.195	0.170	4478
12.5 - 13.49	0.125	0.189	0.166	2612
13.5 - 14.49	0.127	0.185	0.163	1384
14.5 - 15.49	0.126	0.180	0.160	737
15.5 - 16.49	0.133	0.176	0.158	405
16.5 - 17.49	0.135	0.173	0.156	182
17.5 - 18.49	0.130	0.170	0.153	75
18.5 - 19.49	0.131	0.168	0.152	48
19.5 - 20.49	0.136	0.165	0.150	19
20.5 - 21.49	0.141	0.163	0.149	10
21.5 - 22.49	0.110	0.161	0.147	3
22.5 - 23.49	0.120	0.159	0.146	3
23.5 - 24.49	0.091	0.157	0.145	1
24.5 - 25.49				0
25.5 - 26.49				0
26.5 - 27.49				0
27.5 - 28.49				0
28.5 - 29.49				0
29.5 - 30.49				0
Ambient Characteristic turbulence intensity at 15 m/s determined from measurement above 10 m/s (I 15): 0.121				

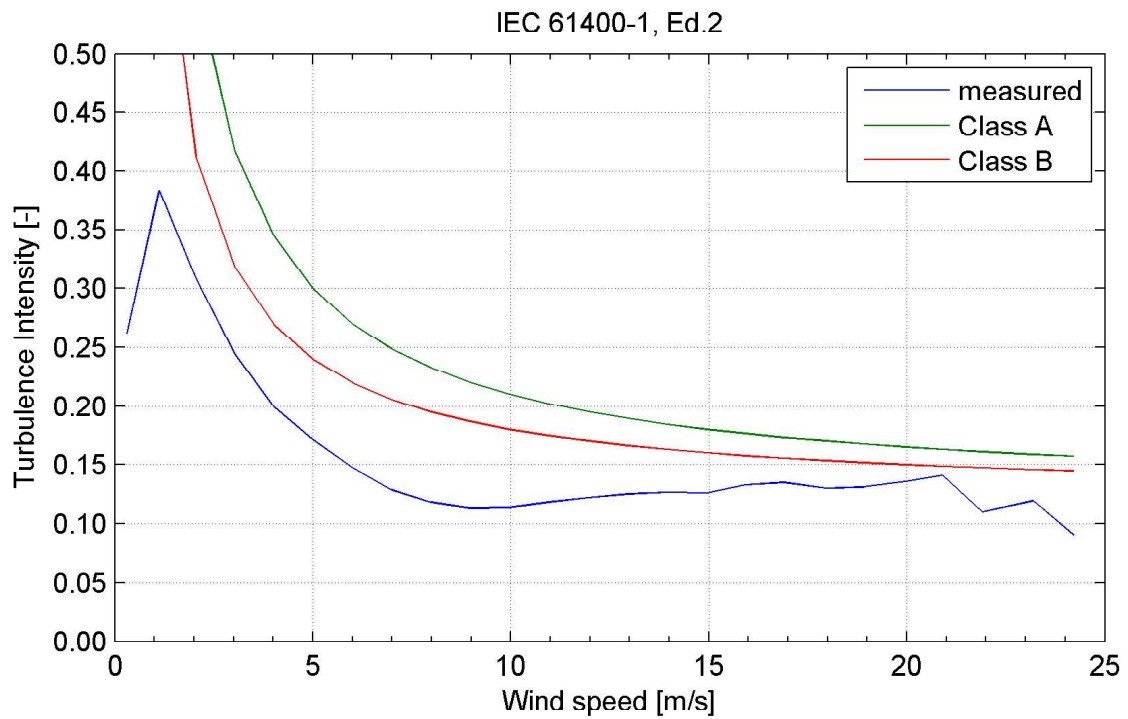


Figure 5.10: Ambient characteristic turbulence intensity at 97.9 m according to IEC 61400-1, Edition 2

### 5.4.9 Ambient Representative Turbulence Intensity According to IEC 61400-1, Edition 3 at 97.9 m

Table 5.21: Ambient representative turbulence intensity at 97.9 m as function of wind speed according to IEC 61400-1; Edition 3

Wind Speed	I <sub>t</sub>	Class A	Class B	Class C	Frequency
[m/s]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.408	2.993	2.619	2.245	685
0.5 - 1.49	0.429	0.922	0.807	0.691	5000
1.5 - 2.49	0.341	0.557	0.487	0.418	12073
2.5 - 3.49	0.270	0.416	0.364	0.312	19281
3.5 - 4.49	0.221	0.343	0.300	0.257	25447
4.5 - 5.49	0.190	0.299	0.262	0.224	28960
5.5 - 6.49	0.163	0.269	0.236	0.202	29987
6.5 - 7.49	0.142	0.248	0.217	0.186	28772
7.5 - 8.49	0.131	0.232	0.203	0.174	25589
8.5 - 9.49	0.125	0.220	0.192	0.165	19232
9.5 - 10.49	0.126	0.210	0.184	0.157	12812
10.5 - 11.49	0.130	0.202	0.177	0.151	7495
11.5 - 12.49	0.134	0.195	0.171	0.146	4478
12.5 - 13.49	0.136	0.189	0.166	0.142	2612
13.5 - 14.49	0.137	0.184	0.161	0.138	1384
14.5 - 15.49	0.135	0.180	0.157	0.135	737
15.5 - 16.49	0.142	0.176	0.154	0.132	405
16.5 - 17.49	0.144	0.173	0.151	0.130	182
17.5 - 18.49	0.139	0.170	0.149	0.127	75
18.5 - 19.49	0.138	0.167	0.146	0.126	48
19.5 - 20.49	0.146	0.165	0.144	0.124	19
20.5 - 21.49	0.149	0.163	0.143	0.122	10
21.5 - 22.49	0.120	0.161	0.141	0.121	3
22.5 - 23.49	0.126	0.159	0.139	0.119	3
23.5 - 24.49	0.091	0.157	0.137	0.118	1
24.5 - 25.49					0
25.5 - 26.49					0
26.5 - 27.49					0
27.5 - 28.49					0
28.5 - 29.49					0
29.5 - 30.49					0

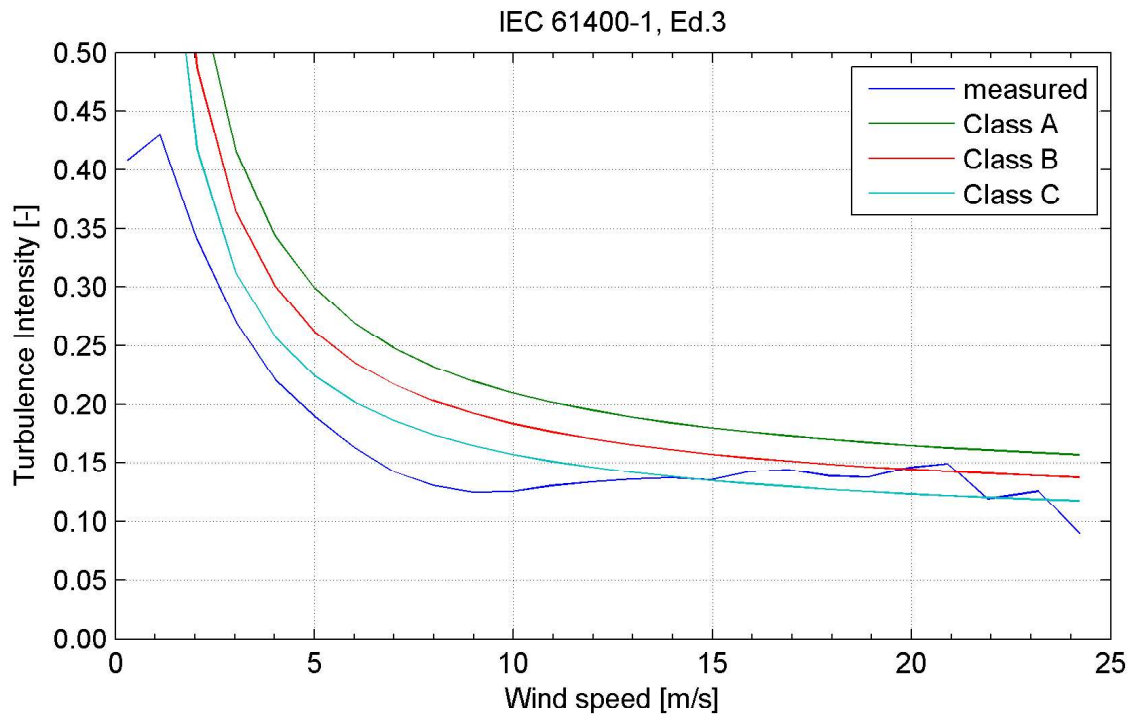


Figure 5.11: Ambient representative turbulence intensity at 97.9 m according to IEC 61400-1, Edition 3



#### 5.4.10 Extreme Values of Wind Speed at 97.9 m

Table 5.22: Monthly averages and extreme values of wind speed at 97.9 m (continued)

month	n	v-average	v-max 10 minutes	v-max 1 second
[-]	[-]	[m/s]	[m/s]	[m/s]
02.09	2022	5.96	15.2	18.6
03.09	4460	7.08	24.2	31.9
04.09	4320	6.55	15.4	18.5
05.09	4464	5.60	14.9	16.2
06.09	4320	5.96	16.3	21.4
07.09	4464	5.64	17.5	20.6
08.09	4464	5.39	13.5	23.5
09.09	4320	6.06	13.7	16.9
10.09	4464	6.50	16.6	22.5
11.09	4320	6.33	16.5	20.0
12.09	3598	7.80	19.0	23.6
01.10	3670	7.08	17.6	21.6
02.10	1728	8.32	16.8	19.4
03.10	0	0.00	0.0	0.0
04.10	0	0.00	0.0	0.0
05.10	3670	6.01	15.3	19.3
06.10	4316	5.62	17.7	23.3
07.10	4320	5.62	19.9	26.6
08.10	4464	5.66	13.0	17.6
09.10	4320	6.38	15.9	20.8
10.10	4464	6.71	13.9	18.6
11.10	4320	7.55	20.2	26.3
12.10	3685	7.82	18.1	23.6
01.11	3356	5.63	14.5	17.0
02.11	3156	6.88	22.0	28.1
03.11	4109	6.61	16.0	18.1
04.11	4212	6.47	16.1	22.9
05.11	4435	5.74	14.6	18.3
06.11	4320	5.80	16.6	24.1
07.11	4464	5.34	13.5	17.3
08.11	4464	5.85	14.5	18.8
09.11	4320	6.01	15.4	18.9
10.11	4464	6.38	20.0	26.3
11.11	3863	5.27	11.8	13.4
12.11	4290	6.60	16.2	20.8

Table 5.22: Monthly averages and extreme values of wind speed at 97.9 m (end)

month	n	v-average	v-max 10 minutes	v-max 1 second
[-]	[-]	[m/s]	[m/s]	[m/s]
01.12	4464	8.34	18.8	22.7
02.12	2768	6.68	15.9	20.5
03.12	4464	6.43	16.9	20.7
04.12	4320	7.44	17.1	22.6
05.12	4464	5.61	13.6	17.6
06.12	4320	5.21	13.9	21.0
07.12	4446	6.05	16.2	25.4
08.12	4464	6.17	17.3	22.7
09.12	4318	6.19	14.6	17.8
10.12	4464	6.26	16.6	21.7
11.12	4286	5.76	20.0	25.2
12.12	4464	6.69	22.8	28.6
01.13	4327	7.68	19.1	22.2
02.13	3977	7.42	19.0	24.2
03.13	4391	7.24	18.4	28.7
04.13	4320	7.27	15.5	18.9
05.13	4464	6.41	16.3	21.7
06.13	4320	5.94	13.9	18.3
07.13	4464	5.69	18.0	22.0
08.13	4464	5.61	12.0	15.5
09.13	4320	6.70	16.5	21.7
10.13	1375	7.69	16.9	22.7
complete period	225290	6.37	24.2	31.9

## 5.5 Measurement Height 74.0 m

### 5.5.1 Averages of Wind Speed and Time Series at 74.0 m

Table 5.23: Monthly averages at measurement height 74.0 m

Monthly mean values of wind speed in m/s							
Month	2009	2010	2011	2012	2013	mean	mean of months
January		6.51	4.98	7.77	7.17	7.01	6.61
February	5.51	6.93	6.33	6.17	7.08	6.54	6.41
March	6.59	6.64	6.21	6.06	6.91	6.48	6.48
April	6.17	5.90	6.10	7.03	6.84	6.41	6.41
May	5.23	5.85	5.46	5.32	6.08	5.59	5.59
June	5.55	5.29	5.54	4.95	5.58	5.38	5.38
July	5.30	5.27	5.09	5.74	5.32	5.34	5.34
August	5.04	5.28	5.59	5.81	5.30	5.40	5.40
September	5.62	5.98	5.65	5.79	6.26	5.86	5.86
October	5.92	6.19	5.92	5.85	7.24	6.06	6.22
November	5.80	6.87	4.88	5.40		5.74	5.74
December	7.14		6.12	6.35		6.50	6.53
mean, all data	5.80	6.04	5.69	6.02	6.30	5.96	
mean of months	5.81	6.06	5.66	6.02	6.38		6.00

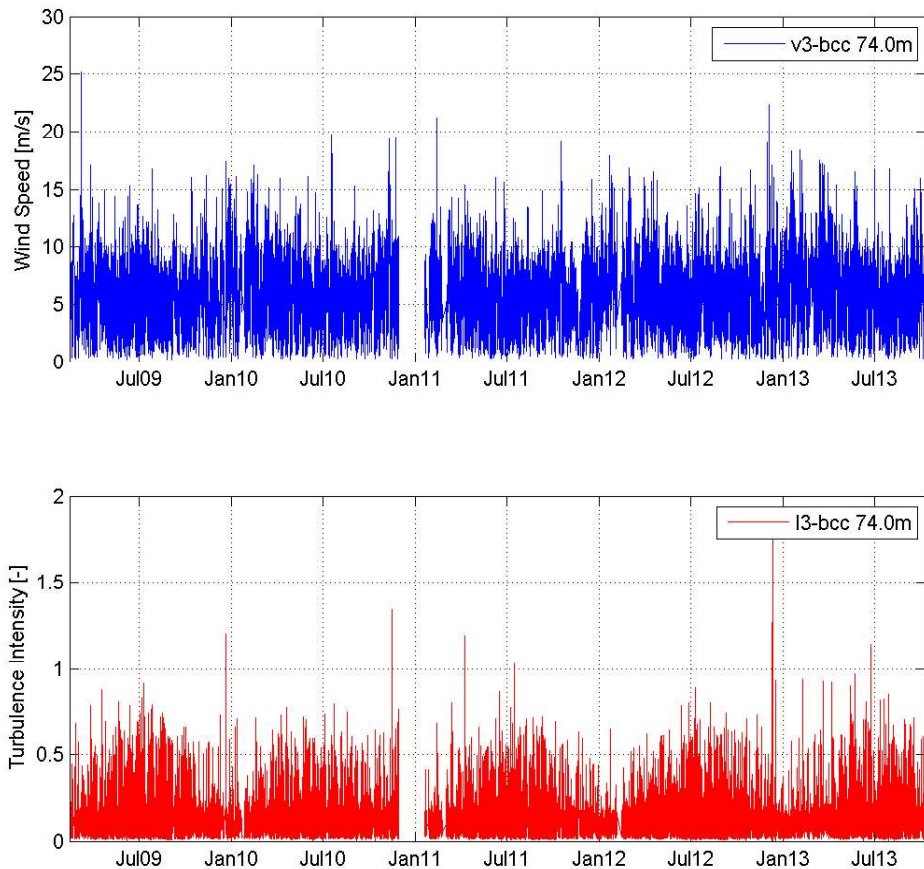


Figure 5.12: Wind speed, turbulence intensity and time series at measurement height 74.0 m

### 5.5.2 Joint Probability Distribution of Wind Speeds at 74.0 m and Wind Directions at 97.9 m

Table 5.24: Number of datasets per wind speed bin and per sector at 74.0 m

Wind Speed	Sum	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	717	49	36	60	101	17	16	10	33	34	120	135	106
0.5 - 1.49	5289	533	535	509	456	370	402	259	397	371	481	479	497
1.5 - 2.49	13400	1566	1376	1248	977	798	815	750	844	933	1102	1387	1604
2.5 - 3.49	21450	2790	2404	1842	1397	1149	1057	1135	1313	1324	1945	2371	2723
3.5 - 4.49	28636	3988	3001	2276	1908	1594	1462	1584	1516	1532	2845	3432	3498
4.5 - 5.49	33659	4330	3018	2408	2625	1862	2326	2657	1562	1708	3418	3908	3837
5.5 - 6.49	35464	4345	2744	2263	2666	2215	3136	3360	1729	1725	3882	3744	3655
6.5 - 7.49	32485	3436	2274	1649	2122	1940	3363	4068	2103	1807	4031	2902	2790
7.5 - 8.49	24521	2517	1362	1080	1278	1372	2619	4349	2123	1319	3220	1635	1647
8.5 - 9.49	15333	1841	685	607	650	555	1505	3458	1578	734	2091	747	882
9.5 - 10.49	8796	1206	442	359	358	196	898	1985	838	311	1244	396	563
10.5 - 11.49	4930	677	290	219	186	86	431	1133	359	136	823	232	358
11.5 - 12.49	2932	482	180	107	104	90	257	611	186	46	515	111	243
12.5 - 13.49	1617	289	98	61	58	91	150	251	185	21	265	53	95
13.5 - 14.49	791	108	47	41	29	45	72	134	115	11	127	29	33
14.5 - 15.49	461	84	28	39	27	22	19	61	71	1	73	14	22
15.5 - 16.49	189	49	11	6	8	2	15	28	39	0	22	4	5
16.5 - 17.49	98	31	2	0	1	2	13	14	21	1	10	0	3
17.5 - 18.49	48	15	0	1	0	0	0	5	12	1	14	0	0
18.5 - 19.49	13	3	0	0	0	0	0	2	2	0	6	0	0
19.5 - 20.49	11	0	0	1	0	0	0	0	0	1	9	0	0
20.5 - 21.49	2	0	0	0	0	0	0	1	0	0	1	0	0
21.5 - 22.49	1	0	0	0	0	0	0	0	0	1	0	0	0
22.5 - 23.49	0	0	0	0	0	0	0	0	0	0	0	0	0
23.5 - 24.49	1	0	0	0	0	0	0	1	0	0	0	0	0
24.5 - 25.49	1	0	0	0	0	0	0	1	0	0	0	0	0
25.5 - 26.49	0	0	0	0	0	0	0	0	0	0	0	0	0
26.5 - 27.49	0	0	0	0	0	0	0	0	0	0	0	0	0
27.5 - 28.49	0	0	0	0	0	0	0	0	0	0	0	0	0
28.5 - 29.49	0	0	0	0	0	0	0	0	0	0	0	0	0
29.5 - 30.49	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	230845	28339	18533	14776	14951	12406	18556	25857	15026	12017	26244	21579	22561

### 5.5.3 Wind Speed Distribution at 74.0 m, Wind Direction Distribution at 97.9 m, Weibull Fit at 74.0 m

Table 5.25: Weibull parameters, average wind speeds at 74.0 m per sector.

Sector	A-Parameter	Mean Wind Speed	k-Parameter	Frequency
	[m/s]	[m/s]	[-]	[%]
N	6.77	6.00	2.32	12.28
NNE	6.05	5.36	2.29	8.03
ENE	5.98	5.30	2.23	6.40
E	6.25	5.55	2.49	6.48
ESE	6.37	5.65	2.55	5.37
SSE	7.26	6.47	2.83	8.04
S	8.04	7.19	3.11	11.20
SSW	7.29	6.46	2.40	6.51
WSW	6.26	5.55	2.52	5.21
W	7.22	6.41	2.54	11.37
WNW	6.02	5.35	2.58	9.35
NNW	6.11	5.42	2.39	9.77
mean	6.72	5.96	2.45	100.00

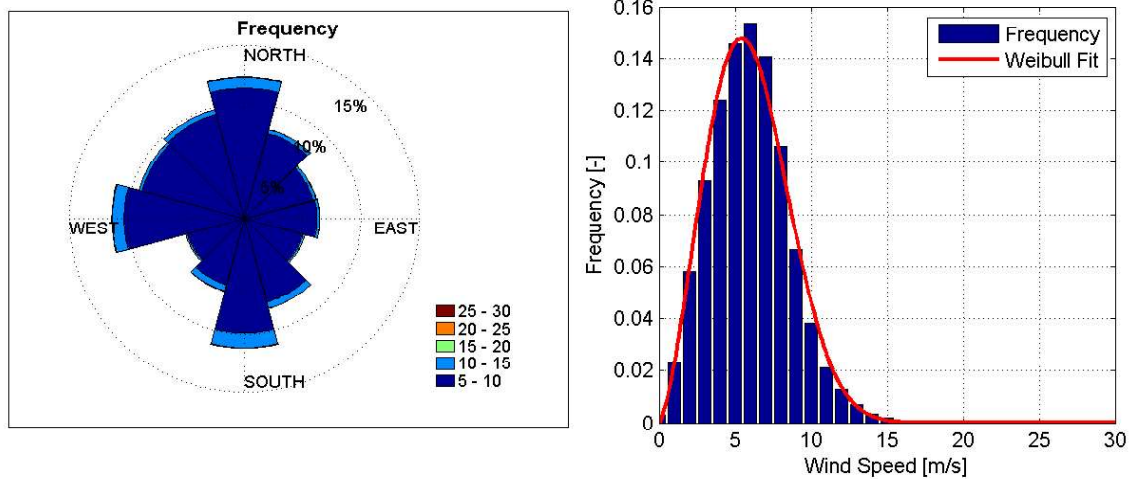


Figure 5.13: Frequency distribution of wind speeds at 74.0 m and of wind direction at 97.9 m

### 5.5.4 Turbulence Intensity at 74.0 m

Table 5.26: Turbulence intensity per wind speed bin and per sector at 74.0 m

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.102	0.100	0.172	0.224	0.088	0.225	0.243	0.148	0.213	0.227	0.043	0.052	0.034
0.5 - 1.49	0.241	0.251	0.232	0.232	0.220	0.255	0.231	0.176	0.257	0.266	0.244	0.247	0.264
1.5 - 2.49	0.182	0.186	0.181	0.172	0.180	0.190	0.202	0.121	0.197	0.194	0.183	0.182	0.190
2.5 - 3.49	0.147	0.152	0.155	0.151	0.152	0.146	0.158	0.098	0.154	0.150	0.139	0.150	0.141
3.5 - 4.49	0.121	0.125	0.130	0.128	0.127	0.128	0.134	0.090	0.124	0.115	0.111	0.120	0.120
4.5 - 5.49	0.104	0.115	0.113	0.115	0.117	0.107	0.109	0.076	0.093	0.093	0.098	0.100	0.105
5.5 - 6.49	0.093	0.106	0.103	0.102	0.107	0.086	0.099	0.069	0.078	0.079	0.090	0.089	0.091
6.5 - 7.49	0.085	0.102	0.106	0.092	0.099	0.079	0.088	0.065	0.062	0.067	0.086	0.084	0.088
7.5 - 8.49	0.083	0.107	0.108	0.098	0.100	0.074	0.087	0.062	0.054	0.067	0.091	0.090	0.092
8.5 - 9.49	0.086	0.109	0.117	0.107	0.102	0.080	0.092	0.061	0.056	0.073	0.100	0.100	0.102
9.5 - 10.49	0.094	0.114	0.119	0.111	0.104	0.086	0.091	0.064	0.074	0.083	0.112	0.115	0.108
10.5 - 11.49	0.101	0.119	0.121	0.106	0.105	0.094	0.093	0.072	0.085	0.099	0.118	0.124	0.112
11.5 - 12.49	0.104	0.114	0.121	0.107	0.105	0.090	0.096	0.074	0.116	0.114	0.117	0.119	0.114
12.5 - 13.49	0.109	0.109	0.116	0.113	0.117	0.086	0.098	0.085	0.122	0.122	0.121	0.135	0.123
13.5 - 14.49	0.110	0.115	0.122	0.107	0.116	0.079	0.093	0.086	0.128	0.131	0.119	0.137	0.116
14.5 - 15.49	0.111	0.118	0.118	0.102	0.113	0.070	0.095	0.091	0.128	0.080	0.117	0.139	0.118
15.5 - 16.49	0.112	0.116	0.114	0.107	0.106	0.085	0.092	0.097	0.117		0.116	0.135	0.146
16.5 - 17.49	0.112	0.120	0.148		0.129	0.068	0.091	0.094	0.119	0.112	0.120		0.138
17.5 - 18.49	0.120	0.114		0.157				0.111	0.115	0.131	0.130		
18.5 - 19.49	0.121	0.120						0.085	0.157		0.121		
19.5 - 20.49	0.132			0.173						0.150	0.125		
20.5 - 21.49	0.108							0.083			0.133		
21.5 - 22.49	0.122									0.122			
22.5 - 23.49													
23.5 - 24.49	0.082							0.082					
24.5 - 25.49	0.117							0.117					
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.110	0.123	0.128	0.124	0.122	0.109	0.109	0.072	0.096	0.106	0.107	0.113	0.116
Measured Turbulence Intensity above 10 m/s: 0.103													

