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Energy Island North Sea

Site Wind Conditions Assessment

Energy Island North Sea

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Executive Summary

Objective

The objective of this technical report is to present the findings of the Site Wind Conditions Assessment conducted by EMD International A/S for Energinet in relation to the Energy Island project in the North Sea.

Background

Energinet has commissioned the construction of an artificial island in the North Sea, which will serve as a hub for offshore wind farms. The Energy Island project is expected to generate significant amounts of renewable energy and reduce carbon emissions. As wind is the primary source of energy for the project, a thorough assessment of the site wind conditions is crucial for its successful implementation.

Methodology

The site wind condition assessment is based on 12 months of onsite measurements using floating LiDAR systems (FLS) in the North Sea Energy Island Offshore Wind farm Zone (OWF) and delivers the site wind condition parameters according to IEC 61400-1 [1], IEC 61400-3-1 [2] and in addition refers to Eurocode EN1991-1-4 [3] including the Danish annex [4], DS 472 ed.2 [5] and IEC 61400-15-1 CD [6].

The site wind conditions assessment is intended to serve as basis for:

- Preliminary site-suitability analysis of the Wind Turbine Generator (WTG) and Rotor Nacelle Assembly (RNA)
- Front-End Engineering and Design (FEED) of offshore support structures for WTGs and other structures.

The report includes a presentation and analysis of onsite data from the two buoys deployed on site as well as secondary measurements surrounding the site and sourced for this purpose. A wind model has been created for the site through long-term correction of 12 months of onsite LiDAR data with 20 years of EMD-WRF mesoscale data (labelled "Primary Wind Model").

The Primary Wind Model has been backed up by three alternative models, based on data from the FLS for the offshore project Thor, the FINO3 meteorological mast and Harald B oilrig. The three alternative models are in good agreement with the Primary Model on mean wind speed for the site, given the distance from the North Sea Energy Island OWF and the data quality.

Due to the short measurement period and the nature of the LiDAR measurements, the site condition parameters are supported or replaced by data from secondary sources. These include the GASP [7] dataset, secondary measurements or WRF model data.

Calculations are done in windPRO 3.6 and 4.0, developed by EMD International A/S.

Results

The site condition parameters are summarized in Table 1.

Table 1. Summary table of Site Wind Condition parameters at the three selected positions on the North Sea Energy Island OWF zone. All values refer to 150 m height above sea level (ASL). Based on 1 year of onsite measurements.

PARAMETER	POSITION 1	POSITION 2	POSITION 3
Mean wind speed	10.91 m/s	10.80 m/s	10.95 m/s
Weibull distribution, A parameter (scale)	12.31 m/s	12.19 m/s	12.35 m/s
Weibull distribution, k parameter (shape)	2.36	2.33	2.35
Normal wind profile power law exponent	0.093	0.092	0.093
Turbulence intensity mean value (TI_{μ}) at a 10-min average wind speed of 15m/s*	5.1%	5.1%	5.1%
Turbulence intensity standard deviation (TI_{σ}) at a 10-min average wind speed of 15m/s*	2.0%	2.0%	2.0%
Turbulence intensity 90% quantile at a 10-min average wind speed of 15m/s*	7.7%	7.7%	7.7%
Mean air density	1.23 kg/m^3	1.23 kg/m^3	1.23 kg/m^3
Mean air temperature	8.9°C	9.0°C	8.9°C
50-year extreme wind speed	51.8 m/s	51.8 m/s	51.8 m/s
1-year extreme wind speed	29.1 m/s	29.1 m/s	29.1 m/s
Wind shear for extreme wind speed extrapolation	0.11	0.11	0.11
Characteristic turbulence intensity at 50-year extreme wind speed	13.0%	13.0%	13.0%
Air density for extreme wind	1.24 kg/m^3	1.24 kg/m^3	1.24 kg/m^3

*Turbulence values at other wind speeds can be found in Appendix H.

The datasets produced by this study are available in a data package prepared for Energinet.

Recommendations

EMD recommends updating this site wind conditions parameter assessment once the measurement campaign has been concluded.