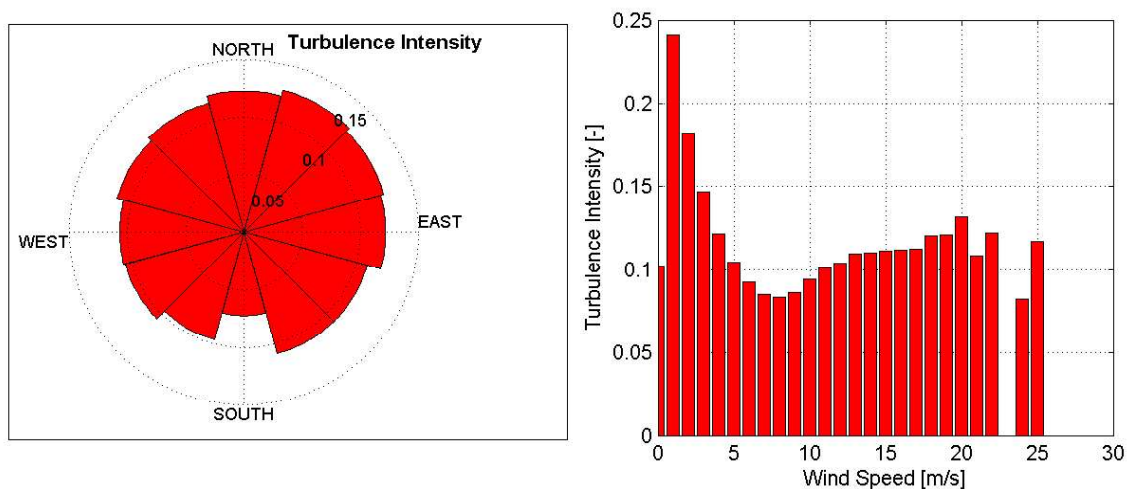


Figure 5.14: Sector dependent turbulence intensity at 74.0 m



### 5.5.5 Standard Deviation of Turbulence Intensity at 74.0 m

Table 5.27: Standard deviation of turbulence intensity at 74.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.146	0.146	0.161	0.145	0.133	0.136	0.133	0.072	0.123	0.169	0.108	0.127	0.092
0.5 - 1.49	0.143	0.148	0.134	0.144	0.149	0.147	0.132	0.097	0.154	0.145	0.134	0.152	0.136
1.5 - 2.49	0.128	0.128	0.129	0.126	0.137	0.134	0.137	0.083	0.131	0.130	0.120	0.124	0.127
2.5 - 3.49	0.099	0.100	0.103	0.099	0.106	0.104	0.113	0.064	0.107	0.106	0.092	0.093	0.094
3.5 - 4.49	0.080	0.077	0.082	0.081	0.087	0.092	0.091	0.055	0.084	0.081	0.074	0.076	0.076
4.5 - 5.49	0.067	0.063	0.065	0.071	0.074	0.075	0.071	0.046	0.071	0.072	0.062	0.062	0.066
5.5 - 6.49	0.056	0.054	0.058	0.061	0.059	0.061	0.058	0.037	0.058	0.055	0.050	0.055	0.055
6.5 - 7.49	0.048	0.047	0.050	0.051	0.049	0.046	0.048	0.033	0.044	0.047	0.043	0.046	0.049
7.5 - 8.49	0.045	0.042	0.043	0.045	0.047	0.045	0.043	0.031	0.039	0.043	0.042	0.049	0.046
8.5 - 9.49	0.043	0.036	0.033	0.032	0.037	0.039	0.039	0.030	0.040	0.046	0.038	0.049	0.045
9.5 - 10.49	0.040	0.029	0.031	0.030	0.031	0.039	0.035	0.030	0.044	0.045	0.033	0.039	0.031
10.5 - 11.49	0.038	0.030	0.034	0.025	0.028	0.038	0.031	0.029	0.047	0.041	0.030	0.040	0.029
11.5 - 12.49	0.033	0.023	0.027	0.034	0.025	0.022	0.024	0.030	0.036	0.046	0.025	0.042	0.030
12.5 - 13.49	0.030	0.021	0.021	0.039	0.020	0.020	0.021	0.026	0.032	0.021	0.027	0.033	0.029
13.5 - 14.49	0.030	0.020	0.021	0.024	0.021	0.021	0.023	0.030	0.026	0.043	0.024	0.032	0.030
14.5 - 15.49	0.030	0.024	0.039	0.012	0.016	0.016	0.019	0.025	0.023	0.000	0.020	0.071	0.031
15.5 - 16.49	0.027	0.025	0.029	0.005	0.011	0.014	0.025	0.031	0.020		0.027	0.040	0.044
16.5 - 17.49	0.024	0.016	0.008		0.000	0.017	0.019	0.022	0.020	0.000	0.020		0.013
17.5 - 18.49	0.024	0.017		0.000				0.045	0.023	0.000	0.020		
18.5 - 19.49	0.027	0.006						0.001	0.056		0.009		
19.5 - 20.49	0.022			0.000						0.000	0.017		
20.5 - 21.49	0.035							0.000			0.000		
21.5 - 22.49	0.000									0.000			
22.5 - 23.49													
23.5 - 24.49	0.000							0.000					
24.5 - 25.49	0.000							0.000					
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.079	0.075	0.083	0.086	0.084	0.088	0.076	0.044	0.086	0.091	0.068	0.080	0.081
Measured Standard Deviation of Turbulence Intensity above 10 m/s: 0.036													

### 5.5.6 Standard Deviation of Wind Speed at 74.0 m

Table 5.28: Standard deviation of wind speed at 74.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]
0 - 0.49	0.042	0.042	0.070	0.089	0.036	0.097	0.087	0.061	0.087	0.094	0.017	0.022	0.014
0.5 - 1.49	0.264	0.282	0.250	0.247	0.233	0.274	0.253	0.194	0.277	0.289	0.270	0.270	0.299
1.5 - 2.49	0.371	0.382	0.368	0.352	0.363	0.387	0.405	0.245	0.400	0.392	0.373	0.372	0.386
2.5 - 3.49	0.442	0.458	0.467	0.455	0.458	0.442	0.475	0.298	0.462	0.447	0.419	0.452	0.428
3.5 - 4.49	0.485	0.500	0.520	0.511	0.510	0.516	0.537	0.361	0.494	0.461	0.444	0.477	0.479
4.5 - 5.49	0.522	0.574	0.565	0.572	0.589	0.532	0.547	0.383	0.466	0.465	0.491	0.499	0.525
5.5 - 6.49	0.554	0.636	0.618	0.611	0.639	0.516	0.591	0.417	0.468	0.474	0.540	0.532	0.547
6.5 - 7.49	0.593	0.714	0.741	0.644	0.689	0.552	0.617	0.455	0.434	0.466	0.604	0.586	0.616
7.5 - 8.49	0.665	0.855	0.860	0.782	0.798	0.583	0.696	0.493	0.433	0.537	0.728	0.717	0.730
8.5 - 9.49	0.773	0.982	1.047	0.959	0.919	0.713	0.828	0.546	0.497	0.657	0.895	0.897	0.910
9.5 - 10.49	0.936	1.130	1.183	1.110	1.037	0.855	0.906	0.641	0.736	0.824	1.118	1.146	1.071
10.5 - 11.49	1.107	1.306	1.334	1.165	1.148	1.027	1.015	0.790	0.932	1.088	1.290	1.355	1.231
11.5 - 12.49	1.245	1.364	1.442	1.274	1.257	1.082	1.149	0.880	1.392	1.371	1.405	1.425	1.364
12.5 - 13.49	1.415	1.416	1.509	1.468	1.509	1.116	1.268	1.099	1.583	1.593	1.569	1.740	1.599
13.5 - 14.49	1.534	1.609	1.714	1.496	1.640	1.106	1.301	1.204	1.784	1.803	1.666	1.918	1.618
14.5 - 15.49	1.668	1.766	1.783	1.525	1.682	1.049	1.412	1.355	1.902	1.201	1.760	2.098	1.771
15.5 - 16.49	1.779	1.855	1.807	1.691	1.661	1.338	1.481	1.552	1.870		1.852	2.128	2.312
16.5 - 17.49	1.905	2.046	2.551		2.188	1.138	1.547	1.587	2.006	1.932	2.026		2.343
17.5 - 18.49	2.168	2.049		2.827				2.011	2.090	2.310	2.361		
18.5 - 19.49	2.296	2.244						1.621	3.016		2.308		
19.5 - 20.49	2.627			3.401						3.056	2.493		
20.5 - 21.49	2.286							1.748			2.823		
21.5 - 22.49	2.728									2.728			
22.5 - 23.49													
23.5 - 24.49	1.980							1.980					
24.5 - 25.49	2.940							2.940					
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.592	0.689	0.635	0.598	0.623	0.538	0.641	0.493	0.529	0.495	0.652	0.554	0.575

### 5.5.7 Standard Deviation of Standard Deviation of Wind Speed at 74.0 m

Table 5.29: Standard deviation of standard deviation of wind speed at 74.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]
0 - 0.49	0.062	0.063	0.071	0.062	0.056	0.064	0.055	0.035	0.054	0.075	0.044	0.056	0.040
0.5 - 1.49	0.165	0.177	0.147	0.165	0.166	0.166	0.158	0.114	0.172	0.167	0.165	0.173	0.160
1.5 - 2.49	0.260	0.263	0.260	0.260	0.276	0.273	0.277	0.167	0.267	0.261	0.248	0.257	0.258
2.5 - 3.49	0.298	0.304	0.307	0.297	0.320	0.316	0.342	0.194	0.317	0.311	0.275	0.279	0.284
3.5 - 4.49	0.319	0.309	0.330	0.322	0.354	0.366	0.362	0.217	0.332	0.326	0.296	0.301	0.302
4.5 - 5.49	0.332	0.315	0.322	0.356	0.369	0.370	0.355	0.228	0.350	0.353	0.310	0.308	0.327
5.5 - 6.49	0.334	0.324	0.348	0.364	0.350	0.361	0.344	0.222	0.345	0.333	0.303	0.328	0.327
6.5 - 7.49	0.332	0.329	0.352	0.352	0.339	0.323	0.335	0.230	0.308	0.325	0.303	0.323	0.342
7.5 - 8.49	0.361	0.334	0.349	0.358	0.373	0.355	0.340	0.248	0.312	0.349	0.341	0.393	0.366
8.5 - 9.49	0.387	0.325	0.299	0.287	0.332	0.345	0.353	0.273	0.363	0.415	0.344	0.446	0.405
9.5 - 10.49	0.395	0.287	0.308	0.302	0.313	0.385	0.354	0.298	0.440	0.453	0.337	0.393	0.306
10.5 - 11.49	0.414	0.333	0.374	0.272	0.305	0.429	0.345	0.315	0.523	0.449	0.335	0.438	0.322
11.5 - 12.49	0.401	0.280	0.316	0.402	0.300	0.271	0.290	0.357	0.442	0.566	0.306	0.503	0.364
12.5 - 13.49	0.388	0.272	0.270	0.523	0.261	0.254	0.271	0.344	0.417	0.281	0.353	0.428	0.382
13.5 - 14.49	0.424	0.291	0.291	0.323	0.293	0.288	0.321	0.417	0.369	0.570	0.335	0.459	0.418
14.5 - 15.49	0.453	0.358	0.601	0.190	0.244	0.245	0.283	0.364	0.337	0.000	0.306	1.109	0.466
15.5 - 16.49	0.436	0.396	0.479	0.079	0.162	0.243	0.384	0.498	0.308		0.442	0.661	0.696
16.5 - 17.49	0.407	0.282	0.171		0.000	0.270	0.330	0.379	0.344	0.000	0.362		0.262
17.5 - 18.49	0.433	0.299		0.000				0.807	0.432	0.000	0.343		
18.5 - 19.49	0.517	0.093						0.009	1.018		0.199		
19.5 - 20.49	0.433			0.000						0.000	0.341		
20.5 - 21.49	0.760							0.000			0.000		
21.5 - 22.49	0.000									0.000			
22.5 - 23.49													
23.5 - 24.49	0.000							0.000					
24.5 - 25.49	0.000							0.000					
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.392	0.412	0.405	0.391	0.395	0.364	0.380	0.301	0.429	0.364	0.423	0.379	0.383

### 5.5.8 Ambient Characteristic Turbulence Intensity According to IEC 61400-1, Edition 2 at 74.0 m

Table 5.30: Ambient characteristic turbulence intensity at 74.0 m as function of wind speed according to IEC 61400-1; Edition 2

Wind Speed	I1	Class A	Class B	Frequency
[m/s]	[-]	[-]	[-]	[-]
0 - 0.49	0.248	2.957	2.011	717
0.5 - 1.49	0.384	0.925	0.657	5289
1.5 - 2.49	0.310	0.558	0.412	13400
2.5 - 3.49	0.246	0.417	0.318	21450
3.5 - 4.49	0.201	0.344	0.269	28636
4.5 - 5.49	0.171	0.300	0.240	33659
5.5 - 6.49	0.148	0.270	0.220	35464
6.5 - 7.49	0.132	0.249	0.206	32485
7.5 - 8.49	0.129	0.233	0.195	24521
8.5 - 9.49	0.129	0.221	0.187	15333
9.5 - 10.49	0.134	0.210	0.180	8796
10.5 - 11.49	0.139	0.202	0.175	4930
11.5 - 12.49	0.137	0.195	0.170	2932
12.5 - 13.49	0.139	0.190	0.166	1617
13.5 - 14.49	0.140	0.184	0.163	791
14.5 - 15.49	0.141	0.180	0.160	461
15.5 - 16.49	0.139	0.176	0.158	189
16.5 - 17.49	0.136	0.173	0.155	98
17.5 - 18.49	0.144	0.170	0.153	48
18.5 - 19.49	0.148	0.167	0.152	13
19.5 - 20.49	0.153	0.165	0.150	11
20.5 - 21.49	0.144	0.163	0.148	2
21.5 - 22.49	0.122	0.160	0.147	1
22.5 - 23.49				0
23.5 - 24.49	0.082	0.157	0.145	1
24.5 - 25.49	0.117	0.156	0.144	1
25.5 - 26.49				0
26.5 - 27.49				0
27.5 - 28.49				0
28.5 - 29.49				0
29.5 - 30.49				0
Ambient Characteristic turbulence intensity at 15 m/s determined from measurement above 10 m/s (I 15): 0.138				

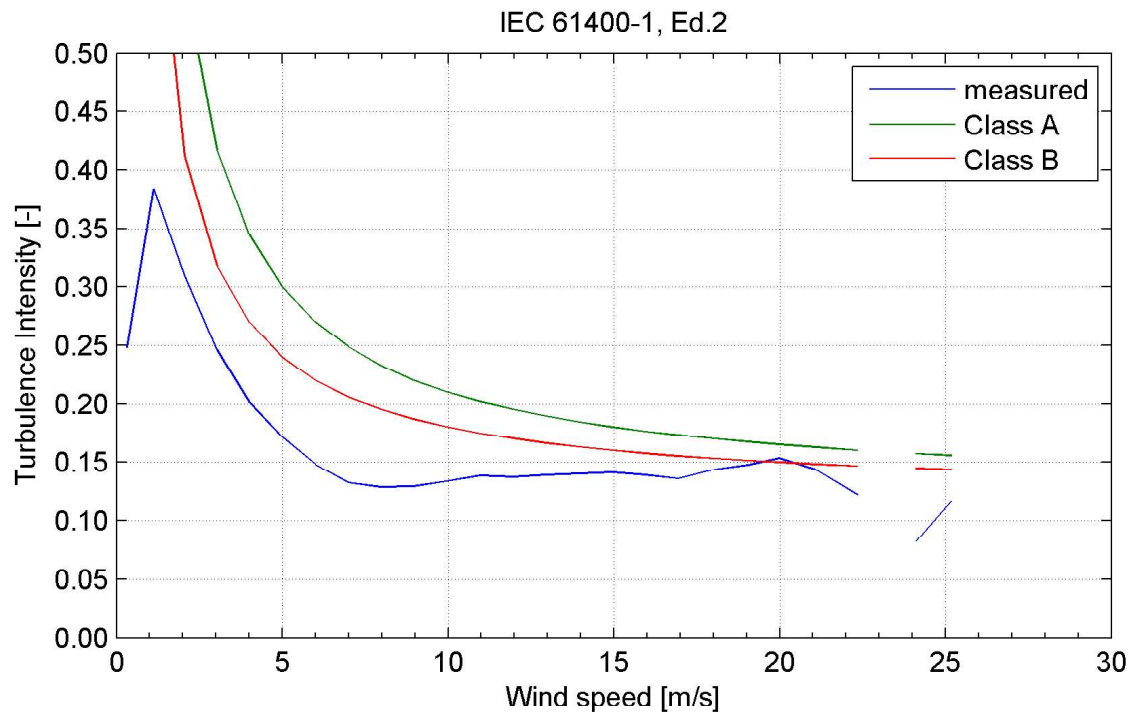


Figure 5.15: Ambient characteristic turbulence intensity at 74.0 m according to IEC 61400-1, Edition 2

### 5.5.9 Ambient Representative Turbulence Intensity According to IEC 61400-1, Edition 3 at 74.0 m

Table 5.31: Ambient representative turbulence intensity at 74.0 m as function of wind speed according to IEC 61400-1; Edition 3

Wind Speed	I <sub>t</sub>	Class A	Class B	Class C	Frequency
[m/s]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.381	2.944	2.576	2.208	717
0.5 - 1.49	0.425	0.922	0.807	0.691	5289
1.5 - 2.49	0.343	0.556	0.487	0.417	13400
2.5 - 3.49	0.272	0.416	0.364	0.312	21450
3.5 - 4.49	0.223	0.343	0.300	0.257	28636
4.5 - 5.49	0.189	0.299	0.262	0.224	33659
5.5 - 6.49	0.164	0.269	0.236	0.202	35464
6.5 - 7.49	0.146	0.248	0.217	0.186	32485
7.5 - 8.49	0.141	0.232	0.203	0.174	24521
8.5 - 9.49	0.142	0.220	0.193	0.165	15333
9.5 - 10.49	0.145	0.210	0.184	0.158	8796
10.5 - 11.49	0.149	0.202	0.177	0.151	4930
11.5 - 12.49	0.147	0.195	0.171	0.146	2932
12.5 - 13.49	0.148	0.189	0.166	0.142	1617
13.5 - 14.49	0.149	0.184	0.161	0.138	791
14.5 - 15.49	0.150	0.180	0.157	0.135	461
15.5 - 16.49	0.147	0.176	0.154	0.132	189
16.5 - 17.49	0.143	0.173	0.151	0.130	98
17.5 - 18.49	0.151	0.170	0.148	0.127	48
18.5 - 19.49	0.155	0.167	0.146	0.125	13
19.5 - 20.49	0.159	0.165	0.144	0.124	11
20.5 - 21.49	0.154	0.162	0.142	0.122	2
21.5 - 22.49	0.122	0.160	0.140	0.120	1
22.5 - 23.49					0
23.5 - 24.49	0.082	0.157	0.138	0.118	1
24.5 - 25.49	0.117	0.156	0.136	0.117	1
25.5 - 26.49					0
26.5 - 27.49					0
27.5 - 28.49					0
28.5 - 29.49					0
29.5 - 30.49					0

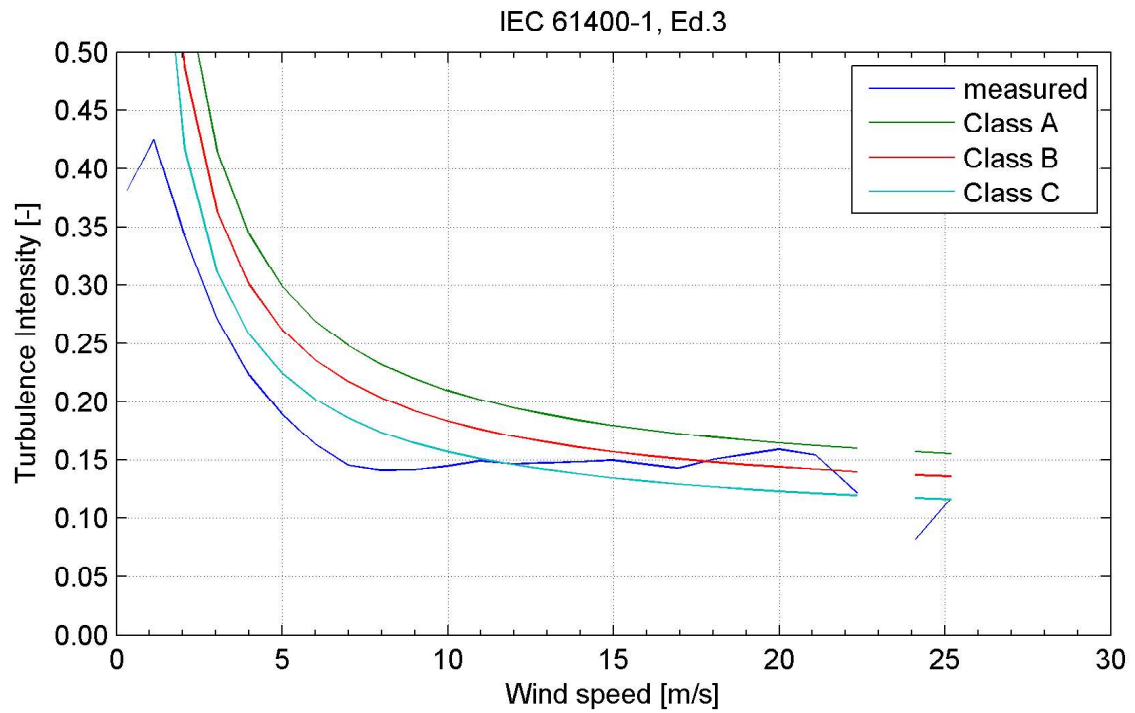


Figure 5.16: Ambient representative turbulence intensity at 74.0 m according to IEC 61400-1, Edition 3



### 5.5.10 Extreme Values of Wind Speed at 74.0 m

Table 5.32: Monthly averages and extreme values of wind speed at 74.0 m (continued)

month	n	v-average	v-max 10 minutes	v-max 1 second
[-]	[-]	[m/s]	[m/s]	[m/s]
02.09	2022	5.51	15.0	19.4
03.09	4460	6.59	25.2	31.0
04.09	4320	6.17	14.9	18.7
05.09	4464	5.23	14.4	15.4
06.09	4320	5.55	15.3	20.6
07.09	4464	5.30	16.8	20.4
08.09	4464	5.04	13.2	24.8
09.09	4320	5.62	12.8	16.4
10.09	4464	5.92	16.0	21.1
11.09	4320	5.80	16.1	19.8
12.09	3598	7.14	17.4	22.3
01.10	3670	6.51	16.1	19.9
02.10	4031	6.93	17.0	20.9
03.10	4372	6.64	15.1	18.8
04.10	4320	5.90	15.9	19.6
05.10	4453	5.85	14.4	18.3
06.10	4316	5.29	16.1	21.3
07.10	4320	5.27	19.7	26.4
08.10	4464	5.28	11.9	17.4
09.10	4320	5.98	15.3	20.5
10.10	4464	6.19	13.2	18.8
11.10	4008	6.87	19.5	25.8
12.10	0	0.00	0.0	0.0
01.11	1130	4.98	9.9	11.5
02.11	3156	6.33	21.2	28.1
03.11	4109	6.21	14.3	18.5
04.11	4212	6.10	15.4	22.0
05.11	4435	5.46	13.2	18.0
06.11	4320	5.54	16.0	23.6
07.11	4464	5.09	12.4	17.2
08.11	4464	5.59	13.5	18.6
09.11	4320	5.65	14.9	18.7
10.11	4464	5.92	19.1	24.3
11.11	3863	4.88	10.4	12.0
12.11	4290	6.12	15.9	20.5

Table 5.32: Monthly averages and extreme values of wind speed at 74.0 m (end)

month	n	v-average	v-max 10 minutes	v-max 1 second
[-]	[-]	[m/s]	[m/s]	[m/s]
01.12	4464	7.77	17.9	21.4
02.12	2768	6.17	15.1	19.2
03.12	4464	6.06	16.8	21.0
04.12	4320	7.03	16.5	22.2
05.12	4464	5.32	13.0	17.5
06.12	4320	4.95	13.6	20.9
07.12	4446	5.74	15.1	25.2
08.12	4464	5.81	16.9	22.4
09.12	4318	5.79	14.1	17.6
10.12	4464	5.85	16.6	21.0
11.12	4286	5.40	19.0	25.3
12.12	4464	6.35	22.4	29.1
01.13	4327	7.17	18.3	22.9
02.13	3977	7.08	18.4	23.9
03.13	4391	6.91	17.5	25.9
04.13	4320	6.84	15.3	18.8
05.13	4464	6.08	16.5	23.1
06.13	4320	5.58	12.7	17.7
07.13	4464	5.32	16.7	21.6
08.13	4464	5.30	11.2	15.1
09.13	4320	6.26	15.6	21.5
10.13	1375	7.24	16.0	21.0
complete period	230845	5.96	25.2	31.0

## 5.6 Measurement Height 40.0 m

### 5.6.1 Averages of Wind Speed and Time Series at 40.0 m

Table 5.33: Monthly averages at measurement height 40.0 m

Monthly mean values of wind speed in m/s							
Month	2009	2010	2011	2012	2013	mean	mean of months
January		5.60	4.45	6.72	6.25	5.86	5.76
February	4.86	6.04	5.43	5.34	6.33	5.72	5.60
March	5.92	5.88	5.50	5.31	6.20	5.77	5.76
April	5.39	5.17	5.38	6.27	6.05	5.65	5.65
May	4.60	5.05	4.80	4.68	5.27	4.88	4.88
June	4.82	4.55	4.81	4.33	4.83	4.69	4.67
July	4.50	4.49	4.45	4.87	4.52	4.56	4.56
August	4.23	4.49	4.77	4.90	4.55	4.59	4.59
September	4.77	5.22	4.65	4.85	5.48	4.99	4.99
October	5.15	5.19	5.00	5.08	6.13	5.18	5.31
November	5.00	6.07	4.08	4.77		5.01	4.98
December	6.17	6.18	5.21	5.66		5.77	5.80
mean, all data	5.03	5.36	4.87	5.23	5.51	5.19	
mean of months	5.04	5.33	4.88	5.23	5.56		5.21

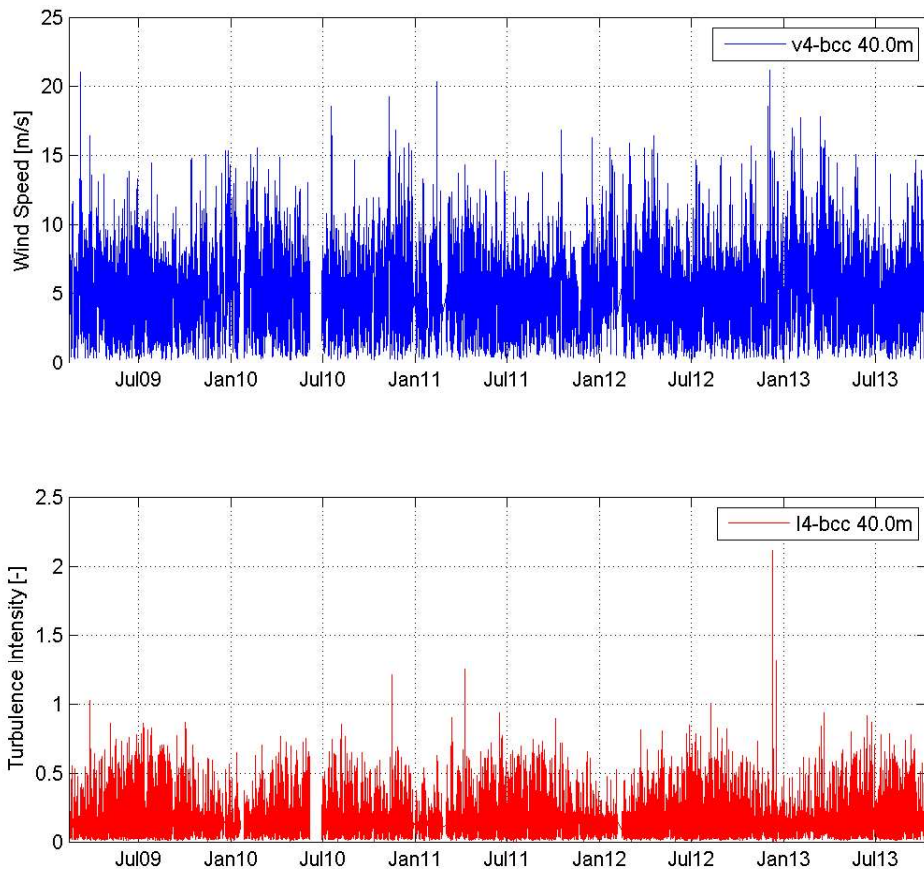


Figure 5.17: Wind speed, turbulence intensity and time series at measurement height 40.0 m

### 5.6.2 Joint Probability Distribution of Wind Speeds at 40.0 m and Wind Directions at 97.9 m

Table 5.34: Number of datasets per wind speed bin and per sector at 40.0 m

Wind Speed	Sum	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	724	57	29	36	28	38	31	22	32	42	149	164	96
0.5 - 1.49	6537	635	641	561	436	465	377	396	427	512	600	728	759
1.5 - 2.49	17896	1952	1651	1409	1142	989	904	868	959	1484	1781	2122	2635
2.5 - 3.49	30413	3613	2935	2047	1698	1597	1589	1544	1623	2568	3169	3900	4130
3.5 - 4.49	41013	4517	3221	2411	2667	2646	2617	2463	2517	3437	4513	4994	5010
4.5 - 5.49	43342	4399	2487	2506	3029	3033	3980	3822	3193	3460	4789	4118	4526
5.5 - 6.49	35857	3478	1742	1936	2238	2224	4369	4428	2958	2236	4477	2722	3049
6.5 - 7.49	23293	2553	1034	1201	1200	1142	3622	3483	1675	1044	3118	1461	1760
7.5 - 8.49	14368	1840	595	819	754	637	2598	1964	890	520	1977	668	1106
8.5 - 9.49	8340	1167	422	475	366	260	1414	997	510	250	1325	381	773
9.5 - 10.49	4954	653	252	322	155	141	741	591	286	137	967	222	487
10.5 - 11.49	3108	461	156	148	77	120	429	390	172	74	666	105	310
11.5 - 12.49	1680	218	81	70	66	72	176	231	164	33	360	62	147
12.5 - 13.49	889	99	49	51	34	27	69	123	144	27	194	24	48
13.5 - 14.49	456	71	39	21	8	5	26	69	92	10	87	14	14
14.5 - 15.49	208	37	4	3	1	3	10	34	56	1	52	3	4
15.5 - 16.49	96	16	0	1	0	0	1	18	41	1	18	0	0
16.5 - 17.49	28	2	0	0	0	0	2	5	8	0	11	0	0
17.5 - 18.49	19	0	0	0	0	0	0	2	10	0	7	0	0
18.5 - 19.49	15	0	0	1	0	0	0	1	3	2	8	0	0
19.5 - 20.49	5	0	0	0	0	0	0	2	0	0	3	0	0
20.5 - 21.49	2	0	0	0	0	0	0	1	0	1	0	0	0
21.5 - 22.49	0	0	0	0	0	0	0	0	0	0	0	0	0
22.5 - 23.49	0	0	0	0	0	0	0	0	0	0	0	0	0
23.5 - 24.49	0	0	0	0	0	0	0	0	0	0	0	0	0
24.5 - 25.49	0	0	0	0	0	0	0	0	0	0	0	0	0
25.5 - 26.49	0	0	0	0	0	0	0	0	0	0	0	0	0
26.5 - 27.49	0	0	0	0	0	0	0	0	0	0	0	0	0
27.5 - 28.49	0	0	0	0	0	0	0	0	0	0	0	0	0
28.5 - 29.49	0	0	0	0	0	0	0	0	0	0	0	0	0
29.5 - 30.49	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	233243	25768	15338	14018	13899	13399	22955	21454	15760	15839	28271	21688	24854

### 5.6.3 Wind Speed Distribution at 40.0 m, Wind Direction Distribution at 97.9 m, Weibull Fit at 40.0 m

Table 5.35: Weibull parameters, average wind speeds at 40.0 m per sector.

Sector	A-Parameter	Mean Wind Speed	k-Parameter	Frequency
	[m/s]	[m/s]	[-]	[%]
N	5.99	5.31	2.25	11.05
NNE	5.21	4.61	2.08	6.58
ENE	5.58	4.94	2.21	6.01
E	5.55	4.92	2.53	5.96
ESE	5.53	4.91	2.53	5.74
SSE	6.74	6.02	2.92	9.84
S	6.70	5.96	2.73	9.20
SSW	6.18	5.47	2.22	6.76
WSW	5.16	4.58	2.47	6.79
W	6.34	5.62	2.26	12.12
WNW	5.06	4.49	2.37	9.30
NNW	5.39	4.77	2.21	10.66
mean	5.86	5.19	2.31	100.00

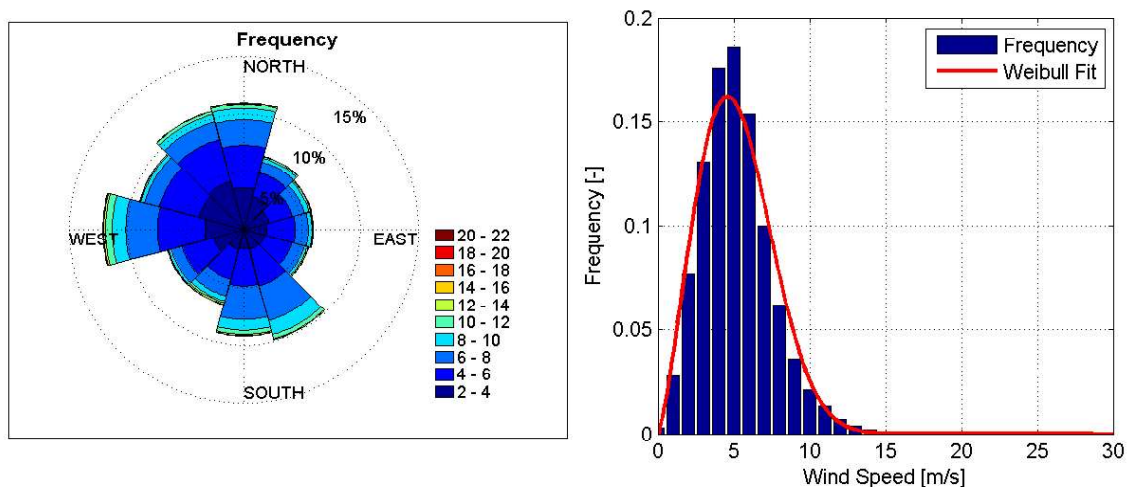


Figure 5.18: Frequency distribution of wind speeds at 40.0 m and of wind direction at 97.9 m

#### 5.6.4 Turbulence Intensity at 40.0 m

Table 5.36: Turbulence intensity per wind speed bin and per sector at 40.0 m

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.136	0.189	0.296	0.259	0.259	0.231	0.291	0.219	0.276	0.262	0.042	0.042	0.072
0.5 - 1.49	0.240	0.242	0.242	0.241	0.244	0.240	0.236	0.237	0.232	0.240	0.248	0.242	0.235
1.5 - 2.49	0.177	0.186	0.189	0.176	0.188	0.189	0.164	0.154	0.177	0.176	0.176	0.176	0.166
2.5 - 3.49	0.143	0.153	0.156	0.154	0.162	0.154	0.140	0.113	0.139	0.133	0.129	0.144	0.140
3.5 - 4.49	0.122	0.138	0.139	0.141	0.138	0.129	0.112	0.089	0.100	0.104	0.107	0.125	0.127
4.5 - 5.49	0.112	0.136	0.137	0.137	0.137	0.114	0.106	0.077	0.077	0.090	0.100	0.121	0.126
5.5 - 6.49	0.109	0.139	0.143	0.135	0.143	0.119	0.104	0.069	0.069	0.092	0.100	0.121	0.131
6.5 - 7.49	0.112	0.138	0.143	0.133	0.149	0.126	0.104	0.070	0.074	0.104	0.108	0.126	0.139
7.5 - 8.49	0.117	0.139	0.140	0.131	0.148	0.130	0.102	0.074	0.085	0.127	0.120	0.135	0.141
8.5 - 9.49	0.121	0.141	0.137	0.128	0.145	0.134	0.105	0.079	0.100	0.135	0.127	0.137	0.140
9.5 - 10.49	0.123	0.142	0.138	0.123	0.143	0.123	0.104	0.086	0.112	0.127	0.128	0.145	0.138
10.5 - 11.49	0.122	0.137	0.129	0.122	0.135	0.120	0.107	0.089	0.120	0.136	0.127	0.147	0.137
11.5 - 12.49	0.124	0.132	0.129	0.124	0.141	0.118	0.114	0.091	0.128	0.132	0.128	0.154	0.136
12.5 - 13.49	0.125	0.142	0.133	0.115	0.143	0.116	0.113	0.091	0.126	0.131	0.130	0.146	0.146
13.5 - 14.49	0.124	0.141	0.127	0.107	0.153	0.116	0.119	0.096	0.121	0.129	0.125	0.154	0.172
14.5 - 15.49	0.120	0.143	0.110	0.099	0.145	0.127	0.115	0.089	0.121	0.084	0.120	0.156	0.157
15.5 - 16.49	0.121	0.137		0.168			0.136	0.115	0.113	0.130	0.129		
16.5 - 17.49	0.127	0.131					0.120	0.124	0.109		0.142		
17.5 - 18.49	0.116							0.111	0.107		0.131		
18.5 - 19.49	0.140			0.190				0.138	0.142	0.150	0.130		
19.5 - 20.49	0.123							0.097			0.141		
20.5 - 21.49	0.128							0.118		0.138			
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.127	0.147	0.153	0.147	0.151	0.135	0.113	0.085	0.100	0.117	0.118	0.137	0.139
Measured Turbulence Intensity above 10 m/s: 0.123													

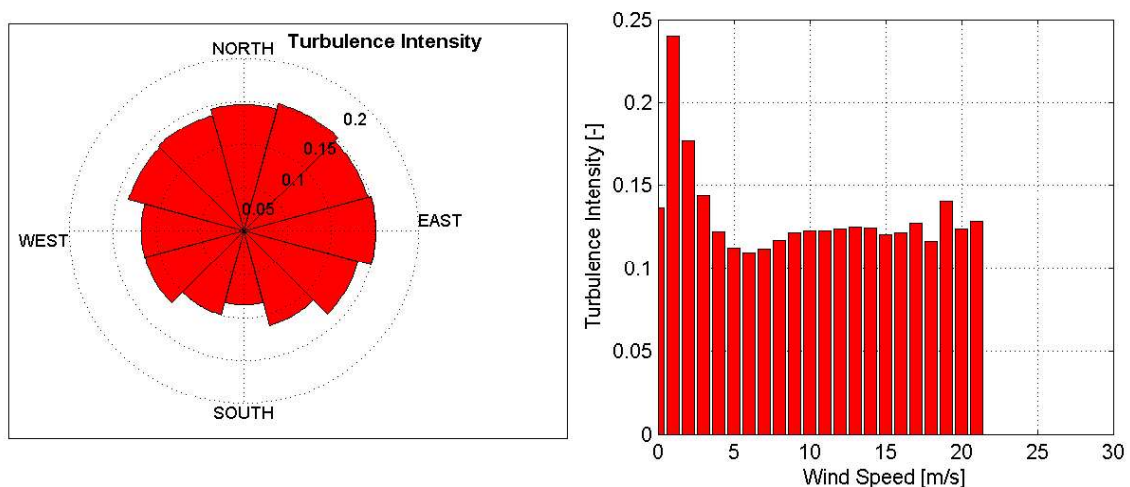


Figure 5.19: Sector dependent turbulence intensity at 40.0 m

### 5.6.5 Standard Deviation of Turbulence Intensity at 40.0 m

Table 5.37: Standard deviation of turbulence intensity at 40.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.157	0.174	0.129	0.128	0.133	0.119	0.135	0.106	0.123	0.115	0.105	0.097	0.125
0.5 - 1.49	0.141	0.143	0.140	0.144	0.141	0.146	0.138	0.127	0.130	0.132	0.141	0.156	0.139
1.5 - 2.49	0.120	0.122	0.129	0.125	0.124	0.124	0.123	0.097	0.115	0.122	0.115	0.116	0.117
2.5 - 3.49	0.096	0.097	0.099	0.103	0.108	0.112	0.104	0.071	0.092	0.093	0.089	0.090	0.092
3.5 - 4.49	0.077	0.078	0.080	0.088	0.087	0.085	0.077	0.049	0.071	0.075	0.070	0.070	0.071
4.5 - 5.49	0.063	0.061	0.063	0.072	0.067	0.067	0.060	0.039	0.056	0.056	0.058	0.055	0.059
5.5 - 6.49	0.055	0.047	0.048	0.054	0.052	0.053	0.053	0.030	0.049	0.052	0.049	0.049	0.048
6.5 - 7.49	0.048	0.038	0.037	0.042	0.039	0.044	0.047	0.029	0.046	0.047	0.043	0.041	0.039
7.5 - 8.49	0.044	0.031	0.031	0.036	0.034	0.036	0.043	0.030	0.049	0.041	0.040	0.036	0.034
8.5 - 9.49	0.040	0.030	0.027	0.028	0.032	0.041	0.038	0.026	0.046	0.036	0.033	0.035	0.032
9.5 - 10.49	0.035	0.030	0.028	0.028	0.032	0.024	0.032	0.026	0.039	0.030	0.030	0.036	0.027
10.5 - 11.49	0.033	0.024	0.027	0.033	0.030	0.030	0.030	0.021	0.043	0.042	0.026	0.026	0.027
11.5 - 12.49	0.032	0.021	0.020	0.039	0.031	0.020	0.028	0.018	0.038	0.032	0.027	0.039	0.030
12.5 - 13.49	0.030	0.017	0.017	0.018	0.024	0.023	0.029	0.017	0.033	0.025	0.029	0.024	0.027
13.5 - 14.49	0.030	0.020	0.029	0.012	0.011	0.023	0.015	0.020	0.028	0.027	0.019	0.067	0.034
14.5 - 15.49	0.030	0.019	0.006	0.015	0.000	0.011	0.017	0.028	0.031	0.000	0.019	0.040	0.012
15.5 - 16.49	0.027	0.019		0.000			0.000	0.027	0.026	0.000	0.028		
16.5 - 17.49	0.025	0.001					0.064	0.026	0.013		0.021		
17.5 - 18.49	0.024							0.028	0.026		0.012		
18.5 - 19.49	0.027			0.000				0.000	0.049	0.017	0.016		
19.5 - 20.49	0.027							0.020			0.011		
20.5 - 21.49	0.014							0.000		0.000			
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.080	0.075	0.087	0.087	0.083	0.086	0.069	0.054	0.078	0.084	0.072	0.081	0.078
Measured Standard Deviation of Turbulence Intensity above 10 m/s: 0.032													



### 5.6.6 Standard Deviation of Wind Speed at 40.0 m

Table 5.38: Standard deviation of wind speed at 40.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]
0 - 0.49	0.055	0.078	0.120	0.100	0.107	0.092	0.121	0.088	0.113	0.107	0.017	0.018	0.029
0.5 - 1.49	0.262	0.267	0.267	0.265	0.262	0.263	0.250	0.254	0.248	0.260	0.272	0.263	0.260
1.5 - 2.49	0.360	0.381	0.386	0.359	0.384	0.383	0.329	0.313	0.361	0.360	0.359	0.362	0.337
2.5 - 3.49	0.433	0.462	0.471	0.464	0.489	0.464	0.425	0.342	0.420	0.399	0.390	0.436	0.422
3.5 - 4.49	0.487	0.554	0.556	0.564	0.555	0.519	0.450	0.358	0.404	0.417	0.427	0.500	0.508
4.5 - 5.49	0.560	0.679	0.677	0.686	0.686	0.569	0.530	0.386	0.386	0.449	0.498	0.603	0.628
5.5 - 6.49	0.653	0.827	0.857	0.805	0.849	0.710	0.621	0.416	0.411	0.547	0.598	0.722	0.781
6.5 - 7.49	0.778	0.960	0.992	0.929	1.035	0.877	0.729	0.489	0.511	0.726	0.754	0.876	0.968
7.5 - 8.49	0.930	1.111	1.108	1.043	1.172	1.034	0.815	0.591	0.678	1.014	0.955	1.073	1.126
8.5 - 9.49	1.085	1.258	1.235	1.143	1.288	1.193	0.940	0.709	0.900	1.207	1.137	1.225	1.250
9.5 - 10.49	1.222	1.414	1.374	1.224	1.419	1.226	1.038	0.862	1.121	1.268	1.277	1.443	1.379
10.5 - 11.49	1.339	1.507	1.412	1.332	1.485	1.307	1.167	0.976	1.315	1.486	1.391	1.609	1.500
11.5 - 12.49	1.479	1.581	1.547	1.492	1.688	1.410	1.356	1.090	1.534	1.592	1.534	1.821	1.622
12.5 - 13.49	1.616	1.838	1.716	1.486	1.858	1.515	1.461	1.175	1.639	1.689	1.685	1.908	1.888
13.5 - 14.49	1.730	1.973	1.772	1.485	2.095	1.645	1.658	1.334	1.683	1.806	1.745	2.161	2.398
14.5 - 15.49	1.791	2.135	1.609	1.467	2.124	1.853	1.719	1.334	1.815	1.217	1.793	2.298	2.368
15.5 - 16.49	1.930	2.171		2.763			2.141	1.822	1.803	2.046	2.048		
16.5 - 17.49	2.171	2.200					2.034	2.114	1.854		2.447		
17.5 - 18.49	2.077							1.987	1.909		2.344		
18.5 - 19.49	2.632			3.518				2.581	2.665	2.876	2.455		
19.5 - 20.49	2.450							1.934			2.794		
20.5 - 21.49	2.693							2.475		2.910			
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.623	0.750	0.666	0.683	0.717	0.625	0.646	0.473	0.503	0.499	0.643	0.588	0.645

### 5.6.7 Standard Deviation of Standard Deviation of Wind Speed at 40.0 m

Table 5.39: Standard deviation of standard deviation of wind speed at 40.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]
0 - 0.49	0.066	0.078	0.059	0.056	0.059	0.053	0.065	0.048	0.056	0.049	0.044	0.043	0.051
0.5 - 1.49	0.163	0.163	0.169	0.173	0.168	0.181	0.155	0.148	0.154	0.153	0.163	0.160	0.160
1.5 - 2.49	0.245	0.250	0.264	0.254	0.259	0.252	0.250	0.193	0.235	0.251	0.236	0.239	0.237
2.5 - 3.49	0.288	0.291	0.298	0.309	0.323	0.337	0.313	0.212	0.274	0.276	0.264	0.270	0.278
3.5 - 4.49	0.306	0.310	0.318	0.346	0.350	0.340	0.305	0.198	0.283	0.297	0.280	0.278	0.284
4.5 - 5.49	0.314	0.305	0.312	0.357	0.337	0.335	0.300	0.193	0.277	0.279	0.290	0.278	0.295
5.5 - 6.49	0.328	0.283	0.291	0.321	0.313	0.318	0.318	0.182	0.295	0.313	0.293	0.295	0.288
6.5 - 7.49	0.339	0.264	0.258	0.299	0.273	0.306	0.326	0.206	0.327	0.331	0.306	0.287	0.273
7.5 - 8.49	0.353	0.247	0.247	0.279	0.269	0.289	0.341	0.238	0.392	0.334	0.323	0.285	0.274
8.5 - 9.49	0.355	0.265	0.248	0.249	0.291	0.366	0.345	0.232	0.420	0.330	0.302	0.312	0.283
9.5 - 10.49	0.351	0.300	0.288	0.273	0.320	0.240	0.315	0.256	0.388	0.298	0.302	0.358	0.267
10.5 - 11.49	0.359	0.267	0.290	0.375	0.328	0.333	0.333	0.233	0.480	0.474	0.288	0.293	0.291
11.5 - 12.49	0.380	0.246	0.232	0.477	0.381	0.244	0.334	0.219	0.465	0.393	0.322	0.448	0.361
12.5 - 13.49	0.394	0.230	0.221	0.234	0.322	0.288	0.384	0.220	0.433	0.321	0.371	0.336	0.373
13.5 - 14.49	0.429	0.289	0.397	0.169	0.133	0.333	0.206	0.290	0.396	0.378	0.269	0.980	0.488
14.5 - 15.49	0.444	0.285	0.075	0.242	0.000	0.157	0.251	0.406	0.473	0.000	0.279	0.593	0.191
15.5 - 16.49	0.427	0.305		0.000			0.000	0.424	0.411	0.000	0.443		
16.5 - 17.49	0.439	0.032					1.072	0.442	0.230		0.348		
17.5 - 18.49	0.427							0.504	0.469		0.202		
18.5 - 19.49	0.498			0.000				0.000	0.884	0.383	0.293		
19.5 - 20.49	0.538							0.433			0.208		
20.5 - 21.49	0.308							0.000		0.000			
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.401	0.427	0.402	0.408	0.419	0.389	0.379	0.274	0.411	0.359	0.431	0.369	0.408

### 5.6.8 Ambient Characteristic Turbulence Intensity According to IEC 61400-1, Edition 2 at 40.0 m

Table 5.40: Ambient characteristic turbulence intensity at 40.0 m as function of wind speed according to IEC 61400-1; Edition 2

Wind Speed	I1	Class A	Class B	Frequency
[m/s]	[-]	[-]	[-]	[-]
0 - 0.49	0.293	2.793	1.902	724
0.5 - 1.49	0.381	0.925	0.657	6537
1.5 - 2.49	0.297	0.557	0.411	17896
2.5 - 3.49	0.239	0.417	0.318	30413
3.5 - 4.49	0.198	0.344	0.269	41013
4.5 - 5.49	0.175	0.300	0.240	43342
5.5 - 6.49	0.164	0.271	0.221	35857
6.5 - 7.49	0.160	0.249	0.206	23293
7.5 - 8.49	0.161	0.233	0.195	14368
8.5 - 9.49	0.161	0.221	0.187	8340
9.5 - 10.49	0.158	0.210	0.180	4954
10.5 - 11.49	0.155	0.202	0.175	3108
11.5 - 12.49	0.155	0.195	0.170	1680
12.5 - 13.49	0.155	0.189	0.166	889
13.5 - 14.49	0.155	0.185	0.163	456
14.5 - 15.49	0.149	0.180	0.160	208
15.5 - 16.49	0.148	0.177	0.158	96
16.5 - 17.49	0.152	0.173	0.155	28
17.5 - 18.49	0.140	0.170	0.154	19
18.5 - 19.49	0.167	0.168	0.152	15
19.5 - 20.49	0.151	0.165	0.150	5
20.5 - 21.49	0.142	0.163	0.148	2
21.5 - 22.49				0
22.5 - 23.49				0
23.5 - 24.49				0
24.5 - 25.49				0
25.5 - 26.49				0
26.5 - 27.49				0
27.5 - 28.49				0
28.5 - 29.49				0
29.5 - 30.49				0
Ambient Characteristic turbulence intensity at 15 m/s determined from measurement above 10 m/s (I 15): 0.155				