Contents

List of Figures

List of Tables

1 Introduction

EMD International A/S has been tasked by Energinet to provide a site wind condition assessment for the Energy Island North Sea.

The objectives of the site wind condition assessment are outlined in the Scope of Services Site Wind Conditions Assessment [8] provided by Energinet and aims for a site wind condition assessment adequate for a preliminary site-suitability analysis for the Wind Turbine Generator (WTG) and Rotor Nacelle Assembly as well as input for Front-End Engineering and Design (FEED) of offshore support structures for WTGs and other structures.

The parameters for the wind condition assessment are listed in Table 2 and are defined according to IEC61400-1 [1], IEC 61400-3-1 [2] and IEC 61400-15-1 CD [6].

Table 2. List of Site Wind Conditions Parameter.

SITE WIND PARAMETERS AT 150 M MSL	
Normal Conditions Parameters	**Extreme Conditions Parameters**
Mean wind speed	Extreme Turbulence Model (ETM) at hub height
Omni-directional Weibull wind speed distribution parameters	Wind profile for extreme wind speed extrapolation with elevation
Wind profile for wind speed extrapolation with elevation	Wind profile for integrated load analysis
Wind profile for Integrated Load Analysis, Normal Wind Profile (NWP)	Turbulence intensity
Normal Turbulence Model (NTM)	Mean air density
Mean air density	Maximum 10-minute mean wind speed for a 50-year EWM
Mean air temperature	

The site wind condition parameter list is populated through a wind condition and resource assessment based on onsite floating LiDAR data from two locations and mesoscale WRF data. This model is supported by a selection of secondary stations located within meaningful distance of the North Sea Energy Island wind farm zone.

Beside the present report, measurement data as well as WRF and long-term corrected datasets are provided in the form of time series text files.

All elevations throughout are referred to as Above Sea Level (ASL) with the reference sea level being the mean sea level.

A naming convention is used for turbulence conditioned on wind speed where 'mean turbulence' is the mean of 10min wind speed standard deviations (σ) within a wind speed bin. The 'standard deviation of turbulence' is the standard deviation across 10min wind speed standard deviations ($\sigma\sigma$) in a wind speed bin. Both these quantities (mean and standard deviation of turbulence) may be normalized to the wind speed of the wind speed bin in question, in this case the normalized turbulence is referred to as Turbulence Intensity (TI), either mean or standard deviation.

2 Site Description

Energy Island North Sea is located in the North Sea, off the coast of Jutland, Denmark (Figure 1).

The North Sea Energy Island Offshore Wind farm Zone (OWF) is defined through the boundary nodes listed in Table 3.

Closest distance to land from the OWF zone is 81 km.

The neighbouring planned Thor Offshore Wind Farm is located 52 km to the east. Thor is the closest wind farm operating or in advanced planning.