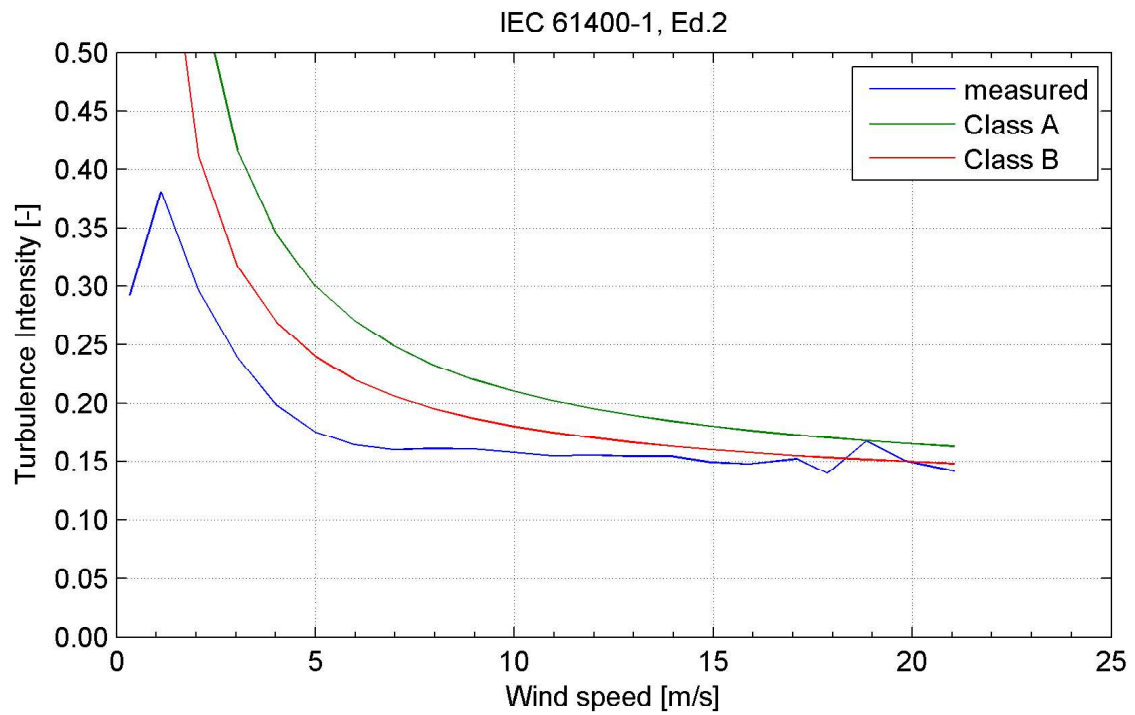


Figure 5.20: Ambient characteristic turbulence intensity at 40.0 m according to IEC 61400-1, Edition 2

### 5.6.9 Ambient Representative Turbulence Intensity According to IEC 61400-1, Edition 3 at 40.0 m

Table 5.41: Ambient representative turbulence intensity at 40.0 m as function of wind speed according to IEC 61400-1; Edition 3

Wind Speed	II	Class A	Class B	Class C	Frequency
[m/s]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.417	2.781	2.433	2.086	724
0.5 - 1.49	0.421	0.922	0.806	0.691	6537
1.5 - 2.49	0.327	0.555	0.486	0.416	17896
2.5 - 3.49	0.264	0.415	0.363	0.311	30413
3.5 - 4.49	0.219	0.343	0.300	0.257	41013
4.5 - 5.49	0.193	0.299	0.262	0.225	43342
5.5 - 6.49	0.180	0.270	0.236	0.203	35857
6.5 - 7.49	0.174	0.249	0.218	0.187	23293
7.5 - 8.49	0.174	0.233	0.204	0.174	14368
8.5 - 9.49	0.172	0.220	0.193	0.165	8340
9.5 - 10.49	0.168	0.210	0.184	0.157	4954
10.5 - 11.49	0.164	0.202	0.177	0.151	3108
11.5 - 12.49	0.164	0.195	0.171	0.146	1680
12.5 - 13.49	0.164	0.189	0.166	0.142	889
13.5 - 14.49	0.164	0.184	0.161	0.138	456
14.5 - 15.49	0.158	0.180	0.158	0.135	208
15.5 - 16.49	0.156	0.176	0.154	0.132	96
16.5 - 17.49	0.160	0.172	0.151	0.129	28
17.5 - 18.49	0.147	0.170	0.149	0.128	19
18.5 - 19.49	0.173	0.168	0.147	0.126	15
19.5 - 20.49	0.158	0.165	0.145	0.124	5
20.5 - 21.49	0.147	0.163	0.142	0.122	2
21.5 - 22.49					0
22.5 - 23.49					0
23.5 - 24.49					0
24.5 - 25.49					0
25.5 - 26.49					0
26.5 - 27.49					0
27.5 - 28.49					0
28.5 - 29.49					0
29.5 - 30.49					0

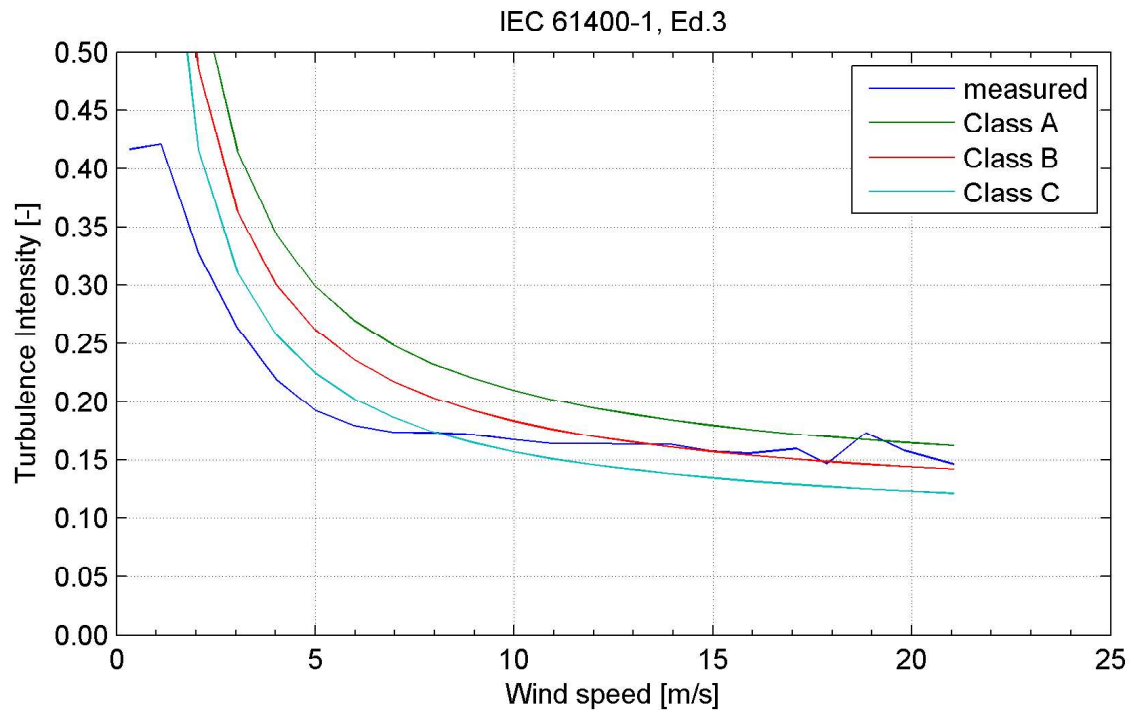


Figure 5.21: Ambient representative turbulence intensity at 40.0 m according to IEC 61400-1, Edition 3

### 5.6.10 Extreme Values of Wind Speed at 40.0 m

Table 5.42: Monthly averages and extreme values of wind speed at 40.0 m (continued)

month	n	v-average	v-max 10 minutes	v-max 1 second
[-]	[-]	[m/s]	[m/s]	[m/s]
02.09	2022	4.86	14.5	17.8
03.09	4460	5.92	21.0	27.5
04.09	4320	5.39	13.6	17.9
05.09	4464	4.60	11.8	15.6
06.09	4320	4.82	13.8	19.6
07.09	4464	4.50	14.4	19.8
08.09	4464	4.23	12.1	23.9
09.09	4320	4.77	11.3	15.3
10.09	4464	5.15	14.8	19.8
11.09	4320	5.00	15.1	18.6
12.09	3598	6.17	15.3	20.9
01.10	3261	5.60	14.0	16.7
02.10	4032	6.04	15.5	20.0
03.10	4372	5.88	13.9	19.1
04.10	4320	5.17	14.8	20.1
05.10	4453	5.05	12.7	18.0
06.10	899	4.55	13.0	18.9
07.10	4320	4.49	18.6	24.4
08.10	4464	4.49	11.0	16.4
09.10	4320	5.22	14.6	19.3
10.10	4464	5.19	11.9	18.7
11.10	4320	6.07	19.2	25.0
12.10	3685	6.18	15.9	21.8
01.11	3356	4.45	13.3	16.7
02.11	3156	5.43	20.3	27.2
03.11	4109	5.50	13.7	18.4
04.11	4212	5.38	14.3	20.2
05.11	4435	4.80	12.5	18.8
06.11	4320	4.81	14.6	22.6
07.11	4464	4.45	12.0	18.8
08.11	4464	4.77	12.3	17.4
09.11	4320	4.65	13.8	18.5
10.11	4464	5.00	16.9	23.1
11.11	3863	4.08	9.5	11.7
12.11	4290	5.21	16.3	19.3



Table 5.42: Monthly averages and extreme values of wind speed at 40.0 m (end)

month	n	v-average	v-max 10 minutes	v-max 1 second
[-]	[-]	[m/s]	[m/s]	[m/s]
01.12	4464	6.72	15.5	19.8
02.12	2768	5.34	13.6	18.3
03.12	4464	5.31	15.9	20.5
04.12	4320	6.27	16.5	21.2
05.12	4464	4.68	13.0	17.2
06.12	4320	4.33	11.4	19.7
07.12	4446	4.87	14.6	23.9
08.12	4464	4.90	14.8	20.8
09.12	4318	4.85	13.4	17.3
10.12	4464	5.08	15.7	20.8
11.12	4286	4.77	18.6	23.5
12.12	4464	5.66	21.1	29.9
01.13	4327	6.25	17.0	20.7
02.13	3977	6.33	17.7	22.0
03.13	4391	6.20	17.8	25.9
04.13	4320	6.05	14.4	18.3
05.13	4464	5.27	15.1	22.2
06.13	4320	4.83	10.9	18.3
07.13	4464	4.52	15.0	20.2
08.13	4464	4.55	10.3	14.6
09.13	4320	5.48	14.6	19.4
10.13	1375	6.13	13.9	20.2
complete period	233243	5.19	21.1	29.9

## 5.7 Measurement Height 25.0 m

### 5.7.1 Averages of Wind Speed and Time Series at 25.0 m

Table 5.43: Monthly averages at measurement height 25.0 m

Monthly mean values of wind speed in m/s							
Month	2009	2010	2011	2012	2013	mean	mean of months
January		5.21	3.87	5.97	5.37	5.18	5.11
February	4.39	5.21	4.80	4.75	5.65	5.06	4.96
March	5.32	5.18	4.94	4.71	5.56	5.14	5.14
April	4.73	4.53	4.79	5.57	5.35	5.00	5.00
May	4.05	4.41	4.24	4.16	4.58	4.29	4.29
June	4.14	3.85	4.15	3.68	4.19	4.00	4.00
July	3.82	3.91	3.89	4.08	3.89	3.92	3.92
August	3.50	3.87	4.09	4.12	3.88	3.89	3.89
September	4.05	4.63	3.89	4.11	4.89	4.31	4.31
October	4.55	4.54	4.36	4.39	5.32	4.52	4.63
November	4.38	5.23	3.52	4.08		4.32	4.30
December	5.37	5.31	4.49	4.99		5.02	5.04
mean, all data	4.37	4.64	4.25	4.55	4.82	4.52	
mean of months	4.39	4.66	4.25	4.55	4.87		4.55

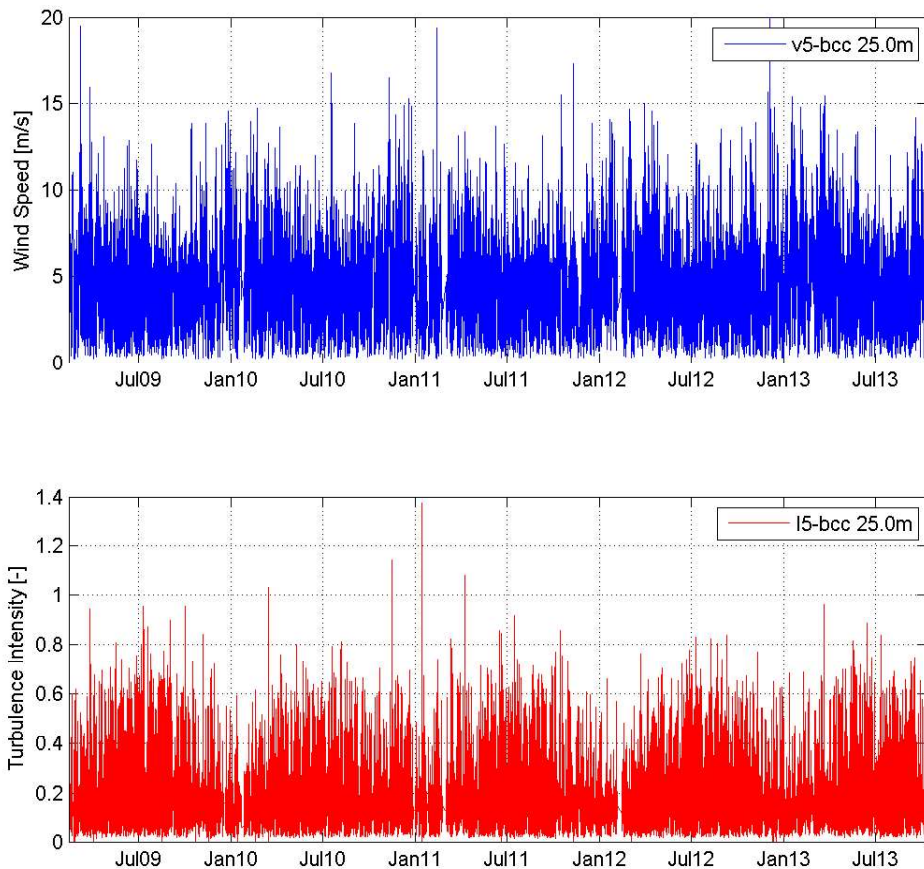


Figure 5.22: Wind speed, turbulence intensity and time series at measurement height 25.0 m

### 5.7.2 Joint Probability Distribution of Wind Speeds at 25.0 m and Wind Directions at 97.9 m

Table 5.44: Number of datasets per wind speed bin and per sector at 25.0 m

Wind Speed	Sum	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	856	64	61	79	59	39	19	15	27	40	161	181	111
0.5 - 1.49	10144	1050	1114	1020	738	645	544	487	588	786	864	1078	1230
1.5 - 2.49	28631	3048	2572	1896	1753	1716	1598	1727	1707	2640	2824	3335	3815
2.5 - 3.49	45108	4674	3345	2235	2715	3056	2979	3602	3671	3987	4193	5134	5517
3.5 - 4.49	48172	4753	2790	2406	3065	3299	4067	4680	4319	3891	4947	4871	5084
4.5 - 5.49	38683	3969	2018	2356	2564	2283	4580	4218	2644	2444	4676	3341	3590
5.5 - 6.49	26075	3114	1521	1619	1509	1287	3826	2871	1265	1047	3720	1949	2347
6.5 - 7.49	16454	2211	839	1084	940	664	2810	1753	647	592	2384	1034	1496
7.5 - 8.49	9821	1555	531	703	435	310	1495	900	356	323	1641	518	1054
8.5 - 9.49	5850	794	385	433	150	173	814	576	224	165	1174	295	667
9.5 - 10.49	3643	527	196	245	81	111	428	433	195	100	832	138	357
10.5 - 11.49	1914	264	80	79	61	44	185	228	158	44	529	82	160
11.5 - 12.49	952	113	64	62	23	18	75	115	100	32	274	26	50
12.5 - 13.49	462	76	37	34	2	6	26	52	57	15	131	16	10
13.5 - 14.49	183	37	14	3	0	0	8	17	24	5	66	6	3
14.5 - 15.49	70	12	0	1	0	0	3	10	13	0	31	0	0
15.5 - 16.49	16	0	0	0	0	0	0	4	4	0	8	0	0
16.5 - 17.49	17	0	0	2	0	0	0	2	0	0	13	0	0
17.5 - 18.49	13	0	0	0	0	0	0	2	0	2	9	0	0
18.5 - 19.49	4	0	0	0	0	0	0	1	0	0	3	0	0
19.5 - 20.49	1	0	0	0	0	0	0	0	0	1	0	0	0
20.5 - 21.49	0	0	0	0	0	0	0	0	0	0	0	0	0
21.5 - 22.49	0	0	0	0	0	0	0	0	0	0	0	0	0
22.5 - 23.49	0	0	0	0	0	0	0	0	0	0	0	0	0
23.5 - 24.49	0	0	0	0	0	0	0	0	0	0	0	0	0
24.5 - 25.49	0	0	0	0	0	0	0	0	0	0	0	0	0
25.5 - 26.49	0	0	0	0	0	0	0	0	0	0	0	0	0
26.5 - 27.49	0	0	0	0	0	0	0	0	0	0	0	0	0
27.5 - 28.49	0	0	0	0	0	0	0	0	0	0	0	0	0
28.5 - 29.49	0	0	0	0	0	0	0	0	0	0	0	0	0
29.5 - 30.49	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	237069	26261	15567	14257	14095	13651	23457	21693	15999	16114	28480	22004	25491

### 5.7.3 Wind Speed Distribution at 25.0 m, Wind Direction Distribution at 97.9 m, Weibull Fit at 25.0 m

Table 5.45: Weibull parameters, average wind speeds at 25.0 m per sector.

Sector	A-Parameter	Mean Wind Speed	k-Parameter	Frequency
	[m/s]	[m/s]	[-]	[%]
N	5.37	4.76	2.12	11.08
NNE	4.67	4.15	1.91	6.57
ENE	5.09	4.51	2.03	6.01
E	4.78	4.24	2.34	5.95
ESE	4.64	4.11	2.33	5.76
SSE	5.83	5.18	2.65	9.89
S	5.51	4.88	2.33	9.15
SSW	4.84	4.29	2.04	6.75
WSW	4.38	3.88	2.17	6.80
W	5.79	5.13	2.08	12.01
WNW	4.51	4.00	2.18	9.28
NNW	4.82	4.27	2.07	10.75
mean	5.10	4.52	2.12	100.00

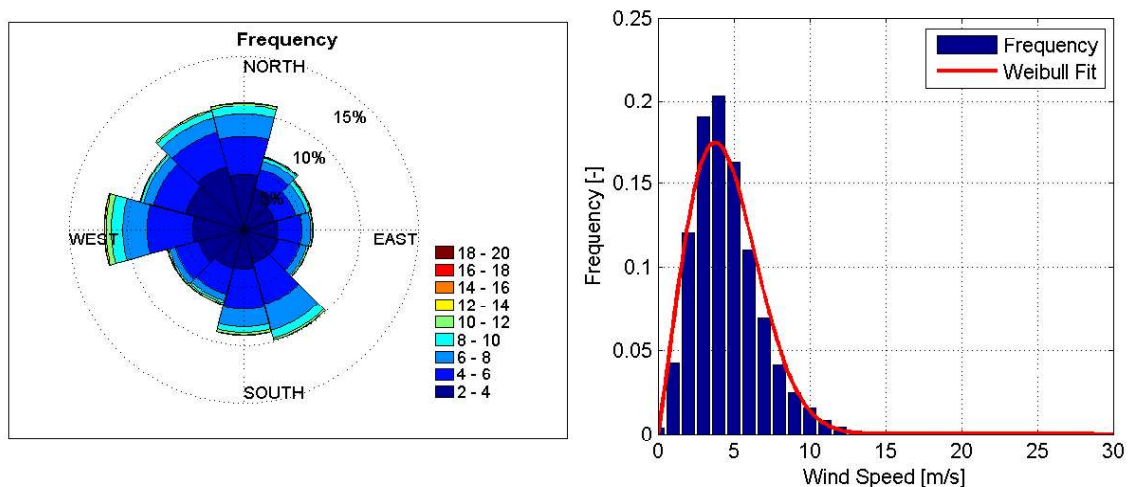


Figure 5.23: Frequency distribution of wind speeds at 25.0 m and of wind direction at 97.9 m

### 5.7.4 Turbulence Intensity at 25.0 m

Table 5.46: Turbulence intensity per wind speed bin and per sector at 25.0 m

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.171	0.212	0.299	0.271	0.290	0.270	0.265	0.231	0.299	0.283	0.063	0.077	0.121
0.5 - 1.49	0.229	0.225	0.220	0.210	0.226	0.228	0.240	0.222	0.235	0.248	0.251	0.233	0.222
1.5 - 2.49	0.170	0.173	0.174	0.170	0.182	0.177	0.165	0.151	0.187	0.171	0.167	0.169	0.159
2.5 - 3.49	0.147	0.156	0.164	0.167	0.165	0.155	0.142	0.121	0.149	0.137	0.130	0.146	0.148
3.5 - 4.49	0.140	0.160	0.167	0.158	0.175	0.161	0.131	0.111	0.125	0.120	0.114	0.139	0.150
4.5 - 5.49	0.140	0.160	0.160	0.161	0.186	0.174	0.137	0.109	0.120	0.118	0.108	0.140	0.154
5.5 - 6.49	0.142	0.155	0.156	0.152	0.183	0.179	0.140	0.105	0.141	0.129	0.115	0.144	0.155
6.5 - 7.49	0.142	0.152	0.150	0.145	0.177	0.178	0.139	0.105	0.159	0.138	0.123	0.143	0.152
7.5 - 8.49	0.143	0.151	0.143	0.139	0.174	0.171	0.136	0.111	0.171	0.151	0.132	0.146	0.151
8.5 - 9.49	0.140	0.148	0.142	0.134	0.167	0.159	0.134	0.110	0.177	0.142	0.134	0.149	0.150
9.5 - 10.49	0.139	0.146	0.136	0.130	0.174	0.153	0.132	0.114	0.180	0.142	0.133	0.152	0.147
10.5 - 11.49	0.140	0.139	0.132	0.127	0.164	0.152	0.139	0.116	0.182	0.137	0.133	0.158	0.145
11.5 - 12.49	0.141	0.145	0.137	0.125	0.165	0.152	0.140	0.117	0.176	0.137	0.135	0.144	0.156
12.5 - 13.49	0.138	0.145	0.129	0.113	0.167	0.152	0.140	0.122	0.175	0.133	0.129	0.143	0.176
13.5 - 14.49	0.139	0.150	0.118	0.100			0.141	0.120	0.166	0.134	0.127	0.197	0.167
14.5 - 15.49	0.139	0.141		0.174			0.128	0.132	0.169		0.127		
15.5 - 16.49	0.149							0.139	0.187		0.135		
16.5 - 17.49	0.134			0.089				0.129			0.141		
17.5 - 18.49	0.139							0.144		0.160	0.134		
18.5 - 19.49	0.138							0.128			0.142		
19.5 - 20.49	0.156									0.156			
20.5 - 21.49													
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.149	0.161	0.167	0.162	0.180	0.170	0.142	0.117	0.147	0.141	0.128	0.151	0.155
Measured Turbulence Intensity above 10 m/s: 0.139													

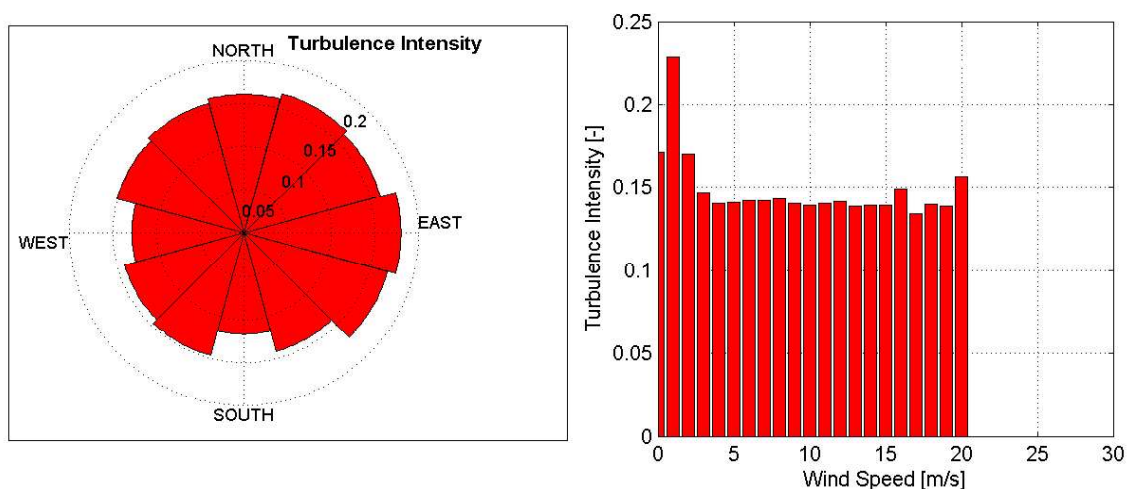


Figure 5.24: Sector dependent turbulence intensity at 25.0 m

### 5.7.5 Standard Deviation of Turbulence Intensity at 25.0 m

Table 5.47: Standard deviation of turbulence intensity at 25.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.176	0.171	0.138	0.129	0.121	0.137	0.129	0.095	0.155	0.144	0.134	0.149	0.186
0.5 - 1.49	0.132	0.139	0.127	0.134	0.142	0.133	0.126	0.115	0.118	0.134	0.139	0.128	0.130
1.5 - 2.49	0.112	0.117	0.122	0.121	0.118	0.114	0.110	0.084	0.100	0.112	0.112	0.109	0.106
2.5 - 3.49	0.088	0.094	0.099	0.105	0.095	0.095	0.091	0.058	0.070	0.081	0.087	0.088	0.086
3.5 - 4.49	0.071	0.072	0.077	0.084	0.069	0.077	0.070	0.042	0.063	0.069	0.070	0.067	0.066
4.5 - 5.49	0.061	0.053	0.058	0.068	0.049	0.059	0.062	0.039	0.061	0.058	0.061	0.056	0.052
5.5 - 6.49	0.051	0.041	0.047	0.049	0.037	0.046	0.055	0.037	0.057	0.054	0.049	0.045	0.039
6.5 - 7.49	0.044	0.034	0.037	0.041	0.031	0.037	0.049	0.035	0.043	0.045	0.045	0.034	0.033
7.5 - 8.49	0.038	0.031	0.029	0.034	0.029	0.034	0.042	0.030	0.034	0.042	0.038	0.033	0.033
8.5 - 9.49	0.034	0.030	0.027	0.027	0.027	0.032	0.036	0.023	0.036	0.033	0.033	0.033	0.028
9.5 - 10.49	0.033	0.026	0.030	0.032	0.036	0.024	0.033	0.024	0.033	0.042	0.028	0.033	0.025
10.5 - 11.49	0.032	0.021	0.021	0.040	0.023	0.025	0.029	0.023	0.031	0.032	0.026	0.037	0.029
11.5 - 12.49	0.030	0.018	0.024	0.019	0.016	0.018	0.027	0.021	0.026	0.025	0.029	0.023	0.033
12.5 - 13.49	0.028	0.019	0.018	0.015	0.024	0.009	0.018	0.030	0.026	0.030	0.019	0.020	0.035
13.5 - 14.49	0.032	0.019	0.008	0.013			0.013	0.034	0.021	0.023	0.018	0.092	0.005
14.5 - 15.49	0.028	0.017		0.000			0.047	0.030	0.021		0.022		
15.5 - 16.49	0.035							0.006	0.045		0.024		
16.5 - 17.49	0.039			0.125				0.028			0.016		
17.5 - 18.49	0.018							0.011		0.015	0.017		
18.5 - 19.49	0.009							0.000			0.006		
19.5 - 20.49	0.000									0.000			
20.5 - 21.49													
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.080	0.078	0.090	0.089	0.081	0.084	0.072	0.053	0.075	0.087	0.077	0.083	0.078
Measured Standard Deviation of Turbulence Intensity above 10 m/s: 0.031													

### 5.7.6 Standard Deviation of Wind Speed at 25.0 m

Table 5.48: Standard deviation of wind speed at 25.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]
0 - 0.49	0.070	0.087	0.129	0.108	0.118	0.106	0.109	0.093	0.130	0.117	0.027	0.031	0.050
0.5 - 1.49	0.251	0.246	0.235	0.225	0.245	0.249	0.259	0.240	0.264	0.273	0.279	0.258	0.248
1.5 - 2.49	0.346	0.352	0.355	0.344	0.370	0.363	0.337	0.310	0.383	0.350	0.339	0.348	0.323
2.5 - 3.49	0.443	0.468	0.493	0.502	0.500	0.472	0.430	0.366	0.449	0.410	0.390	0.437	0.445
3.5 - 4.49	0.558	0.641	0.665	0.629	0.701	0.640	0.527	0.443	0.496	0.478	0.455	0.553	0.597
4.5 - 5.49	0.698	0.794	0.798	0.802	0.922	0.863	0.685	0.542	0.594	0.584	0.539	0.697	0.768
5.5 - 6.49	0.845	0.927	0.931	0.906	1.087	1.064	0.839	0.628	0.836	0.765	0.685	0.854	0.924
6.5 - 7.49	0.987	1.059	1.042	1.014	1.232	1.230	0.970	0.734	1.106	0.961	0.859	0.995	1.059
7.5 - 8.49	1.135	1.199	1.141	1.099	1.380	1.356	1.083	0.878	1.363	1.195	1.054	1.163	1.203
8.5 - 9.49	1.256	1.322	1.276	1.206	1.482	1.438	1.198	0.987	1.585	1.264	1.206	1.337	1.343
9.5 - 10.49	1.381	1.453	1.352	1.289	1.728	1.522	1.313	1.135	1.792	1.412	1.324	1.510	1.459
10.5 - 11.49	1.530	1.518	1.439	1.387	1.814	1.666	1.514	1.263	2.000	1.511	1.461	1.733	1.586
11.5 - 12.49	1.683	1.734	1.642	1.501	1.958	1.812	1.674	1.401	2.101	1.645	1.620	1.733	1.847
12.5 - 13.49	1.786	1.879	1.685	1.458	2.110	1.994	1.792	1.573	2.269	1.704	1.668	1.856	2.257
13.5 - 14.49	1.926	2.090	1.621	1.377			1.961	1.671	2.305	1.857	1.764	2.702	2.313
14.5 - 15.49	2.071	2.098		2.603			1.917	1.981	2.530		1.894		
15.5 - 16.49	2.391							2.239	2.991		2.166		
16.5 - 17.49	2.255			1.494				2.179			2.383		
17.5 - 18.49	2.513							2.607		2.924	2.401		
18.5 - 19.49	2.664							2.489			2.722		
19.5 - 20.49	3.115									3.115			
20.5 - 21.49													
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.650	0.742	0.659	0.691	0.754	0.693	0.717	0.547	0.618	0.517	0.637	0.584	0.651



### 5.7.7 Standard Deviation of Standard Deviation of Wind Speed at 25.0 m

Table 5.49: Standard deviation of standard deviation of wind speed at 25.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]	[m/s]
0 - 0.49	0.075	0.074	0.062	0.058	0.056	0.062	0.058	0.044	0.074	0.061	0.059	0.062	0.078
0.5 - 1.49	0.152	0.155	0.144	0.158	0.168	0.155	0.149	0.132	0.144	0.151	0.155	0.144	0.150
1.5 - 2.49	0.228	0.242	0.250	0.246	0.242	0.233	0.222	0.165	0.203	0.228	0.229	0.227	0.216
2.5 - 3.49	0.266	0.284	0.298	0.321	0.290	0.289	0.277	0.173	0.209	0.243	0.260	0.266	0.258
3.5 - 4.49	0.286	0.291	0.309	0.336	0.280	0.308	0.287	0.168	0.250	0.270	0.280	0.269	0.265
4.5 - 5.49	0.307	0.266	0.291	0.337	0.243	0.296	0.315	0.194	0.303	0.292	0.303	0.279	0.259
5.5 - 6.49	0.308	0.245	0.281	0.292	0.227	0.276	0.332	0.219	0.344	0.324	0.296	0.269	0.236
6.5 - 7.49	0.310	0.240	0.254	0.290	0.221	0.257	0.343	0.248	0.309	0.315	0.316	0.240	0.236
7.5 - 8.49	0.305	0.252	0.232	0.265	0.239	0.272	0.335	0.236	0.271	0.331	0.303	0.269	0.263
8.5 - 9.49	0.307	0.276	0.254	0.243	0.242	0.298	0.320	0.213	0.321	0.291	0.299	0.301	0.256
9.5 - 10.49	0.328	0.253	0.296	0.324	0.362	0.238	0.331	0.243	0.339	0.431	0.279	0.327	0.249
10.5 - 11.49	0.351	0.227	0.232	0.440	0.260	0.268	0.319	0.251	0.352	0.330	0.291	0.396	0.319
11.5 - 12.49	0.358	0.220	0.299	0.226	0.191	0.208	0.326	0.252	0.319	0.300	0.353	0.306	0.408
12.5 - 13.49	0.366	0.245	0.231	0.183	0.309	0.117	0.228	0.385	0.351	0.389	0.250	0.237	0.490
13.5 - 14.49	0.434	0.262	0.111	0.203			0.188	0.483	0.285	0.331	0.253	1.231	0.034
14.5 - 15.49	0.425	0.252		0.000			0.705	0.460	0.308		0.345		
15.5 - 16.49	0.548							0.127	0.683		0.401		
16.5 - 17.49	0.651			2.099				0.493			0.250		
17.5 - 18.49	0.334							0.153		0.342	0.302		
18.5 - 19.49	0.149							0.000			0.113		
19.5 - 20.49	0.000									0.000			
20.5 - 21.49													
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.405	0.419	0.403	0.416	0.418	0.417	0.410	0.297	0.442	0.348	0.432	0.367	0.398

### 5.7.8 Ambient Characteristic Turbulence Intensity According to IEC 61400-1, Edition 2 at 25.0 m

Table 5.50: Ambient characteristic turbulence intensity at 25.0 m as function of wind speed according to IEC 61400-1; Edition 2

Wind Speed	I1	Class A	Class B	Frequency
[m/s]	[-]	[-]	[-]	[-]
0 - 0.49	0.347	2.736	1.864	856
0.5 - 1.49	0.361	0.919	0.653	10144
1.5 - 2.49	0.281	0.557	0.411	28631
2.5 - 3.49	0.235	0.418	0.319	45108
3.5 - 4.49	0.211	0.345	0.270	48172
4.5 - 5.49	0.202	0.301	0.241	38683
5.5 - 6.49	0.193	0.271	0.221	26075
6.5 - 7.49	0.186	0.249	0.206	16454
7.5 - 8.49	0.181	0.233	0.195	9821
8.5 - 9.49	0.174	0.220	0.187	5850
9.5 - 10.49	0.172	0.210	0.180	3643
10.5 - 11.49	0.172	0.202	0.175	1914
11.5 - 12.49	0.170	0.195	0.170	952
12.5 - 13.49	0.166	0.190	0.166	462
13.5 - 14.49	0.170	0.185	0.163	183
14.5 - 15.49	0.167	0.180	0.160	70
15.5 - 16.49	0.184	0.176	0.157	16
16.5 - 17.49	0.173	0.173	0.156	17
17.5 - 18.49	0.157	0.170	0.153	13
18.5 - 19.49	0.147	0.167	0.151	4
19.5 - 20.49	0.156	0.165	0.150	1
20.5 - 21.49				0
21.5 - 22.49				0
22.5 - 23.49				0
23.5 - 24.49				0
24.5 - 25.49				0
25.5 - 26.49				0
26.5 - 27.49				0
27.5 - 28.49				0
28.5 - 29.49				0
29.5 - 30.49				0
Ambient Characteristic turbulence intensity at 15 m/s determined from measurement above 10 m/s (I 15): 0.171				

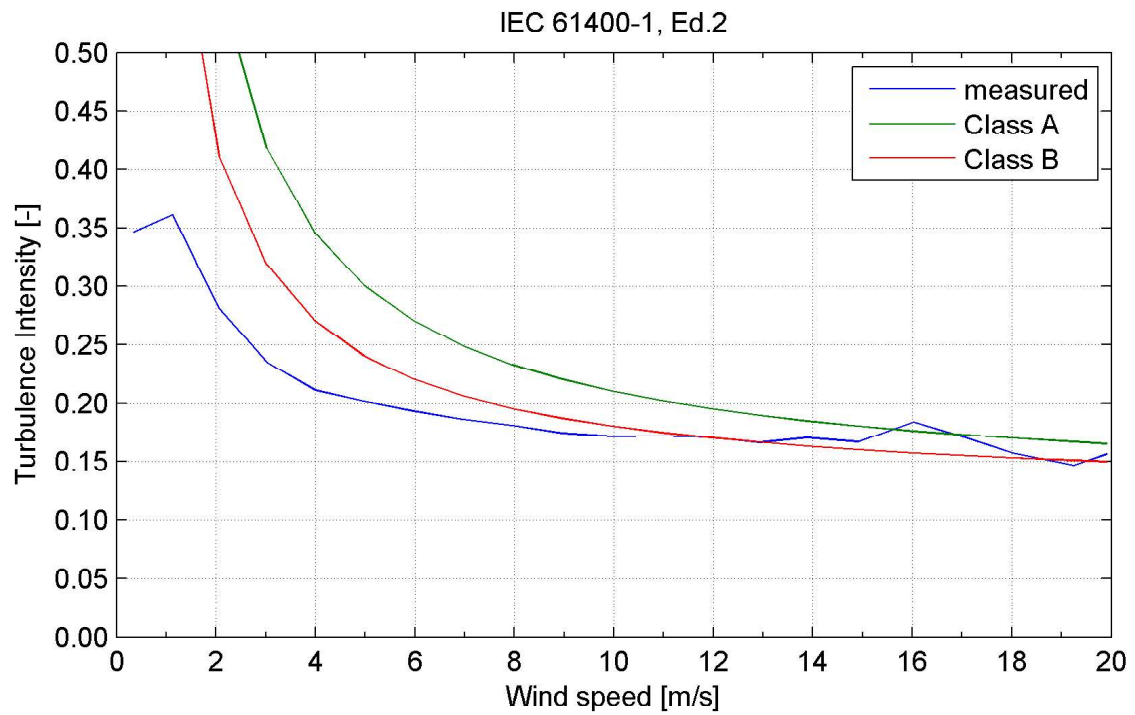


Figure 5.25: Ambient characteristic turbulence intensity at 25.0 m according to IEC 61400-1, Edition 2

### 5.7.9 Ambient Representative Turbulence Intensity According to IEC 61400-1, Edition 3 at 25.0 m

Table 5.51: Ambient representative turbulence intensity at 25.0 m as function of wind speed according to IEC 61400-1; Edition 3

Wind Speed	II	Class A	Class B	Class C	Frequency
[m/s]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.484	2.724	2.384	2.043	856
0.5 - 1.49	0.395	0.916	0.801	0.687	10144
1.5 - 2.49	0.310	0.555	0.486	0.416	28631
2.5 - 3.49	0.260	0.417	0.365	0.313	45108
3.5 - 4.49	0.231	0.344	0.301	0.258	48172
4.5 - 5.49	0.219	0.300	0.263	0.225	38683
5.5 - 6.49	0.208	0.270	0.237	0.203	26075
6.5 - 7.49	0.199	0.249	0.218	0.187	16454
7.5 - 8.49	0.192	0.233	0.204	0.175	9821
8.5 - 9.49	0.184	0.220	0.193	0.165	5850
9.5 - 10.49	0.181	0.210	0.184	0.157	3643
10.5 - 11.49	0.181	0.202	0.177	0.151	1914
11.5 - 12.49	0.179	0.195	0.171	0.146	952
12.5 - 13.49	0.174	0.189	0.166	0.142	462
13.5 - 14.49	0.179	0.185	0.161	0.138	183
14.5 - 15.49	0.175	0.180	0.158	0.135	70
15.5 - 16.49	0.193	0.176	0.154	0.132	16
16.5 - 17.49	0.183	0.173	0.151	0.130	17
17.5 - 18.49	0.163	0.170	0.149	0.127	13
18.5 - 19.49	0.148	0.167	0.146	0.125	4
19.5 - 20.49	0.156	0.165	0.144	0.124	1
20.5 - 21.49					0
21.5 - 22.49					0
22.5 - 23.49					0
23.5 - 24.49					0
24.5 - 25.49					0
25.5 - 26.49					0
26.5 - 27.49					0
27.5 - 28.49					0
28.5 - 29.49					0
29.5 - 30.49					0

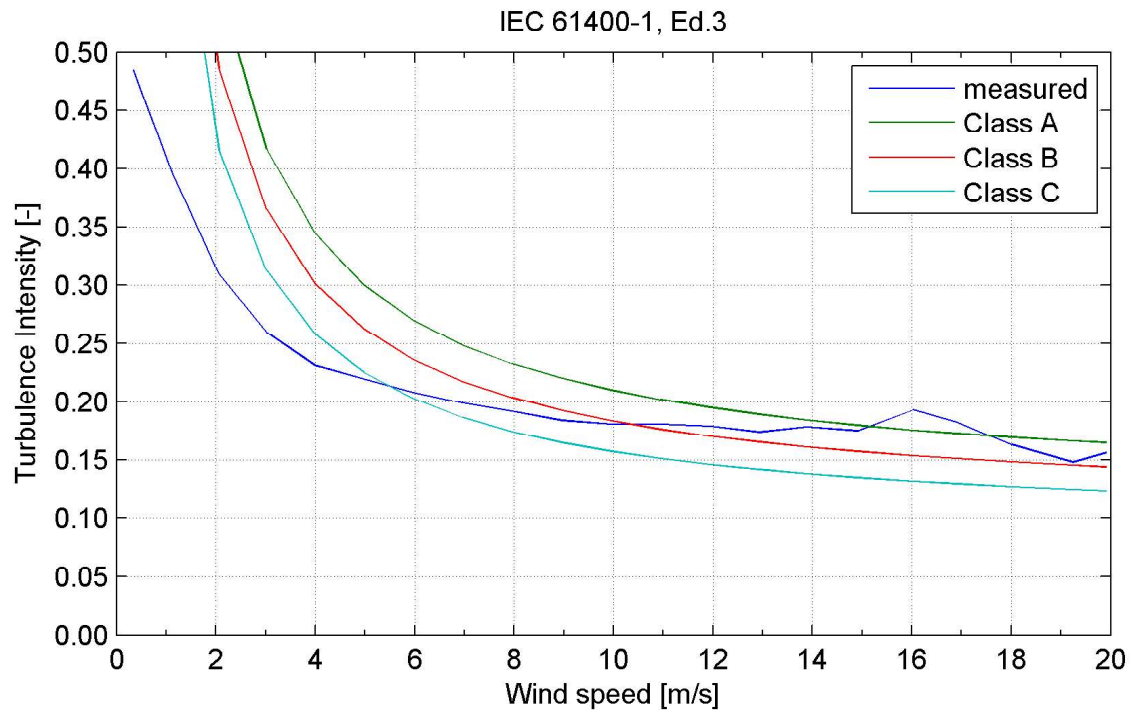


Figure 5.26: Ambient representative turbulence intensity at 25.0 m according to IEC 61400-1, Edition 3

### 5.7.10 Extreme Values of Wind Speed at 25.0 m

Table 5.52: Monthly averages and extreme values of wind speed at 25.0 m (continued)

month	n	v-average	v-max 10 minutes	v-max 1 second
[-]	[-]	[m/s]	[m/s]	[m/s]
02.09	2022	4.39	13.9	17.5
03.09	4460	5.32	19.5	27.4
04.09	4320	4.73	13.1	17.0
05.09	4464	4.05	10.2	14.5
06.09	4320	4.14	12.8	19.0
07.09	4464	3.82	12.6	18.5
08.09	4464	3.50	10.8	24.4
09.09	4320	4.05	10.3	14.5
10.09	4464	4.55	13.8	20.1
11.09	4320	4.38	13.9	17.6
12.09	3598	5.37	14.5	20.7
01.10	3670	5.21	12.1	16.0
02.10	4032	5.21	14.7	19.2
03.10	4372	5.18	12.7	17.4
04.10	4320	4.53	13.7	18.9
05.10	4453	4.41	11.4	17.7
06.10	4316	3.85	12.0	16.9
07.10	4320	3.91	16.7	22.8
08.10	4464	3.87	10.7	16.1
09.10	4320	4.63	13.9	18.9
10.10	4464	4.54	11.4	17.0
11.10	4320	5.23	16.5	23.9
12.10	3685	5.31	15.3	20.8
01.11	3356	3.87	12.3	15.9
02.11	3156	4.80	19.4	26.7
03.11	4109	4.94	13.2	17.5
04.11	4212	4.79	13.4	18.9
05.11	4435	4.24	11.8	17.7
06.11	4320	4.15	13.7	22.1
07.11	4464	3.89	11.5	17.9
08.11	4464	4.09	11.4	17.1
09.11	4320	3.89	13.2	17.7
10.11	4464	4.36	15.5	23.2
11.11	3863	3.52	17.3	17.4
12.11	4290	4.49	13.9	19.0

Table 5.42: Monthly averages and extreme values of wind speed at 25.0 m (end)

month	n	v-average	v-max 10 minutes	v-max 1 second
[-]	[-]	[m/s]	[m/s]	[m/s]
01.12	4464	5.97	14.1	19.8
02.12	2768	4.75	12.4	17.3
03.12	4464	4.71	15.0	20.3
04.12	4320	5.57	14.6	20.1
05.12	4464	4.16	12.1	16.2
06.12	4320	3.68	10.2	18.9
07.12	4446	4.08	12.7	22.3
08.12	4464	4.12	13.5	20.7
09.12	4318	4.11	12.8	16.8
10.12	4464	4.39	13.6	18.8
11.12	4286	4.08	15.6	21.5
12.12	4464	4.99	19.9	28.6
01.13	4327	5.37	15.4	19.4
02.13	3977	5.65	14.8	20.8
03.13	4391	5.56	15.4	24.3
04.13	4320	5.35	13.5	18.3
05.13	4464	4.58	13.4	22.6
06.13	4320	4.19	9.8	17.6
07.13	4464	3.89	13.7	19.3
08.13	4464	3.88	9.5	13.8
09.13	4320	4.89	14.2	18.6
10.13	1375	5.32	12.6	19.3
complete period	237069	4.52	19.9	28.6

## 5.8 Wind Shear

### 5.8.1 Wind Shear Between Measurement Heights 100.2 m and 74.0 m

Table 5.53: Wind shear between measurement heights 100.2 m and 74.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	-0.574	-0.681	-1.066	-0.493	-0.464	-1.897	-1.054	-2.060	-1.771	-1.567	-0.130	-0.194	-0.188
0.5 - 1.49	-0.150	-0.119	0.109	0.446	0.322	-0.076	-0.176	-0.772	-0.347	-0.296	-0.257	-0.227	-0.264
1.5 - 2.49	0.080	0.112	0.256	0.348	0.375	0.129	0.131	-0.362	-0.068	-0.149	-0.016	0.064	0.069
2.5 - 3.49	0.130	0.162	0.240	0.306	0.338	0.202	0.116	-0.145	0.039	-0.083	0.043	0.125	0.104
3.5 - 4.49	0.153	0.177	0.251	0.259	0.261	0.161	0.142	-0.104	0.086	-0.065	0.140	0.172	0.163
4.5 - 5.49	0.191	0.217	0.301	0.275	0.253	0.168	0.124	-0.013	0.115	0.033	0.224	0.246	0.175
5.5 - 6.49	0.235	0.247	0.330	0.283	0.252	0.195	0.168	0.114	0.199	0.102	0.275	0.310	0.224
6.5 - 7.49	0.281	0.284	0.342	0.327	0.265	0.226	0.213	0.218	0.266	0.183	0.334	0.370	0.271
7.5 - 8.49	0.318	0.282	0.355	0.358	0.290	0.270	0.255	0.311	0.325	0.298	0.380	0.384	0.290
8.5 - 9.49	0.338	0.252	0.335	0.349	0.302	0.315	0.269	0.380	0.401	0.348	0.380	0.381	0.283
9.5 - 10.49	0.350	0.228	0.292	0.288	0.276	0.330	0.271	0.442	0.439	0.398	0.356	0.375	0.261
10.5 - 11.49	0.335	0.208	0.252	0.198	0.269	0.282	0.263	0.442	0.453	0.392	0.296	0.313	0.221
11.5 - 12.49	0.293	0.158	0.218	0.211	0.261	0.230	0.236	0.423	0.404	0.332	0.235	0.252	0.213
12.5 - 13.49	0.272	0.142	0.217	0.225	0.274	0.233	0.223	0.416	0.318	0.254	0.206	0.248	0.214
13.5 - 14.49	0.245	0.152	0.197	0.173	0.246	0.248	0.220	0.375	0.224	0.124	0.187	0.282	0.216
14.5 - 15.49	0.214	0.159	0.212	0.199	0.180	0.270	0.227	0.281	0.211	0.061	0.175	0.217	0.181
15.5 - 16.49	0.200	0.174	0.191	0.225	0.200	0.295	0.257	0.214	0.182		0.176	0.222	0.139
16.5 - 17.49	0.201	0.173	0.235	0.241	0.179	0.285	0.265	0.240	0.173		0.180	0.220	0.124
17.5 - 18.49	0.204	0.192					0.247	0.306	0.176		0.164		
18.5 - 19.49	0.201	0.190						0.398	0.147		0.165		
19.5 - 20.49	0.287							0.615			0.172		
20.5 - 21.49	0.237										0.157		
21.5 - 22.49													
22.5 - 23.49	0.051												
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.229	0.215	0.291	0.301	0.276	0.204	0.191	0.217	0.227	0.091	0.255	0.258	0.190