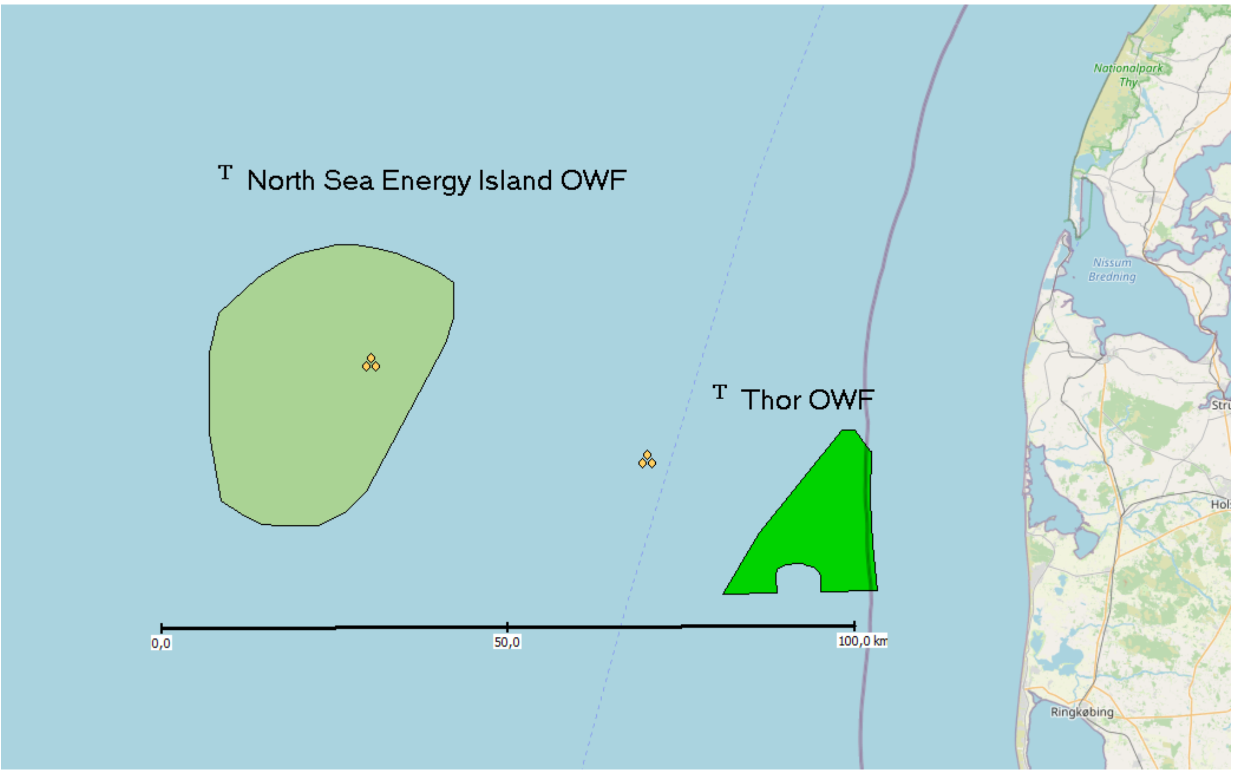


Figure 1. Regional map with location of the North Sea Energy Island OWF and Thor OWF (OpenStreetMap).

Table 3. North Sea Energy Island OWF zone boundary nodes (Geographic coordinates, datum WGS84)

NODE	EASTING	NORTHING
N1	6.2423˚	56.6030˚
N2	6.3343˚	56.6483˚
N3	6.3796˚	56.6653˚
N4	6.4249˚	56.6796˚
N5	6.5170˚	56.6906˚
N6	6.5623˚	56.6917˚
N7	6.6083˚	56.6872˚
N8	6.6557˚	56.6808˚
N9	6.7455˚	56.6592˚
N10	6.7909˚	56.6426˚
N11	6.7909˚	56.5981˚
N12	6.7690˚	56.5650˚
N13	6.5860˚	56.3755˚
N14	6.5401˚	56.3485˚
N15	6.4777˚	56.3305˚
N16	6.4318˚	56.3298˚
N17	6.3865˚	56.3305˚
N18	6.3406˚	56.3323˚
N19	6.2947˚	56.3450˚
N20	6.2488˚	56.3616˚
N21	6.2201˚	56.4476˚
N22	6.2201˚	56.4773˚
N23	6.2201˚	56.5515˚
N24	6.2423˚	56.6030˚

The wind farm zone is located in open water with sufficient distance to any shoreline (minimum 81 km). It is assumed that direct effect of these is negligible and only represented in the variation in wind speed gradient across the site. For this reason, no further terrain assessment has been conducted. The water depth within the OWF is between 25 and 45 m.