Table 5.54: Standard deviation of wind shear between measurement heights 100.2 m and 74.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	1.330	1.283	1.359	1.520	1.297	1.560	1.417	1.382	1.853	1.959	0.923	0.938	0.868
0.5 - 1.49	1.092	0.867	0.952	1.124	1.120	0.896	0.931	1.162	1.205	1.126	1.231	1.095	0.875
1.5 - 2.49	0.670	0.502	0.596	0.754	0.816	0.650	0.615	0.717	0.703	0.679	0.680	0.628	0.484
2.5 - 3.49	0.457	0.372	0.428	0.486	0.498	0.480	0.408	0.568	0.487	0.537	0.451	0.365	0.329
3.5 - 4.49	0.374	0.315	0.345	0.382	0.352	0.369	0.346	0.440	0.428	0.484	0.384	0.334	0.281
4.5 - 5.49	0.326	0.281	0.302	0.318	0.297	0.263	0.254	0.401	0.397	0.433	0.317	0.323	0.247
5.5 - 6.49	0.285	0.250	0.270	0.264	0.224	0.249	0.249	0.376	0.376	0.365	0.262	0.269	0.230
6.5 - 7.49	0.268	0.224	0.242	0.262	0.216	0.244	0.235	0.362	0.350	0.316	0.240	0.259	0.218
7.5 - 8.49	0.248	0.204	0.221	0.242	0.215	0.215	0.229	0.328	0.313	0.287	0.219	0.215	0.202
8.5 - 9.49	0.240	0.187	0.200	0.249	0.220	0.197	0.218	0.316	0.263	0.258	0.201	0.198	0.184
9.5 - 10.49	0.234	0.159	0.177	0.221	0.195	0.197	0.198	0.290	0.225	0.240	0.195	0.188	0.166
10.5 - 11.49	0.231	0.123	0.141	0.122	0.136	0.164	0.174	0.301	0.185	0.208	0.192	0.155	0.117
11.5 - 12.49	0.213	0.095	0.103	0.091	0.120	0.129	0.174	0.288	0.169	0.174	0.152	0.117	0.096
12.5 - 13.49	0.194	0.075	0.075	0.097	0.105	0.090	0.157	0.263	0.179	0.175	0.114	0.119	0.077
13.5 - 14.49	0.169	0.061	0.059	0.070	0.091	0.059	0.132	0.254	0.107	0.087	0.104	0.126	0.075
14.5 - 15.49	0.131	0.064	0.055	0.071	0.041	0.064	0.106	0.232	0.097	0.018	0.070	0.043	0.081
15.5 - 16.49	0.108	0.056	0.050	0.066	0.058	0.053	0.140	0.223	0.068		0.057	0.074	0.045
16.5 - 17.49	0.127	0.057	0.038	0.050	0.025	0.047	0.066	0.308	0.066		0.069	0.042	0.015
17.5 - 18.49	0.126	0.034					0.060	0.435	0.056		0.050		
18.5 - 19.49	0.127	0.037						0.374	0.034		0.020		
19.5 - 20.49	0.238							0.240			0.027		
20.5 - 21.49	0.197										0.025		
21.5 - 22.49													
22.5 - 23.49	0.197												
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.389	0.303	0.360	0.414	0.387	0.370	0.324	0.470	0.464	0.515	0.371	0.380	0.313

Table 5.55: Maximum of wind shear between measurement heights 100.2 m and 74.0 m per wind speed bin and per sector

Wind Speed	Max	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	2.031	0.935	1.006	2.031	0.929	1.974	1.212	0.236	1.709	1.582	1.692	0.387	1.635
0.5 - 1.49	4.650	2.972	4.636	4.568	3.928	3.169	3.813	4.650	3.060	4.079	4.573	4.319	3.139
1.5 - 2.49	4.825	3.136	3.828	4.583	4.671	3.822	3.365	2.759	3.760	4.825	4.668	4.595	4.124
2.5 - 3.49	4.334	4.334	3.440	3.359	4.152	3.312	2.385	4.323	3.858	2.857	2.861	2.142	2.179
3.5 - 4.49	4.525	3.084	2.604	2.617	2.515	3.597	2.671	4.525	2.455	2.613	2.964	2.679	2.323
4.5 - 5.49	3.003	1.976	2.017	1.909	2.213	1.846	1.660	1.621	1.699	1.995	1.944	3.003	2.615
5.5 - 6.49	3.369	1.750	1.840	1.848	1.746	2.193	1.916	3.369	2.122	1.613	1.634	1.816	2.236
6.5 - 7.49	2.286	1.621	1.646	1.560	1.526	1.917	2.286	2.222	2.061	1.416	1.457	1.657	1.384
7.5 - 8.49	1.866	1.398	1.229	1.354	1.349	1.259	1.493	1.674	1.550	1.866	1.421	1.548	1.219
8.5 - 9.49	1.628	0.940	0.993	1.605	1.176	1.201	1.628	1.588	1.375	1.059	1.270	1.157	1.002
9.5 - 10.49	1.410	0.983	1.024	1.410	0.960	1.009	1.059	1.344	1.240	1.091	1.239	1.231	0.939
10.5 - 11.49	1.595	0.716	0.821	0.835	0.825	0.864	0.799	1.595	0.992	0.973	1.198	0.976	0.691
11.5 - 12.49	1.307	0.618	0.639	0.545	0.539	0.544	0.868	1.307	0.912	0.707	0.994	0.726	0.865
12.5 - 13.49	1.256	0.391	0.359	0.457	0.541	0.395	0.841	1.256	0.782	0.579	1.055	0.624	0.414
13.5 - 14.49	1.066	0.313	0.330	0.328	0.433	0.398	0.617	1.066	0.674	0.349	0.881	0.580	0.364
14.5 - 15.49	0.916	0.272	0.323	0.325	0.277	0.394	0.373	0.916	0.520	0.082	0.384	0.296	0.346
15.5 - 16.49	0.845	0.286	0.276	0.352	0.347	0.394	0.582	0.845	0.334		0.315	0.373	0.265
16.5 - 17.49	0.966	0.306	0.304	0.325	0.216	0.365	0.358	0.966	0.383		0.357	0.266	0.136
17.5 - 18.49	0.697	0.264					0.328	0.697	0.311		0.256		
18.5 - 19.49	0.745	0.278						0.745	0.178		0.198		
19.5 - 20.49	0.930							0.930			0.222		
20.5 - 21.49	0.666										0.186		
21.5 - 22.49													
22.5 - 23.49	0.244												
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Max	4.825	4.334	4.636	4.583	4.671	3.822	3.813	4.650	3.858	4.825	4.668	4.595	4.124

Table 5.56: Minimum of wind shear between measurement heights 100.2 m and 74.0 m per wind speed bin and per sector

Wind Speed	Min	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	-4.999	-3.546	-4.177	-4.663	-4.851	-4.527	-3.349	-4.841	-4.271	-4.576	-4.999	-4.976	-4.354
0.5 - 1.49	-4.698	-3.801	-2.421	-2.851	-3.139	-3.581	-4.433	-4.698	-4.458	-4.149	-3.667	-4.312	-3.993
1.5 - 2.49	-3.812	-3.812	-1.818	-1.591	-2.037	-1.810	-1.827	-2.626	-2.321	-2.160	-2.656	-1.765	-2.405
2.5 - 3.49	-2.344	-1.435	-1.408	-1.489	-0.674	-1.194	-1.325	-2.344	-1.700	-2.018	-1.416	-1.260	-1.136
3.5 - 4.49	-1.569	-0.730	-0.780	-0.961	-1.120	-0.874	-1.151	-1.569	-1.144	-1.500	-1.166	-1.039	-0.983
4.5 - 5.49	-1.657	-0.760	-0.703	-0.907	-1.112	-0.623	-0.789	-1.657	-1.352	-1.356	-0.998	-0.994	-0.769
5.5 - 6.49	-1.197	-0.514	-0.385	-0.648	-0.980	-0.603	-0.891	-1.119	-0.853	-1.197	-0.488	-0.803	-0.634
6.5 - 7.49	-1.031	-0.403	-0.290	-0.275	-0.611	-0.247	-0.719	-1.031	-0.757	-0.684	-0.528	-0.605	-0.317
7.5 - 8.49	-0.897	-0.392	-0.167	-0.142	-0.145	-0.421	-0.408	-0.897	-0.670	-0.484	-0.481	-0.337	-0.201
8.5 - 9.49	-0.850	-0.152	0.017	0.017	-0.222	-0.171	-0.256	-0.850	-0.526	-0.551	-0.237	-0.065	-0.233
9.5 - 10.49	-0.727	-0.113	-0.010	0.045	-0.128	-0.181	-0.164	-0.727	-0.452	-0.258	-0.147	0.020	-0.093
10.5 - 11.49	-0.378	-0.091	0.003	0.039	-0.093	-0.020	-0.372	-0.378	-0.215	-0.180	-0.177	0.040	-0.101
11.5 - 12.49	-0.478	-0.055	0.006	0.024	-0.177	-0.019	-0.478	-0.331	-0.039	-0.016	-0.180	0.051	-0.020
12.5 - 13.49	-0.304	-0.009	0.080	-0.118	0.034	-0.201	-0.038	-0.304	0.020	-0.003	-0.014	0.083	0.038
13.5 - 14.49	-0.251	-0.003	0.080	0.043	0.065	0.103	-0.025	-0.251	0.020	0.049	-0.130	0.112	0.043
14.5 - 15.49	-0.212	0.017	0.094	0.067	0.110	0.101	-0.018	-0.212	-0.007	0.050	0.061	0.152	0.062
15.5 - 16.49	-0.120	0.039	0.115	0.079	0.126	0.191	0.008	-0.120	0.017		0.079	0.151	0.080
16.5 - 17.49	-0.157	0.032	0.181	0.180	0.147	0.223	0.136	-0.157	0.031		0.102	0.155	0.103
17.5 - 18.49	-0.286	0.112					0.147	-0.286	0.105		0.084		
18.5 - 19.49	0.047	0.145						0.047	0.076		0.140		
19.5 - 20.49	0.071							0.234			0.133		
20.5 - 21.49	0.091										0.113		
21.5 - 22.49													
22.5 - 23.49	-0.151												
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Min	-4.999	-3.812	-4.177	-4.663	-4.851	-4.527	-4.433	-4.841	-4.458	-4.576	-4.999	-4.976	-4.354

### 5.8.2 Wind Shear Between Measurement Heights 74.0 m and 40.0 m

Table 5.57: Wind shear between measurement heights 74.0 m and 40.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	-0.757	-0.141	-0.859	-1.462	-2.573	-1.125	-0.754	-1.362	-1.099	-1.620	-0.560	-0.234	-0.183
0.5 - 1.49	-0.118	0.059	0.074	0.117	0.068	-0.009	-0.154	-0.298	-0.314	-0.400	-0.252	-0.039	-0.008
1.5 - 2.49	0.110	0.220	0.250	0.205	0.235	0.156	0.099	0.025	-0.091	-0.058	-0.022	0.104	0.163
2.5 - 3.49	0.165	0.214	0.233	0.231	0.237	0.204	0.157	0.101	-0.013	0.039	0.109	0.163	0.222
3.5 - 4.49	0.209	0.238	0.248	0.221	0.259	0.227	0.213	0.155	0.041	0.176	0.194	0.209	0.237
4.5 - 5.49	0.253	0.251	0.282	0.217	0.265	0.279	0.242	0.221	0.180	0.272	0.257	0.273	0.258
5.5 - 6.49	0.284	0.273	0.319	0.228	0.277	0.322	0.266	0.268	0.267	0.339	0.260	0.311	0.294
6.5 - 7.49	0.299	0.272	0.304	0.231	0.285	0.348	0.287	0.316	0.358	0.380	0.256	0.302	0.289
7.5 - 8.49	0.290	0.237	0.260	0.186	0.288	0.368	0.289	0.332	0.387	0.358	0.234	0.265	0.266
8.5 - 9.49	0.262	0.215	0.179	0.132	0.239	0.311	0.279	0.350	0.347	0.298	0.186	0.231	0.219
9.5 - 10.49	0.221	0.196	0.173	0.119	0.229	0.296	0.271	0.293	0.268	0.226	0.124	0.194	0.189
10.5 - 11.49	0.185	0.176	0.166	0.123	0.238	0.269	0.242	0.207	0.224	0.190	0.101	0.170	0.185
11.5 - 12.49	0.168	0.166	0.161	0.137	0.226	0.256	0.235	0.171	0.105	0.146	0.097	0.168	0.182
12.5 - 13.49	0.147	0.168	0.143	0.107	0.214	0.256	0.193	0.130	0.079	0.063	0.081	0.164	0.191
13.5 - 14.49	0.144	0.173	0.153	0.129	0.246	0.255	0.199	0.120	0.057	0.067	0.082	0.162	0.205
14.5 - 15.49	0.145	0.190	0.151	0.122	0.232	0.281	0.236	0.094	0.042	0.064	0.080	0.140	0.226
15.5 - 16.49	0.138	0.193	0.152		0.237	0.270	0.204	0.107	0.042		0.079	0.161	0.209
16.5 - 17.49	0.151	0.202				0.278	0.224	0.099	0.052		0.075		0.224
17.5 - 18.49	0.111	0.204						0.135	0.036		0.073		
18.5 - 19.49	0.123	0.201									0.077		
19.5 - 20.49	0.079										0.072		
20.5 - 21.49													
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.230	0.236	0.257	0.204	0.253	0.280	0.249	0.253	0.192	0.202	0.183	0.229	0.240

Table 5.58: Standard deviation of wind shear between measurement heights 74.0 m and 40.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	1.170	0.388	0.512	1.805	1.999	1.122	0.777	1.073	1.185	1.146	0.949	0.549	0.346
0.5 - 1.49	0.672	0.550	0.546	0.589	0.485	0.621	0.627	0.766	0.757	0.834	0.696	0.576	0.525
1.5 - 2.49	0.467	0.417	0.444	0.434	0.486	0.471	0.491	0.570	0.495	0.525	0.420	0.425	0.382
2.5 - 3.49	0.352	0.289	0.346	0.361	0.327	0.357	0.378	0.413	0.377	0.374	0.336	0.325	0.325
3.5 - 4.49	0.287	0.256	0.286	0.305	0.275	0.253	0.281	0.308	0.328	0.314	0.282	0.285	0.256
4.5 - 5.49	0.260	0.227	0.278	0.269	0.220	0.252	0.264	0.286	0.314	0.272	0.237	0.270	0.244
5.5 - 6.49	0.236	0.217	0.280	0.257	0.191	0.232	0.241	0.254	0.261	0.232	0.204	0.245	0.221
6.5 - 7.49	0.212	0.190	0.250	0.242	0.184	0.217	0.207	0.234	0.237	0.194	0.175	0.210	0.194
7.5 - 8.49	0.198	0.153	0.210	0.187	0.196	0.216	0.194	0.217	0.211	0.187	0.157	0.179	0.170
8.5 - 9.49	0.180	0.118	0.131	0.119	0.140	0.197	0.178	0.215	0.201	0.166	0.139	0.150	0.123
9.5 - 10.49	0.156	0.085	0.104	0.092	0.101	0.165	0.167	0.202	0.185	0.160	0.098	0.114	0.073
10.5 - 11.49	0.130	0.066	0.063	0.068	0.082	0.147	0.150	0.181	0.160	0.163	0.079	0.077	0.070
11.5 - 12.49	0.110	0.056	0.042	0.053	0.075	0.100	0.144	0.149	0.091	0.105	0.071	0.077	0.067
12.5 - 13.49	0.092	0.047	0.039	0.048	0.065	0.083	0.112	0.101	0.082	0.052	0.048	0.054	0.072
13.5 - 14.49	0.094	0.043	0.045	0.058	0.051	0.080	0.117	0.092	0.065	0.050	0.042	0.059	0.064
14.5 - 15.49	0.100	0.048	0.040	0.042	0.032	0.049	0.157	0.114	0.075	0.029	0.037	0.026	0.050
15.5 - 16.49	0.087	0.030	0.014		0.026	0.076	0.086	0.084	0.069		0.020	0.019	0.043
16.5 - 17.49	0.092	0.042				0.058	0.037	0.091	0.050		0.019		0.073
17.5 - 18.49	0.089	0.022						0.190	0.073		0.019		
18.5 - 19.49	0.081	0.020									0.016		
19.5 - 20.49	0.017										0.014		
20.5 - 21.49													
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.300	0.237	0.302	0.312	0.306	0.299	0.259	0.312	0.365	0.401	0.282	0.300	0.261

Table 5.59: Maximum of wind shear between measurement heights 74.0 m and 40.0 m per wind speed bin and per sector

Wind Speed	Max	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.950	0.396	0.178	0.336	0.701	0.869	0.580	0.698	0.950	0.564	0.772	0.564	0.023
0.5 - 1.49	2.672	2.670	2.323	2.439	2.052	2.013	2.330	1.970	2.482	2.466	2.185	2.672	2.527
1.5 - 2.49	3.267	3.267	2.818	2.814	3.055	2.665	3.145	2.296	2.440	2.746	2.334	3.090	2.966
2.5 - 3.49	3.974	2.046	3.764	2.542	2.233	3.414	2.796	2.041	2.419	2.169	2.800	3.905	3.974
3.5 - 4.49	4.300	2.626	2.606	2.327	2.614	2.549	1.918	2.174	2.099	1.952	2.393	4.300	1.891
4.5 - 5.49	4.570	1.535	1.537	2.309	1.793	2.061	2.062	1.819	1.808	1.624	2.196	4.537	4.570
5.5 - 6.49	3.942	1.386	1.786	1.763	1.199	3.942	1.316	1.326	1.411	1.297	1.219	1.348	1.418
6.5 - 7.49	4.785	1.270	1.109	4.785	1.250	1.260	1.303	1.146	1.332	1.354	1.020	1.108	1.202
7.5 - 8.49	1.280	0.908	0.963	1.179	1.049	1.280	1.215	1.094	1.070	1.045	0.950	0.933	1.037
8.5 - 9.49	1.426	0.727	0.754	0.802	0.853	1.129	1.426	1.019	1.118	0.897	0.859	0.710	0.874
9.5 - 10.49	1.065	0.621	0.582	0.504	0.781	1.065	0.961	0.929	0.827	0.707	0.600	0.633	0.527
10.5 - 11.49	0.914	0.463	0.431	0.369	0.606	0.672	0.731	0.914	0.769	0.753	0.566	0.478	0.557
11.5 - 12.49	0.784	0.395	0.322	0.322	0.366	0.575	0.784	0.711	0.476	0.463	0.525	0.465	0.412
12.5 - 13.49	0.692	0.282	0.223	0.237	0.344	0.692	0.519	0.691	0.371	0.245	0.237	0.303	0.375
13.5 - 14.49	0.534	0.294	0.215	0.277	0.340	0.380	0.534	0.370	0.324	0.175	0.232	0.286	0.353
14.5 - 15.49	0.555	0.317	0.241	0.181	0.297	0.376	0.555	0.433	0.351	0.104	0.173	0.182	0.322
15.5 - 16.49	0.382	0.242	0.179		0.279	0.382	0.301	0.293	0.348		0.111	0.184	0.269
16.5 - 17.49	0.355	0.293				0.355	0.256	0.258	0.166		0.104		0.330
17.5 - 18.49	0.272	0.245						0.272	0.256		0.111		
18.5 - 19.49	0.242	0.221									0.098		
19.5 - 20.49	0.108										0.089		
20.5 - 21.49													
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Max	4.785	3.267	3.764	4.785	3.055	3.942	3.145	2.296	2.482	2.746	2.800	4.537	4.570

Table 5.60: Minimum of wind shear between measurement heights 74.0 m and 40.0 m per wind speed bin and per sector

Wind Speed	Min	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	-4.984	-1.688	-1.395	-4.940	-4.984	-3.684	-1.986	-3.031	-3.381	-3.639	-3.296	-2.668	-1.655
0.5 - 1.49	-2.741	-2.563	-1.984	-1.730	-1.560	-1.944	-2.318	-2.630	-2.741	-2.607	-2.494	-2.247	-2.114
1.5 - 2.49	-2.440	-0.942	-0.670	-0.673	-2.440	-1.694	-1.398	-1.530	-1.768	-1.860	-1.440	-1.128	-1.027
2.5 - 3.49	-1.254	-0.432	-0.495	-0.537	-1.139	-0.772	-0.981	-1.131	-1.041	-1.254	-0.973	-0.671	-0.616
3.5 - 4.49	-1.010	-0.289	-0.353	-0.517	-0.405	-0.586	-0.608	-0.892	-1.010	-0.711	-0.617	-0.513	-0.485
4.5 - 5.49	-0.727	-0.259	-0.331	-0.210	-0.254	-0.280	-0.727	-0.705	-0.637	-0.571	-0.331	-0.295	-0.272
5.5 - 6.49	-0.681	-0.103	-0.066	-0.072	-0.093	-0.447	-0.681	-0.525	-0.550	-0.412	-0.321	-0.175	-0.099
6.5 - 7.49	-0.539	-0.120	-0.034	-0.048	-0.032	-0.030	-0.412	-0.539	-0.281	-0.101	-0.089	-0.201	-0.023
7.5 - 8.49	-0.423	-0.311	-0.045	-0.051	-0.003	-0.110	-0.423	-0.321	-0.161	-0.048	-0.077	-0.056	0.005
8.5 - 9.49	-0.215	-0.033	-0.009	-0.051	0.007	-0.005	-0.146	-0.215	-0.139	-0.017	-0.060	-0.024	-0.025
9.5 - 10.49	-0.175	0.024	0.011	-0.025	0.000	0.038	-0.112	-0.131	-0.175	-0.024	-0.027	0.008	0.010
10.5 - 11.49	-0.170	0.014	0.029	-0.008	0.046	0.045	-0.125	-0.170	-0.129	-0.043	-0.047	0.027	0.034
11.5 - 12.49	-0.173	0.054	0.030	0.012	0.079	0.065	-0.151	-0.173	-0.130	-0.022	-0.056	0.016	0.020
12.5 - 13.49	-0.137	0.050	0.059	0.016	0.089	0.102	-0.066	-0.137	-0.098	-0.027	-0.012	0.057	0.034
13.5 - 14.49	-0.094	0.072	0.068	0.051	0.045	0.085	-0.065	-0.094	-0.067	-0.012	0.002	0.078	0.086
14.5 - 15.49	-0.135	0.083	0.074	0.052	0.167	0.210	-0.003	-0.135	-0.081	0.039	-0.025	0.093	0.126
15.5 - 16.49	-0.083	0.092	0.120		0.211	0.216	0.035	-0.083	-0.053		0.047	0.150	0.125
16.5 - 17.49	-0.078	0.093				0.214	0.144	-0.078	-0.021		0.043		0.174
17.5 - 18.49	-0.082	0.162						-0.082	-0.047		0.053		
18.5 - 19.49	0.017	0.180									0.059		
19.5 - 20.49	0.048										0.048		
20.5 - 21.49													
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Min	-4.984	-2.563	-1.984	-4.940	-4.984	-3.684	-2.318	-3.031	-3.381	-3.639	-3.296	-2.668	-2.114

### 5.8.3 Wind Shear Between Measurement Heights 40.0 m and 25.0 m

Table 5.61: Wind shear between measurement heights 40.0 m and 25.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	-0.476	-0.504	-0.540	-0.783	-0.955	-1.213	-1.100	-1.339	-0.934	-0.900	-0.143	-0.153	-0.241
0.5 - 1.49	0.091	0.188	0.291	0.354	0.151	0.062	-0.063	-0.167	-0.114	-0.023	-0.029	0.068	0.148
1.5 - 2.49	0.303	0.312	0.403	0.460	0.414	0.314	0.258	0.161	0.211	0.242	0.261	0.265	0.288
2.5 - 3.49	0.358	0.336	0.365	0.379	0.424	0.387	0.382	0.360	0.368	0.385	0.341	0.321	0.338
3.5 - 4.49	0.380	0.319	0.348	0.298	0.416	0.468	0.449	0.513	0.495	0.459	0.312	0.322	0.337
4.5 - 5.49	0.369	0.279	0.256	0.230	0.364	0.462	0.408	0.561	0.600	0.445	0.257	0.286	0.314
5.5 - 6.49	0.335	0.232	0.171	0.169	0.306	0.397	0.349	0.548	0.646	0.373	0.210	0.227	0.249
6.5 - 7.49	0.289	0.201	0.155	0.134	0.254	0.323	0.305	0.475	0.613	0.293	0.167	0.179	0.204
7.5 - 8.49	0.244	0.179	0.133	0.123	0.247	0.283	0.276	0.372	0.558	0.207	0.129	0.155	0.194
8.5 - 9.49	0.213	0.175	0.130	0.117	0.259	0.265	0.246	0.307	0.477	0.172	0.115	0.154	0.192
9.5 - 10.49	0.192	0.170	0.148	0.118	0.281	0.271	0.227	0.252	0.418	0.151	0.103	0.147	0.190
10.5 - 11.49	0.182	0.165	0.153	0.130	0.263	0.283	0.205	0.237	0.389	0.119	0.094	0.143	0.187
11.5 - 12.49	0.190	0.166	0.141	0.119	0.260	0.287	0.191	0.244	0.386	0.111	0.093	0.133	0.187
12.5 - 13.49	0.197	0.171	0.125	0.122	0.286	0.263	0.181	0.248	0.372	0.095	0.087	0.140	0.204
13.5 - 14.49	0.204	0.174	0.112	0.136	0.233	0.243	0.185	0.267	0.364	0.112	0.091	0.110	0.219
14.5 - 15.49	0.224	0.172	0.123	0.155		0.224	0.182	0.292	0.364		0.096	0.116	0.201
15.5 - 16.49	0.253	0.181						0.261	0.353		0.090		
16.5 - 17.49	0.202							0.186	0.371		0.087		
17.5 - 18.49	0.247								0.365		0.083		
18.5 - 19.49	0.153								0.329		0.100		
19.5 - 20.49	0.147										0.072		
20.5 - 21.49													
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.319	0.260	0.283	0.258	0.346	0.385	0.330	0.442	0.504	0.362	0.221	0.264	0.283