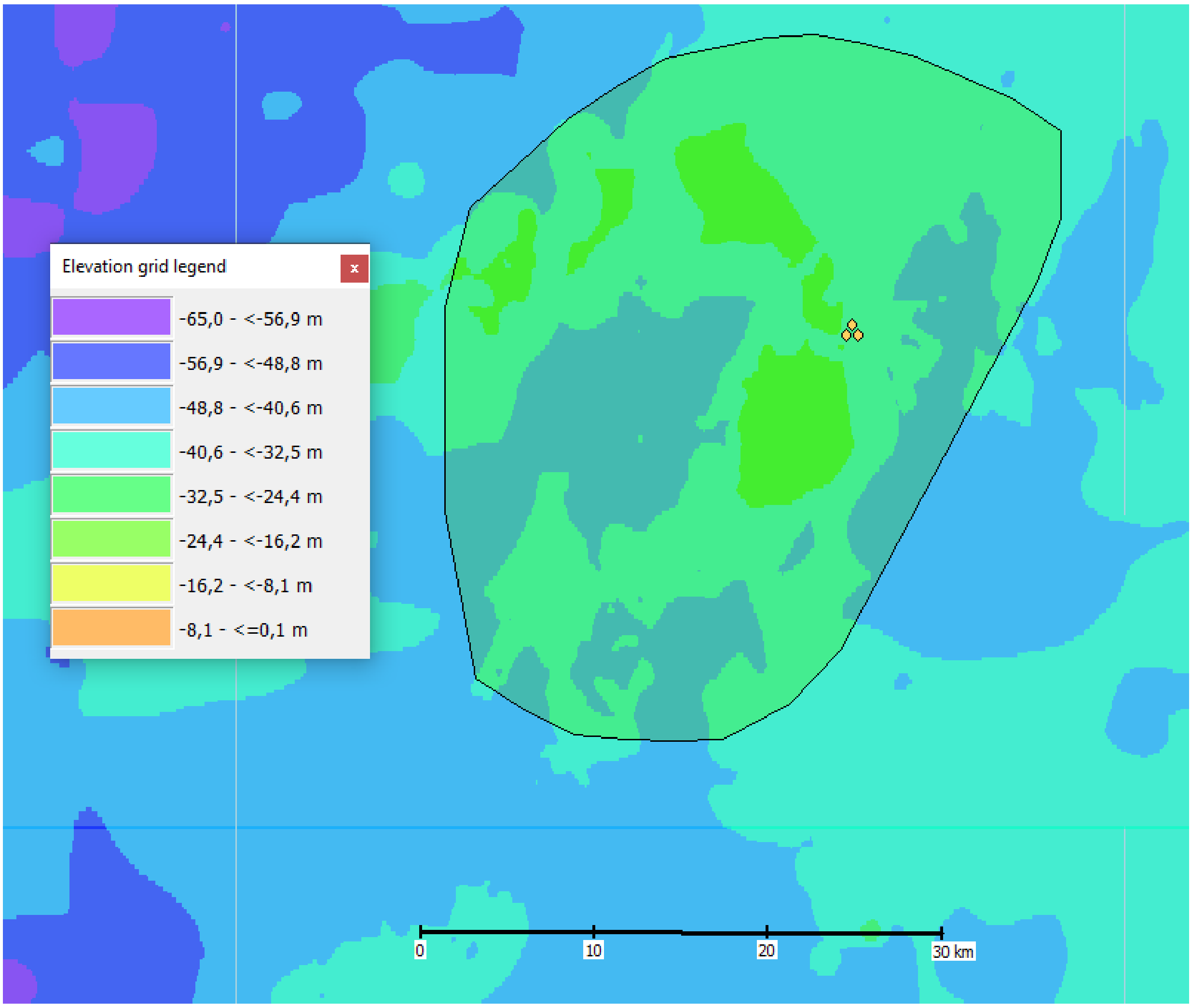


Figure 2. Bathymetric map of North Sea Energy Island OWF (source: EMODnet – 115 m grid resolution)

3 Overview of Available Wind Data

A host of wind data measurements was considered for the wind condition and resource analysis. Each source is listed in Table 4 and Table 5 and considered in the following.

The two onsite floating LiDAR Systems (FLS), commissioned by Energinet, are the primary source of information and are used for the primary wind model. The data are described in section 4.

For the validation of the primary wind model data from Thor, FINO3 and Harald B are used.

For the turbulence model data from FINO3, Høvsøre and mast M2 are used.

Data from oil rigs and ground station from the Danish Meteorological Institute (DMI) and the Norwegian Meteorological Institute (MET Norway) are primarily used to verify the long-term variation in wind climate or the temperature profile for the site.

A number of meteorological stations were considered but it was found that their data were either of insufficient quality, were not representative for the site or redundant, and were therefore not used in this study.

The DMI observations have been retrieved via:
https://confluence.govcloud.dk/display/FDAPI/Meteorological+Observation

The MET Norway data have been retrieved via the Frost API : https://frost.met.no/index.html

The data from the German Federal Maritime and Hydrographic Agency (BSH) has been retrieved from their InSitu-Portal: https://insitu.bsh.de/rave/index.jsf?content=insitu

The measurement locations are plotted on a map in Figure 3.

All secondary data used in this study are presented in Appendix A.

Table 4. Measurement stations considered in the study, including wind speed and temperature (temp) measurement heights ASL and period. FLS: Floating LiDAR System.

NAME	TYPE	MEASUREMENT HEIGHT [M] ASL	MEASUREMENT PERIOD	LENGTH [YEARS]
Lot 1 WS170	LiDAR (FLS)	30 - 270	15/11/2021 – 15/11/2022	1
Lot 2 WS181	LiDAR (FLS)	30 - 270	15/11/2021 – 15/11/2022	1
Thor	LiDAR (FLS)	43 - 200	18/05/2020 - 20/05/2021	1
M2	Met-Mast	62, 45, 30, 15	01/05/2005 - 30/04/2006	1
FINO3	Met-Mast	107, 101, 91, 81, 71, 61, 51, 41, 31	01/01/2010 - 31/12/2013	4
Høvsøre	Met-Mast	116.8, 100.3, 80.3, 60.3, 40.3	31/05/2004 -31/05/2019	15
Harald B	Sensors on oil rig	69	01/10/2015 – 01/11/2022*	4
Sleipner-A	Sensors on oil rig	10, 2 (temp)	01/04/1995 - 31/03/2022	26
Ekofisk	Sensors on oil rig	10, 2 (temp)	01/01/1984 - 31/01/2022	39
Valhall A	Sensors on oil rig	2 (temp)	01/01/2005 - 31/01/2022	8
Hvide Sande	Climate Met-Mast	11.9, 3.9 (temp)	01/01/2002 - 31/12/2022	20
Thyborøn	Climate Met-Mast	12.0, 4.0 (temp)	01/01/2001 - 31/12/2022	21
Lista Fyr	Climate Met-Mast	22.6, 14.6 (temp)	01/01/1995 - 31/12/2022	28
Lindesnes Fyr	Climate Met-Mast	28.6, 20.6 (temp)	01/01/2006 - 31/12/2022	17
Ula	*Sensors on oil rig*	*10, 2 (temp)*	*(not used)*	*(not used)*
Lomond	*Sensors on oil rig*	*10, 2 (temp)*	*(not used)*	*(not used)*
Yme	*Sensors on oil rig*	*10, 2 (temp)*	*(not used)*	*(not used)*
Gorm C	*Sensors on oil rig*	*29*	*(not used)*	*(not used)*
NSBIII	*Climate buoy*	*10, 2 (temp)*	*(not used)*	*(not used)*
Blåvandshuk Fyr	*Climate Met-Mast*	*28.8*	*(not used)*	*(not used)*

*Four non-consecutive years, as detailed in Appendix A.1.1a.v.

Table 5. Location of external wind measurements (geographic coordinates, datum WGS84).

NAME	LONGITUDE	LATITUDE	Z [M]	PROVIDER (CODE#)
Lot 1 WS170	6.3007°	56.6280°	0.0	Energinet
Lot 2 WS181	6.4574°	56.3444°	0.0	Energinet
Thor	7.6050°	56.3467°	0.0	Energinet
M2	7.7870°	55.5201°	0.0	Energinet
FINO3	7.1583°	55.1950°	0.0	BHS
Høvsøre	8.1509°	56.4405°	0.3	Energinet/DTU
Harald B	4.2719°	56.3442°	0.0	DMI (06018)
Sleipner-A	1.9091°	58.3711°	0.0	MET Norway (SN76926)
Ekofisk	3.2243°	56.5434°	0.0	MET Norway (SN76920)
Valhall A	3.3928°	56.2782°	0.0	MET Norway (SN76939)
Hvide Sande	8.1413°	56.0072°	1.9	DMI (6058)
Thyborøn	8.2149°	56.7072°	2.0	DMI (6052)
Lista Fyr	6.5678°	58.1089°	12.6	MET Norway (SN42160)
Lindesnes Fyr	7.0480°	57.9815°	18.6	MET Norway (SN41770)
Ula (not used)	*2.8458°*	*57.4080°*	*0.0*	*MET Norway (SN76938)*
Lomond (not used)	*2.1000°*	*57.2000°*	*0.0*	*MET Norway*
Yme (not used)	*4.5345°*	*57.8188°*	*0.0*	*MET Norway (SN76929)*
Gorm C (not used)	*4.7587°*	*55.5797°*	*0.0*	*DMI (6023)*
NSBIII (not used)	*6.7500°*	*54.6800°*	*0.0*	*BSH*
Blåvandshuk Fyr (not used)	*8.0828°*	*55.5575°*	*18.8*	*DMI (6081)*