Table 5.62: Standard deviation of wind shear between measurement heights 40.0 m and 25.0 m per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	0.941	0.969	0.888	1.007	1.121	1.223	0.899	0.838	0.807	1.210	0.623	0.752	0.807
0.5 - 1.49	0.699	0.561	0.613	0.785	0.761	0.761	0.664	0.754	0.748	0.693	0.688	0.692	0.560
1.5 - 2.49	0.487	0.407	0.538	0.574	0.611	0.500	0.493	0.488	0.498	0.472	0.462	0.446	0.393
2.5 - 3.49	0.381	0.345	0.400	0.465	0.427	0.352	0.373	0.442	0.435	0.396	0.374	0.344	0.317
3.5 - 4.49	0.322	0.284	0.344	0.348	0.315	0.289	0.282	0.402	0.392	0.350	0.268	0.290	0.264
4.5 - 5.49	0.278	0.225	0.243	0.241	0.252	0.241	0.219	0.355	0.335	0.253	0.186	0.230	0.230
5.5 - 6.49	0.251	0.169	0.124	0.141	0.192	0.198	0.172	0.308	0.317	0.188	0.135	0.168	0.168
6.5 - 7.49	0.220	0.111	0.086	0.089	0.134	0.140	0.147	0.277	0.284	0.166	0.099	0.134	0.111
7.5 - 8.49	0.172	0.074	0.064	0.069	0.107	0.106	0.119	0.207	0.244	0.128	0.076	0.097	0.071
8.5 - 9.49	0.135	0.061	0.050	0.061	0.100	0.101	0.095	0.163	0.177	0.101	0.061	0.083	0.052
9.5 - 10.49	0.110	0.048	0.041	0.051	0.089	0.086	0.080	0.123	0.139	0.090	0.050	0.070	0.046
10.5 - 11.49	0.101	0.041	0.036	0.051	0.109	0.079	0.071	0.113	0.110	0.060	0.042	0.064	0.043
11.5 - 12.49	0.109	0.032	0.037	0.044	0.111	0.085	0.070	0.110	0.072	0.054	0.039	0.058	0.043
12.5 - 13.49	0.115	0.028	0.026	0.045	0.068	0.094	0.060	0.114	0.062	0.043	0.032	0.041	0.038
13.5 - 14.49	0.116	0.028	0.032	0.017	0.023	0.093	0.061	0.121	0.051	0.053	0.028	0.037	0.048
14.5 - 15.49	0.122	0.024	0.031	0.012		0.009	0.043	0.113	0.062		0.032	0.027	0.041
15.5 - 16.49	0.120	0.018						0.132	0.048		0.016		
16.5 - 17.49	0.129							0.111	0.059		0.016		
17.5 - 18.49	0.145								0.041		0.012		
18.5 - 19.49	0.097								0.033		0.011		
19.5 - 20.49	0.114										0.026		
20.5 - 21.49													
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Mean	0.332	0.269	0.355	0.376	0.352	0.333	0.258	0.370	0.400	0.361	0.267	0.318	0.279

Table 5.63: Maximum of wind shear between measurement heights 40.0 m and 25.0 m per wind speed bin and per sector

Wind Speed	Max	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	1.265	0.915	0.652	0.931	0.688	0.757	0.466	0.502	0.476	1.124	0.769	1.265	1.222
0.5 - 1.49	3.642	3.329	2.760	3.642	2.939	3.308	2.627	2.605	2.525	3.297	3.147	3.401	3.049
1.5 - 2.49	4.732	3.268	3.183	3.643	3.803	3.302	2.369	2.327	3.095	3.106	4.732	3.301	3.138
2.5 - 3.49	3.433	2.440	2.744	2.873	2.732	2.422	1.772	2.262	3.433	2.526	3.127	1.989	2.314
3.5 - 4.49	2.426	1.806	2.399	1.905	2.293	1.967	1.854	1.810	2.426	2.160	1.626	1.860	1.927
4.5 - 5.49	1.942	1.751	1.841	1.440	1.625	1.569	1.591	1.942	1.825	1.738	1.542	1.356	1.521
5.5 - 6.49	2.604	2.604	0.830	0.906	1.145	1.223	1.209	1.728	1.747	1.223	0.843	1.023	1.050
6.5 - 7.49	1.777	0.830	0.596	0.655	0.878	1.005	1.168	1.777	1.468	0.768	0.624	0.769	0.720
7.5 - 8.49	1.477	0.616	0.470	0.442	0.545	0.954	1.172	1.397	1.477	0.723	0.547	0.618	0.641
8.5 - 9.49	1.234	0.523	0.371	0.326	0.531	0.629	0.672	1.234	1.200	0.625	0.427	0.475	0.363
9.5 - 10.49	1.321	0.332	0.250	0.249	0.470	0.553	0.658	0.836	1.321	0.464	0.440	0.477	0.364
10.5 - 11.49	1.212	0.294	0.232	0.373	0.480	0.495	0.491	0.566	1.212	0.344	0.255	0.316	0.360
11.5 - 12.49	0.529	0.290	0.202	0.253	0.497	0.481	0.394	0.511	0.529	0.303	0.284	0.266	0.325
12.5 - 13.49	0.542	0.257	0.211	0.319	0.454	0.448	0.324	0.501	0.542	0.238	0.206	0.242	0.312
13.5 - 14.49	0.521	0.283	0.230	0.164	0.263	0.406	0.290	0.456	0.521	0.238	0.165	0.162	0.306
14.5 - 15.49	0.506	0.213	0.169	0.166		0.235	0.240	0.483	0.506		0.176	0.144	0.243
15.5 - 16.49	0.483	0.207						0.483	0.457		0.136		
16.5 - 17.49	0.463							0.346	0.463		0.112		
17.5 - 18.49	0.414								0.414		0.098		
18.5 - 19.49	0.363								0.363		0.119		
19.5 - 20.49	0.327										0.100		
20.5 - 21.49													
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Max	4.732	3.329	3.183	3.643	3.803	3.308	2.627	2.605	3.433	3.297	4.732	3.401	3.138

Table 5.64: Minimum of wind shear between measurement heights 40.0 m and 25.0 m per wind speed bin and per sector

Wind Speed	Min	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
0 - 0.49	-4.089	-4.089	-2.194	-2.729	-3.225	-3.392	-2.780	-3.070	-2.734	-3.330	-2.703	-3.546	-3.243
0.5 - 1.49	-2.630	-1.785	-1.778	-1.689	-2.162	-2.170	-2.186	-2.399	-2.329	-2.459	-2.554	-2.630	-2.108
1.5 - 2.49	-1.778	-0.511	-0.642	-0.371	-1.067	-0.939	-1.299	-1.230	-1.778	-1.130	-1.137	-1.170	-0.728
2.5 - 3.49	-0.915	-0.336	-0.340	-0.181	-0.532	-0.649	-0.745	-0.915	-0.797	-0.659	-0.835	-0.673	-0.685
3.5 - 4.49	-0.698	-0.319	-0.303	-0.080	-0.152	-0.351	-0.493	-0.687	-0.698	-0.613	-0.363	-0.397	-0.266
4.5 - 5.49	-0.748	-0.224	-0.201	-0.126	-0.046	-0.315	-0.254	-0.748	-0.503	-0.475	-0.214	-0.142	-0.068
5.5 - 6.49	-0.322	-0.033	-0.022	-0.045	-0.037	0.035	-0.042	-0.322	-0.186	-0.020	-0.120	-0.037	-0.019
6.5 - 7.49	-0.147	-0.033	-0.023	-0.147	0.007	0.058	-0.097	-0.100	0.031	0.000	-0.070	-0.062	0.014
7.5 - 8.49	-0.251	0.003	0.001	-0.023	0.023	0.036	-0.007	-0.104	-0.099	-0.251	-0.144	-0.032	0.012
8.5 - 9.49	-0.184	-0.117	0.023	0.005	0.044	-0.184	-0.069	-0.079	0.159	0.016	-0.003	-0.003	-0.056
9.5 - 10.49	-0.016	0.045	0.036	-0.002	0.085	0.099	-0.003	-0.016	0.107	0.017	-0.009	0.012	0.066
10.5 - 11.49	-0.017	0.036	0.050	0.014	0.047	0.134	0.023	-0.017	0.085	0.046	0.002	0.009	0.100
11.5 - 12.49	-0.049	0.086	0.063	0.028	0.061	0.123	0.027	-0.049	0.202	0.025	0.010	0.039	0.075
12.5 - 13.49	0.021	0.108	0.074	0.032	0.181	0.113	0.074	0.022	0.242	0.045	0.021	0.081	0.121
13.5 - 14.49	0.028	0.107	0.061	0.099	0.202	0.175	0.034	0.028	0.256	0.071	0.037	0.037	0.145
14.5 - 15.49	0.039	0.113	0.101	0.142		0.218	0.116	0.072	0.250		0.039	0.090	0.146
15.5 - 16.49	0.052	0.142						0.052	0.231		0.070		
16.5 - 17.49	0.064							0.070	0.300		0.064		
17.5 - 18.49	0.069								0.296		0.069		
18.5 - 19.49	0.079								0.297		0.079		
19.5 - 20.49	0.049										0.049		
20.5 - 21.49													
21.5 - 22.49													
22.5 - 23.49													
23.5 - 24.49													
24.5 - 25.49													
25.5 - 26.49													
26.5 - 27.49													
27.5 - 28.49													
28.5 - 29.49													
29.5 - 30.49													
Min	-4.089	-4.089	-2.194	-2.729	-3.225	-3.392	-2.780	-3.070	-2.734	-3.330	-2.703	-3.546	-3.243

## 5.9 Other Meteorological Conditions

Table 5.65: Monthly averages and extreme values of temperature, atmospheric pressure and air density (continued)

month	n	T avg	T max	T min	Pres. avg	Pres. max	Pres. min	Density avg	Density max	Density min	Hum. avg	Hum. max	Hum. min
[-]	[-]	[°C]	[°C]	[°C]	[hPa]	[hPa]	[hPa]	[kg/m³]	[kg/m³]	[kg/m³]	[%]	[%]	[%]
02.09	2022	0.6	7.0	-4.1	0	0	0	0.0000	0.0000	0.0000	82	100	50
03.09	4460	6.3	22.7	-0.5	972	979	960	1.1978	1.2319	1.1423	74	100	26
04.09	4320	11.6	22.1	2.9	972	983	954	1.1888	1.2319	1.1277	63	100	19
05.09	4464	17.2	27.8	7.0	965	976	955	1.1584	1.2100	1.1077	66	100	22
06.09	4320	22.0	31.8	13.7	962	977	950	1.1362	1.1757	1.0894	60	100	18
07.09	4464	24.0	35.9	16.3	956	967	941	1.1206	1.1597	1.0605	63	100	25
08.09	4464	22.7	31.0	15.1	968	977	958	1.1399	1.1802	1.0977	62	100	20
09.09	4320	18.9	32.7	10.3	969	982	958	1.1561	1.1988	1.0975	66	99	24
10.09	4464	13.5	26.6	1.0	970	983	947	1.1793	1.2488	1.1212	81	100	31
11.09	4320	10.2	20.4	-2.2	971	984	953	1.1942	1.2596	1.1446	81	100	38
12.09	3598	6.0	17.1	-4.8	970	983	955	1.2110	1.2678	1.1499	89	100	47
01.10	3670	1.5	17.5	-11.8	972	1000	944	1.2337	1.3144	1.1319	88	100	40
02.10	4032	3.1	19.3	-8.6	968	989	947	1.2209	1.2898	1.1310	87	100	39
03.10	4372	5.8	21.5	-6.2	974	991	956	1.2172	1.2919	1.1461	78	100	28
04.10	4320	11.6	20.3	4.5	971	984	958	1.1881	1.2206	1.1478	71	100	30
05.10	4453	17.2	29.2	7.8	960	971	945	1.1527	1.2013	1.0925	71	100	29
06.10	4316	20.6	32.5	11.0	958	966	947	1.1357	1.1730	1.0864	75	99	27
07.10	4320	23.0	31.2	15.4	958	965	947	1.1276	1.1637	1.0861	74	99	33
08.10	4464	25.4	34.8	11.9	960	974	949	1.1204	1.1701	1.0791	67	99	24
09.10	4320	19.0	29.7	10.4	968	979	955	1.1552	1.1978	1.1113	66	99	27
10.10	4464	10.2	19.6	-0.8	974	987	956	1.1975	1.2547	1.1387	82	100	31
11.10	4313	14.1	24.9	2.5	968	982	948	1.1740	1.2234	1.1286	76	100	32
12.10	3524	5.0	18.3	-7.6	970	982	955	1.2155	1.2757	1.1472	84	100	45
01.11	3347	2.1	11.8	-7.6	980	989	972	1.2407	1.2906	1.1886	91	100	50
02.11	3156	1.3	15.5	-9.4	978	988	961	1.2426	1.3020	1.1692	75	100	32
03.11	4109	6.4	22.4	-5.0	981	995	968	1.2230	1.2856	1.1530	72	100	22
04.11	4212	9.0	17.5	2.0	973	983	955	1.2010	1.2341	1.1532	74	100	25
05.11	4434	16.0	27.0	5.6	971	981	959	1.1701	1.2244	1.1256	75	100	32
06.11	4320	20.7	30.5	12.8	965	974	953	1.1442	1.1777	1.1065	68	99	32
07.11	4464	23.7	32.9	12.1	962	971	950	1.1290	1.1775	1.0856	64	99	25
08.11	4461	22.8	32.1	14.1	967	974	960	1.1382	1.1685	1.1040	62	98	23
09.11	4320	21.1	33.1	10.9	970	982	958	1.1491	1.1993	1.0992	61	98	24
10.11	4464	11.1	26.3	0.4	977	989	959	1.1979	1.2438	1.1225	75	100	26
11.11	3863	4.9	13.4	-17.9	985	995	975	1.2345	1.3346	1.1850	78	100	34
12.11	4290	5.1	16.9	-4.9	977	996	951	1.2235	1.2793	1.1524	85	100	33

Table 5.65: Monthly averages and extreme values of temperature, atmospheric pressure and air density (end)

month	n	T avg	T max	T min	Pres. avg	Pres. max	Pres. min	Density avg	Density max	Density min	Hum. avg	Hum. max	Hum. min
[-]	[-]	[°C]	[°C]	[°C]	[hPa]	[hPa]	[hPa]	[kg/m³]	[kg/m³]	[kg/m³]	[%]	[%]	[%]
01.12	4460	-0.4	11.1	-15.4	977	996	950	1.2481	1.3449	1.1760	84	100	49
02.12	2768	-1.2	9.0	-18.0	979	995	961	1.2556	1.3581	1.1957	82	100	49
03.12	4464	6.8	22.8	-4.2	980	995	959	1.2200	1.2800	1.1469	65	98	20
04.12	4320	14.3	25.4	1.3	966	978	946	1.1708	1.2374	1.1289	64	97	26
05.12	4464	17.6	28.2	7.7	966	978	958	1.1578	1.2027	1.1150	72	99	23
06.12	4320	23.0	32.3	12.9	965	973	956	1.1349	1.1739	1.0907	66	97	33
07.12	4446	25.9	34.1	16.7	962	971	956	1.1207	1.1622	1.0863	61	98	25
08.12	4464	24.6	37.3	14.8	967	976	958	1.1315	1.1733	1.0792	54	98	19
09.12	4318	20.4	32.1	9.0	970	978	961	1.1514	1.1944	1.0961	65	98	24
10.12	4464	16.2	27.4	3.3	970	981	956	1.1674	1.2247	1.1210	72	100	27
11.12	3875	9.7	18.7	-0.7	975	987	956	1.2011	1.2581	1.1459	87	100	50
12.12	4464	1.5	20.2	-10.6	975	993	945	1.2368	1.2970	1.1508	85	100	37
01.13	4327	2.1	15.1	-8.8	972	989	953	1.2313	1.2987	1.1627	85	100	49
02.13	3977	3.8	16.3	-2.3	973	983	958	1.2239	1.2636	1.1562	88	100	42
03.13	4391	6.0	19.6	-6.0	969	991	942	1.2096	1.2758	1.1396	75	100	31
04.13	4320	13.5	26.8	1.4	972	983	959	1.1821	1.2289	1.1268	65	98	25
05.13	4464	19.4	28.5	10.5	966	978	949	1.1508	1.1843	1.0960	64	96	27
06.13	4320	21.2	33.5	11.3	964	971	954	1.1413	1.1758	1.0909	67	97	30
07.13	4464	22.7	33.7	14.8	965	970	955	1.1365	1.1720	1.0878	64	96	31
08.13	4464	24.0	33.3	13.7	967	972	961	1.1341	1.1745	1.0962	58	98	24
09.13	4320	17.7	28.7	10.3	968	977	953	1.1593	1.1973	1.1122	63	97	30
10.13	1375	8.4	21.0	1.7	979	987	953	1.2117	1.2493	1.1504	81	98	44
complete period	236473	13.7	37.3	-18.0	969	1000	0	1.1776	1.3581	0.0000	72	100	18

## 5.10 Overview of all Heights

### 5.10.1 Averages

Table 5.66: Overview of measured averages and extreme values of wind speed

Wind Speed	Availability	n	v-average	v-max 10 minutes	v-max 1 second
[m/s]	[%]	[-]	[m/s]	[m/s]	[m/s]
Mean v1	91.97%	225285	6.44	23.69	32.08
Mean v2	91.97%	225290	6.37	24.21	31.85
Mean v3	94.24%	230845	5.96	25.18	30.97
Mean v4	95.22%	233243	5.19	21.12	29.92
Mean v5	96.78%	237069	4.52	19.92	28.56

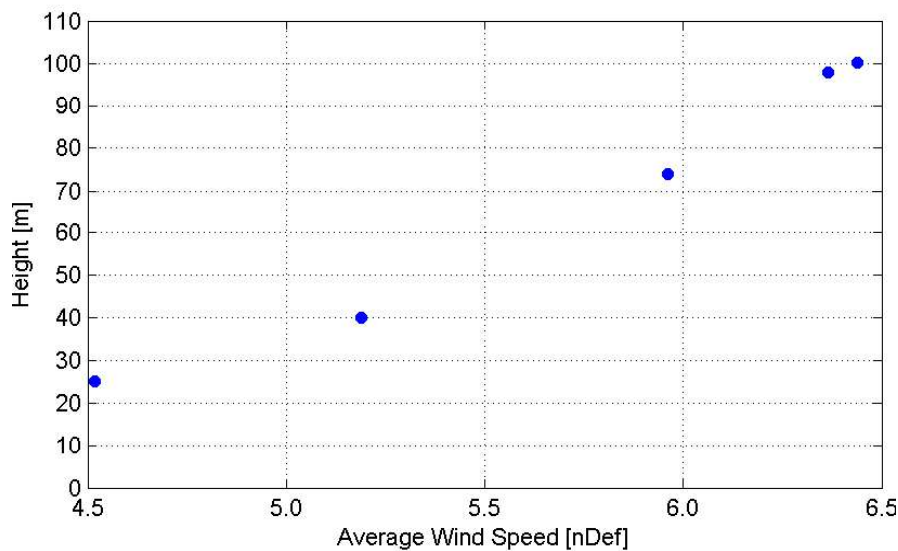


Figure 5.27: Average of wind speed as function of the measured height

### 5.10.2 Turbulence Intensity

Table 5.67 Overview of measured Turbulence intensities per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
Mean v1	0.102	0.113	0.117	0.117	0.109	0.100	0.100	0.074	0.084	0.098	0.100	0.105	0.108
Mean v2	0.102	0.114	0.118	0.117	0.112	0.100	0.100	0.066	0.085	0.098	0.101	0.106	0.108
Mean v3	0.110	0.123	0.128	0.124	0.122	0.109	0.109	0.072	0.096	0.106	0.107	0.113	0.116
Mean v4	0.127	0.147	0.153	0.147	0.151	0.135	0.113	0.085	0.100	0.117	0.118	0.137	0.139
Mean v5	0.149	0.161	0.167	0.162	0.180	0.170	0.142	0.117	0.147	0.141	0.128	0.151	0.155

### 5.10.3 Wind Shear

Table 5.68 Overview of measured Wind shears per wind speed bin and per sector

Wind Speed	Mean	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
[m/s]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
Mean v1-v3	0.229	0.215	0.291	0.301	0.276	0.204	0.191	0.217	0.227	0.091	0.255	0.258	0.190
Mean v3-v4	0.230	0.236	0.257	0.204	0.253	0.280	0.249	0.253	0.192	0.202	0.183	0.229	0.240
Mean v4-v5	0.319	0.260	0.283	0.258	0.346	0.385	0.330	0.442	0.504	0.362	0.221	0.264	0.283

## 6 Measurement Uncertainty

### 6.1 Determination of Measurement Uncertainty

The standard uncertainty of the measurements was calculated according to IEC 61400-12-1 [1] and reference [10] from the assumptions listed below.

Table 6.1: Assumed uncertainty components

Component	Value	Unit
<b>wind speed 100.2m</b>		
wind tunnel calibration	0.055	[m/s]
class according IEC-61400-12-1	1.7	
measurement range	50	[m/s]
data acquisition system	0.01	[% of measurement range]
mounting effects	1	[%]
mast correction / mast effects	0.0	[%]
boom (vertical distance)	0.0	[%]
filling of gaps	0.0	[%]
<b>total standard uncertainty relative to average wind speed</b>	<b>1.8</b>	<b>[%]</b>
<b>wind speed 97.9m</b>		
wind tunnel calibration	0.055	[m/s]
class according IEC-61400-12-1	1.7	
measurement range	50	[m/s]
data acquisition system	0.01	[% of measurement range]
mounting effects	1	[%]
mast correction / mast effects	0.0	[%]
boom (vertical distance)	0.3	[%]
filling of gaps	0.0	[%]
<b>total standard uncertainty relative to average wind speed</b>	<b>1.8</b>	<b>[%]</b>
<b>wind speed 74.0 m</b>		
wind tunnel calibration	0.055	[m/s]
class according IEC-61400-12-1	1.7	
measurement range	50	[m/s]
data acquisition system	0.01	[% of measurement range]
mounting effects	1	[%]
mast correction / mast effects	0.0	[%]
boom (vertical distance)	0.3	[%]
filling of gaps	0.0	[%]
<b>total standard uncertainty relative to average wind speed</b>	<b>1.9</b>	<b>[%]</b>
<b>wind speed 40.0 m</b>		
wind tunnel calibration	0.055	[m/s]
class according IEC-61400-12-1	1.7	
measurement range	50	[m/s]
data acquisition system	0.01	[% of measurement range]
mounting effects	1	[%]
mast correction / mast effects	0.0	[%]
boom (vertical distance)	0.3	[%]
filling of gaps	0.0	[%]
<b>total standard uncertainty relative to average wind speed</b>	<b>2.0</b>	<b>[%]</b>

<b>wind speed 25.0 m</b>		
wind tunnel calibration	0.055	[m/s]
class according IEC-61400-12-1	1.7	
measurement range	50	[m/s]
data acquisition system	0.01	[% of measurement range]
mounting effects	1	[%]
mast correction / mast effects	0.0	[%]
boom (vertical distance)	0.3	[%]
filling of gaps	0.0	[%]
<b>total standard uncertainty relative to average wind speed</b>	<b>2.2</b>	<b>[%]</b>
<b>wind direction</b>		
vane accuracy	2	[°]
mounting error	2	[°]
data acquisition system	1	[°]
northing	2	[°]
declination angle	0.50	[°]
<b>total standard uncertainty</b>	<b>3.6</b>	<b>[°]</b>
<b>air temperature</b>		
sensor calibration	0.5	[K]
radiation shielding	2	[K]
measurement range	100	[K]
data acquisition system	0.1	[% of measurement range]
<b>total standard uncertainty</b>	<b>2.1</b>	<b>[K]</b>
<b>air pressure</b>		
sensor calibration	0.5	[hPa]
mounting effects	0.4	[hPa]
measurement range	300	[hPa]



## 6.2 Uncertainty per Wind Speed Bin

Table 6.2: Standard uncertainties of wind speed measurements as function of wind speed in each measurement height

wind speed	standard uncertainty									
	100.2 m		97.9 m		74.0 m		40.0 m		25.0 m	
	relative	absolute	relative	absolute	relative	absolute	relative	absolute	relative	absolute
[m/s]	[%]	[m/s]	[%]	[m/s]	[%]	[m/s]	[%]	[m/s]	[%]	[m/s]
1	7.7	0.08	7.7	0.08	7.7	0.08	7.7	0.08	7.7	0.08
2	4.1	0.08	4.1	0.08	4.1	0.08	4.1	0.08	4.1	0.08
3	2.9	0.09	3.0	0.09	3.0	0.09	3.0	0.09	3.0	0.09
4	2.4	0.10	2.4	0.10	2.4	0.10	2.4	0.10	2.4	0.10
5	2.1	0.10	2.1	0.10	2.1	0.10	2.1	0.10	2.1	0.10
6	1.9	0.11	1.9	0.11	1.9	0.11	1.9	0.11	1.9	0.11
7	1.7	0.12	1.7	0.12	1.7	0.12	1.7	0.12	1.7	0.12
8	1.6	0.13	1.6	0.13	1.6	0.13	1.6	0.13	1.6	0.13
9	1.5	0.14	1.6	0.14	1.6	0.14	1.6	0.14	1.6	0.14
10	1.5	0.15	1.5	0.15	1.5	0.15	1.5	0.15	1.5	0.15
11	1.4	0.16	1.5	0.16	1.5	0.16	1.5	0.16	1.5	0.16
12	1.4	0.17	1.4	0.17	1.4	0.17	1.4	0.17	1.4	0.17
13	1.4	0.18	1.4	0.18	1.4	0.18	1.4	0.18	1.4	0.18
14	1.3	0.19	1.4	0.19	1.4	0.19	1.4	0.19	1.4	0.19
15	1.3	0.20	1.4	0.20	1.4	0.20	1.4	0.20	1.4	0.20
16	1.3	0.21	1.3	0.21	1.3	0.21	1.3	0.21	1.3	0.21
17	1.3	0.22	1.3	0.22	1.3	0.22	1.3	0.22	1.3	0.22
18	1.3	0.23	1.3	0.24	1.3	0.24	1.3	0.24	1.3	0.24
19	1.3	0.24	1.3	0.25	1.3	0.25	1.3	0.25	1.3	0.25
20	1.3	0.25	1.3	0.26	1.3	0.26	1.3	0.26	1.3	0.26
21	1.3	0.26	1.3	0.27	1.3	0.27	1.3	0.27	1.3	0.27
22	1.2	0.27	1.3	0.28	1.3	0.28	1.3	0.28	1.3	0.28
23	1.2	0.28	1.3	0.29	1.3	0.29	1.3	0.29	1.3	0.29
24	1.2	0.29	1.3	0.30	1.3	0.30	1.3	0.30	1.3	0.30
25	1.2	0.31	1.3	0.31	1.3	0.31	1.3	0.31	1.3	0.31