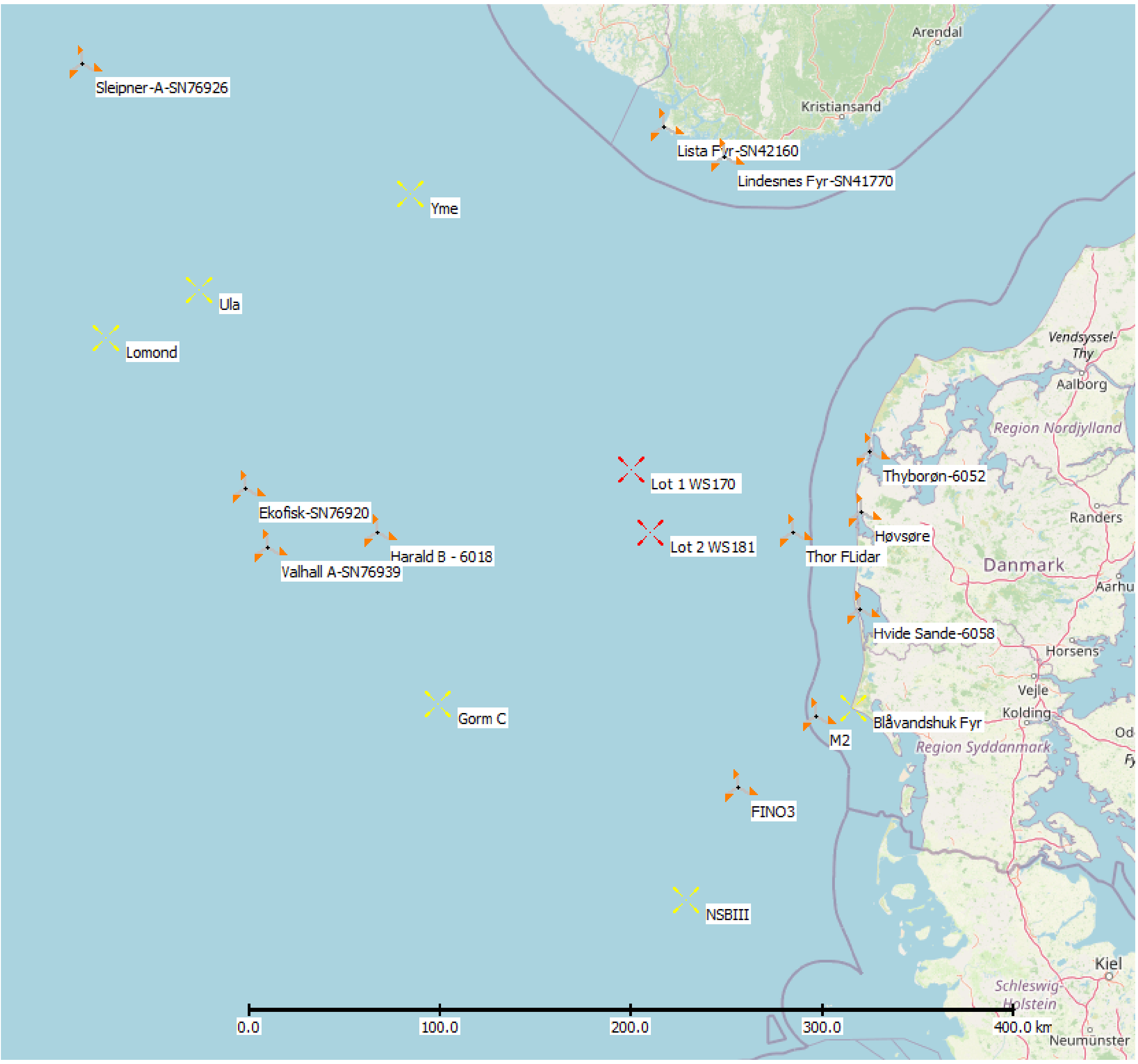


Figure 3. Location of considered measurement stations (in red the North Sea Energy Island LiDAR buoys, orange the used stations and yellow the discarded ones).

4 On-Site Floating LiDAR Measurements

Energinet has commissioned two floating LiDAR measurements on site, operated by Fugro Norway AS. The buoys are labelled LiDAR Buoy 1, WS170 and LiDAR Buoy 2, WS181 and their deployment locations are labelled Lot 1 and Lot 2 respectively. These two locations are in the following also referred to as Position 1 and Position 2. The campaign was commenced on 15/11/2021 and is ongoing.

EMD has received documentation as listed in Table 6.

EMD has received measurement data as monthly batches covering the period 15/11/2021 to 15/11/2022, hence covering consecutive 12 months.

No motion correction is applied. Averaging over 10 minutes is considered sufficient to remove motion effects on mean wind speed data. This was verified during pre-deployment verification. The detrimental effects of motion on the turbulence measurements remain.

EMD has received documentation and measurements beyond those mentioned here, but those are not used directly in this study.

Table 6. List of documentation received on the Floating LiDAR Systems (FLS).

TITLE	SOURCE	DATE	CONTENT	REFERENCE
SWLB measurements at Energy Islands	Fugro	6/4/2022	Description of instrument deployment, data collection and processing.	[9]
Energy Islands – Floating LiDAR Measurements, Monthly report (Lot2 1 + 2, 9 installments)	Fugro	25/03/2022 – 19/12/2022	Monthly reports on operation and measurements. Reports available until July – August 2022	[10]