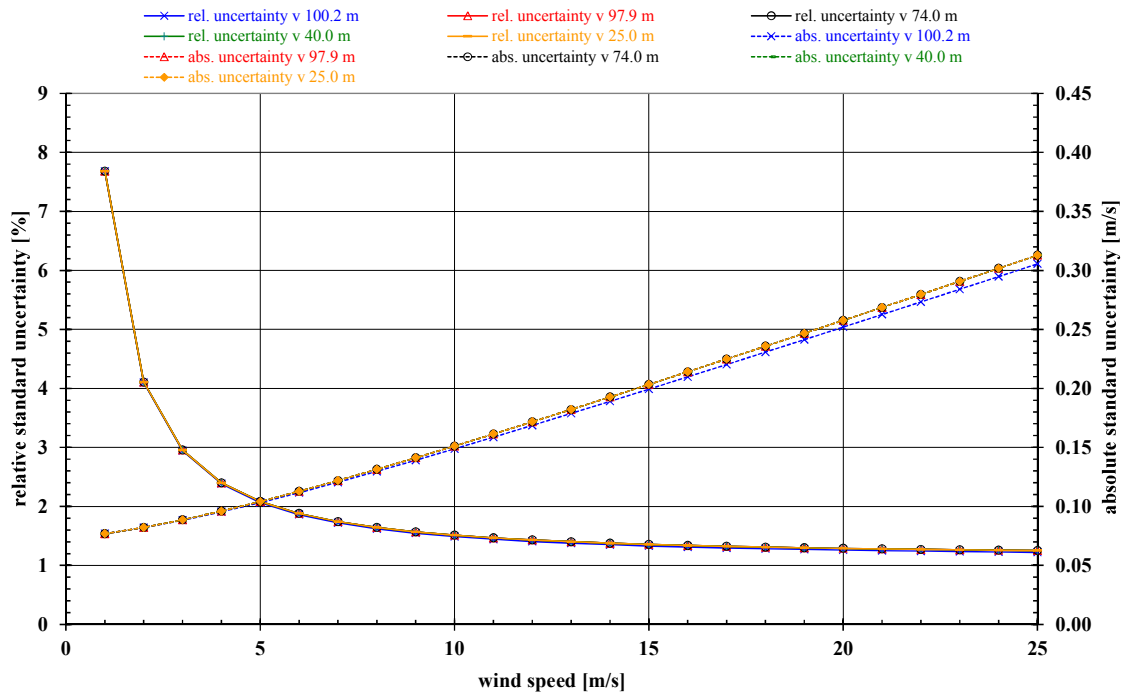


Figure 6.1: Relative and absolute overall uncertainties of wind speed measurements

## **7 Deviations from IEC 61400-12-1 [1], MEASNET Guideline ‘Evaluation of Site Specific Wind Conditions’ [4] and Technical Guidelines for Wind Turbines, Part 6 [10].**

- The configuration of the control anemometer and tested anemometer for the in-situ test in case of the measurement heights 40.0 m and 25.0 m does not fulfil the requirements of IEC 61400-12-1, as the distance of the sensors is larger than demanded. Still the in-situ test reasonably indicates that no significant changes of the anemometer calibrations took place during the measurement period.
- The air humidity sensor was not calibrated. The influence on the evaluated air density is negligible, as air density is mainly depending on air temperature and air pressure.
- This report covers only the measurement tasks according to MEASNET Guideline Evaluation of Site Specific Wind Conditions [4]. A full site assessment according to this guideline was not subject of the assigned work.

## 8 References

- [1] IEC 61400-12-1, Wind turbines, Part 12-1: Power performance measurements of electricity producing wind turbines, 2005
- [2] IEC 61400-1, Wind turbines, Part 1: Design requirements, Second Edition, 1999
- [3] IEC 61400-1, Wind turbines, Part 1: Design requirements, Third Edition, 2005
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- [5] T.F. Pedersen, J.-A. Dahlberg, P. Busche; ACCUWIND – Classification of Five Cup Anemometers According to IEC 61400-12-1, Risoe National Laboratory Denmark, report Risoe-R-1556(EN), May 2006
- [6] A. Albers; Identification of variables for Site Calibration and Power Curve Assessment in Complex Terrain; Project Task 6, Relative Power Curve Measurements in Flat terrain, Final Report-No.: JOR3-CT98-0257-0601-DEWI07, 2001
- [7] Investigation and Classification of the Anemometer Thies First Class, Excerpt of report Deutsche WindGuard Wind Tunnel Services GmbH AK 03 002, 2003-04-07
- [8] MEASNET, Cup Anemometer Calibration Procedure, 1997
- [9] H. Bergström et al; Improved Tools to Predict Wind Energy in Mountain, Part B: Extreme Winds, Finnish Meteorological Institute, Helsinki 2000
- [10] Technical Guidelines for Wind Turbines, Part 6: Evaluation of Wind Resource and Energy Yields, 2011-05-19, Revision 8, Fördergesellschaft Windenergie e.V., D-22083 Hamburg, Germany
- [11] ISO: Information Publication: Guide to the expression of uncertainty in measurement 1995, ISBN 92-67-10188-9
- [12] ISO 2533: 1975, standard atmosphere
- [13] QM-PKL-MV-VA, Verfahrensanweisung für Windmessungen an Standorten und potentiellen Standorten von Windenergieanlagen, Deutsche WindGuard quality management system

## 9 Appendix

### 9.1 Installation Protocol and Amendments

#### 9.1.1 Installation Protocol

	<p align="center"><b>Documentation</b> VC09002 Wind Measurement at Lozenec, Bulgaria</p>
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### Installation Report

Project	VC09002	
Task	Wind Measurement	
Client	IWC Innovative Wind Concepts	
Site	Lozenec, Bulgaria	
Height	100 m	
Mast Type	tubular	
Contact Person at WindGuard	Markus Meyer zu Himmern Tim Jakobi	+49 (0) 152 08971987 +49 (0) 172 440 40 20
Contact Person Customer	Oliver Lütz, Lars Levermann	+49 (0) 4841 8944 956 +49 (0) 4841 8944 281
Contact Person on Site		Tel.
Subcontractor		Tel.
Person in Charge Windhunter	Roman Synowski Rafal Kramek	+48 (0) 94 - 341 64 85
Person in Charge WindGuard	Markus Meyer zu Himmern Tim Jakobi	+49 (0) 152 08971987 +49 (0) 172 440 40 20
Date of Erection	2009 Week 07	

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<b>Deutsche WindGuard GmbH</b> <b>Deutsche WindGuard Consulting GmbH</b> <b>Deutsche WindGuard Wind Tunnel Services GmbH</b> Oldenburger Str. 65, 26316 Varel Tel.: 04451 - 95 15 – 0, Fax: – 29
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## 1 Sensors

No.	Sensor	Type	Serial	Calibration	Height (m)	Orientation	Remark
1	V1	Thies First Class	0806153	08_3083	100,22m	Central	
2	V2	Thies First Class	0806149	08_3080	97,925m	355° MaN	
3	V3	Thies First Class	1005388	08_3081	73,96m	355° MaN	
4	dir1	Thies First Class	0208489		97,915m	180° MaN	North pointing outwards Logger: 4°
5	dir2	Thies First Class	0208490		39,95m	179° MaN	North pointing outwards Logger: 356°
6	H1	KPK1/6ME	60330		24,5m	178° MaN	
7	T1	KPK1/6ME	60330	IK08_0015	24,5m	178° MaN	
8	B1	Ammonit AB60	B08-0008	IK08_0003	Cabinet 5m	135° MaN	
9	V4	Thies First Class	0806151	08_3082	39,96m	358° MaN	
10	V5	Thies First Class	0706084	08_3084	24,96m	358° MaN	Ausleger Biegung nach oben und nach Osten
11	T2	TPK1/6ME	64708	IK08_0014	97,485m	180° MaN	
12	Pyrano	Kipp&Zonen CMP 3	071706		9m	180° MaN	Pyranometer CMP 3
13							
	Light- ning rod WEC	-				213° MaN	
	Solar		ET- M59601BE16046			180° MaN	12V / 20W

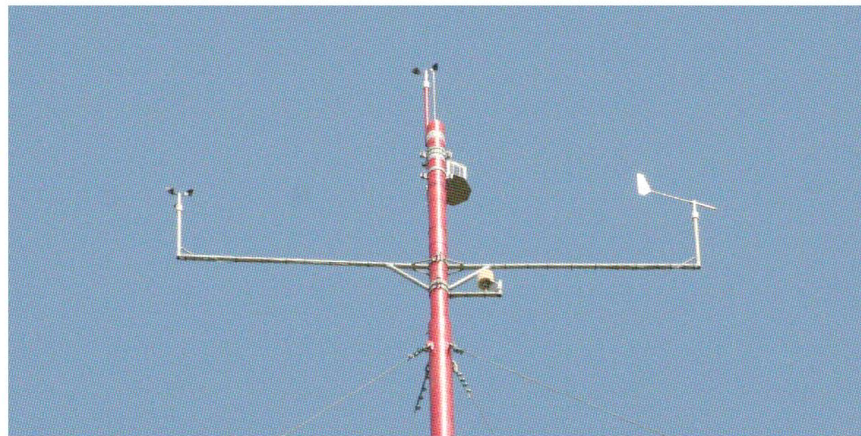
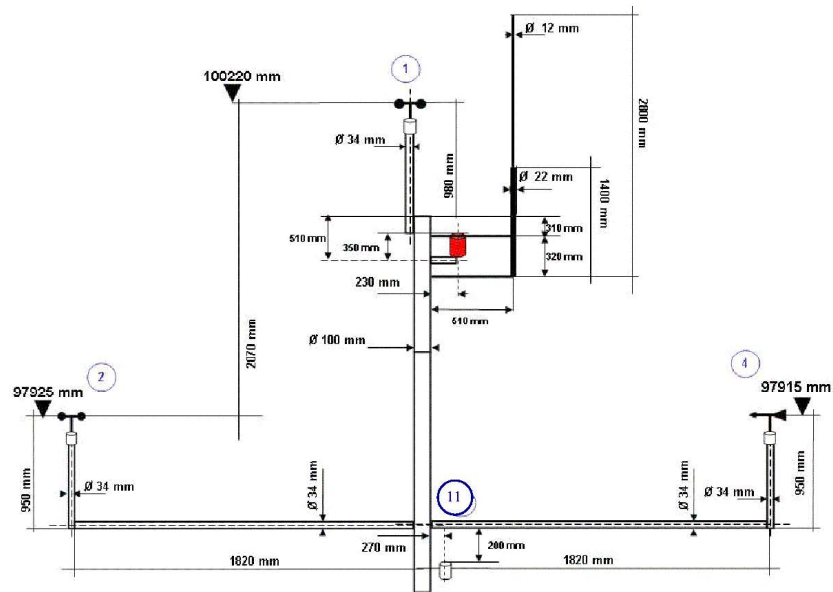
Orientation in magnetic north (MaN) (geographic north (GeN) or map grid north (GiN))

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## 2 Mast

### Top (100 m)

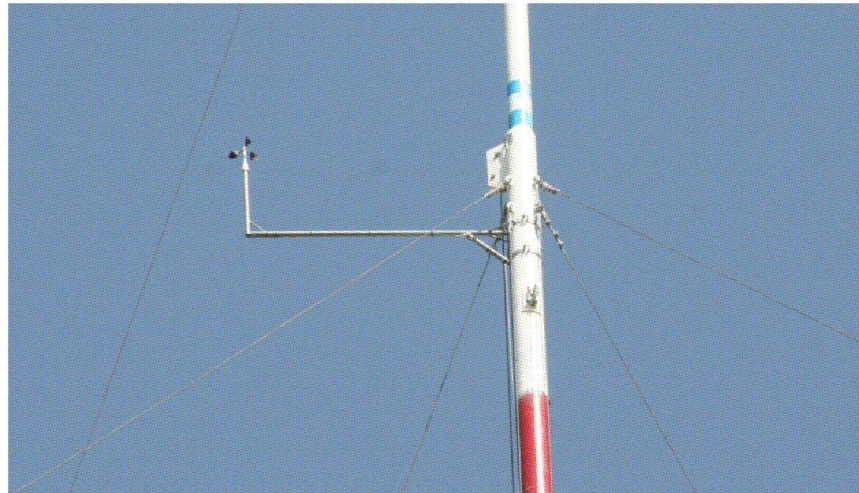
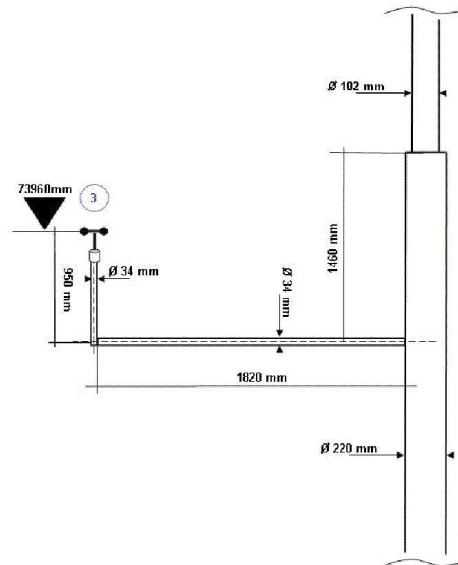


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**Boom (74 m)**

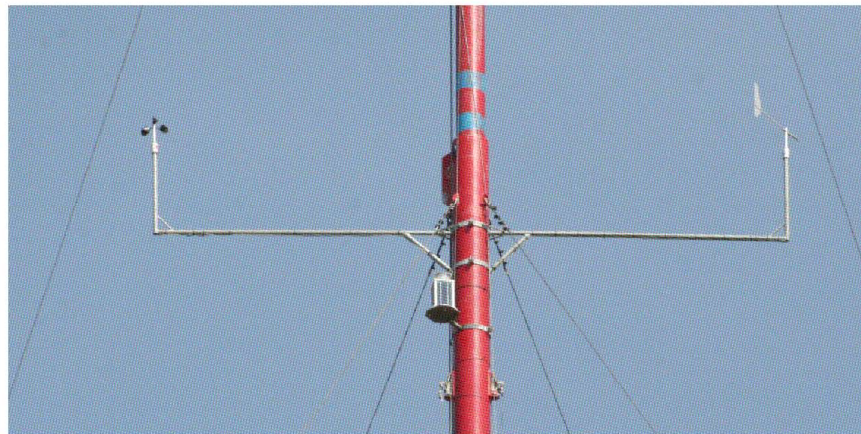
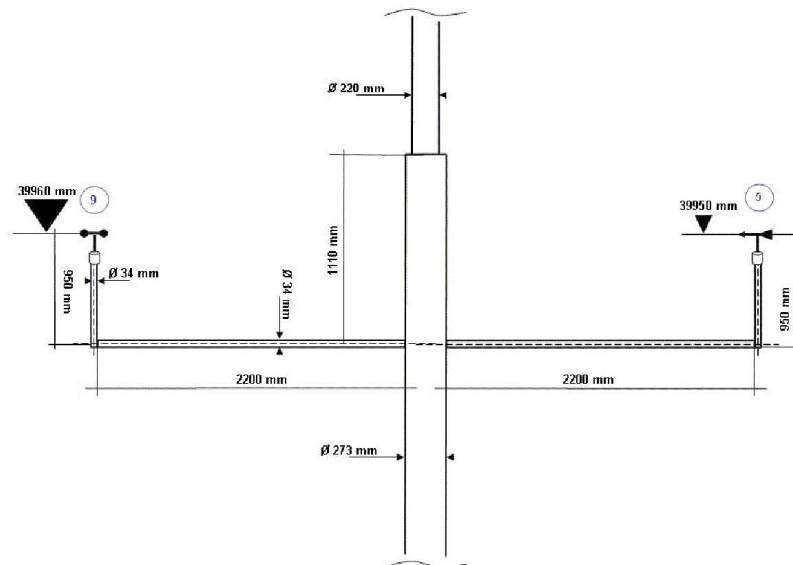


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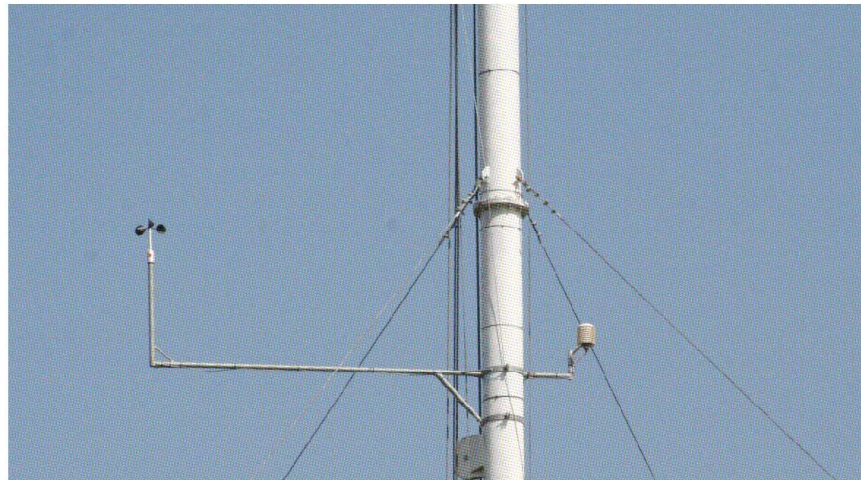
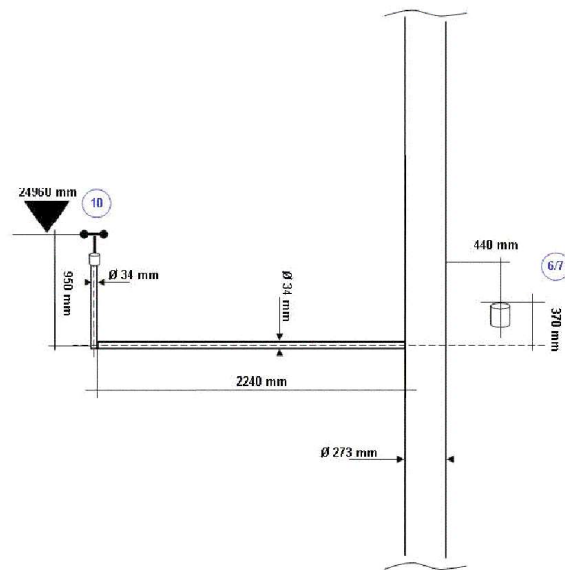
**Boom (40 m)**



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**Boom (25 m)**



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### 3 Logger

Sampling rate	1/sec	
Average interval	10 minutes	
Logger type	Meteo 32X	
Serial	C08-0016	
Software	V1.6, date: 01nov07	
Logger password	No Password	
Mobile number	+49(0)1724119731	
PIN	No Pin	
SIM card provider	Vodafone	
Provider at site, Signal quality	M-Tel BG, Q 6	
GSM connection times	06:00; 09:00; 10:00; 14:00	
Modem registered for	45 minutes	
GPRS APN	Web.vodafone.de	
GPRS User-ID, password	foo, boo	
SMTP-Server	e.g. smtp.1und1.de	
SMTP User-ID	e.g. datasend@windguard.de	
SMTP password	*****	
SMTP e-mail (1 <sup>st</sup> )	winddata@wkn-ag.de	
SMTP e-mail (2 <sup>nd</sup> )	winddata@windguard.de	
Supply	Solar, 7Ah, 20 W	
Clock	MET, Middle European Time (UTC+01)	
Start of data sampling according to logger time	12.02.2009 10:10:00	

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#### 4 Location

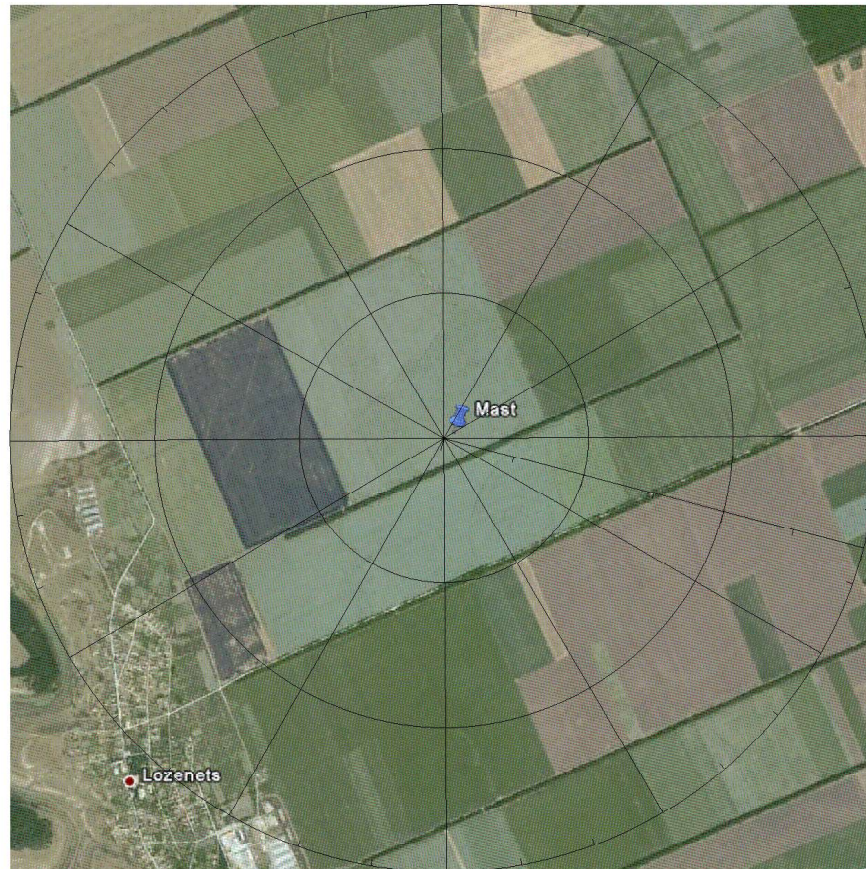
Object	X	Y	Height	Remark
Mast	559761	4847264	213 m	Met mast
Coordinate System:		UTM		
Date:		WGS 84	Zone:	35 T

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**Sketch of Surroundings**



Describe obstacles if they are higher than 3 third measurement height and closer than 50 times the obstacle height (a1, R1, a2, R2, H, P)

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## 5 Remarks

Keys of cabinet lock, transmission cable at:	-

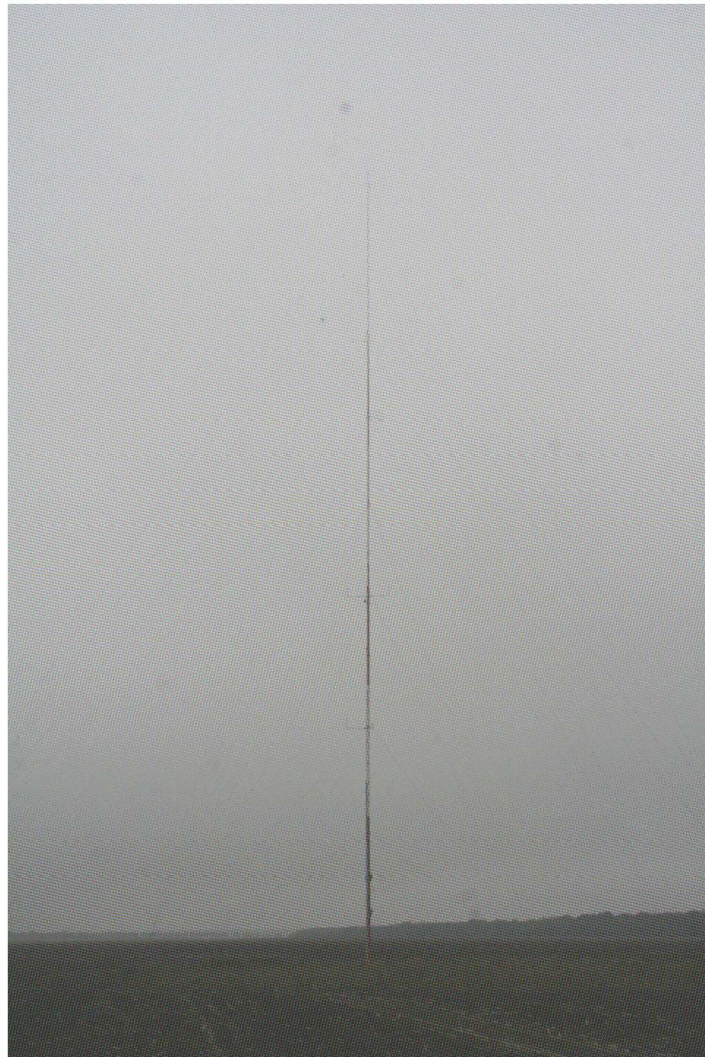
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### 6 Photo of entire met mast



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Name: Tim Jakobi/ Markus Meyer zu Himmern