Summary Reports of Major events (Lot 1 + 2, 7 installments)	Fugro	21/06/2022 – 31/08/2022	7 event logs describing event with impact on measurements	[11]
ZX585, Independent analysis and reporting of ZX LiDARs performance verification executed by Zephir Ltd. at the UK Remote Sensing Test Site	DNV	05/10/2021	LiDAR verification report for ZX585, mounted on WS170 (Lot 1)	[12]
ZX759, Independent analysis and reporting of ZX LiDARs performance verification executed by Zephir Ltd. at the UK Remote Sensing Test Site	DNV	17/02/2021	LiDAR verification report for ZX759, mounted on WS181 (Lot 2)	[13]
WS170, Independent performance verification of Seawatch Wind LiDAR Buoy at the LEG offshore platform	DNV	09/07/2021	Pre-deployment verification document for WS170 (Lot 1)	[14]
WS181, Independent performance verification of Seawatch Wind LiDAR Buoy at Frøya, Norway	DNV	07/05/2021	Pre-deployment verification document for WS181 (Lot 2)	[15]
DNV GL 10281716-L_1_A_20210902	DNV	02/09/2021	Statement about non-necessity of new FLS verification for WS181	[16]

4.1 Buoy Positions

The buoy deployment positions are reported by Fugro as listed in Table 7.

The buoys positions are recorded in the logged data series. EMD has plotted a section of these and can confirm that the drift of the buoys is within 100 m (Figure 4). For all practical purposes the buoys can be considered stationary.

Table 7. List of wind speed measurement locations.

BUOY	UTM WGS84, Zone 32		GEOGRAPHICAL COORDINATES WGS84	
Bouy 1, WS170, Lot 1	334,414	6,279,236	6.3007°	56.6280°
Bouy 2, WS181, Lot 2	342,856	6,247,314	6.4574°	56.3444°

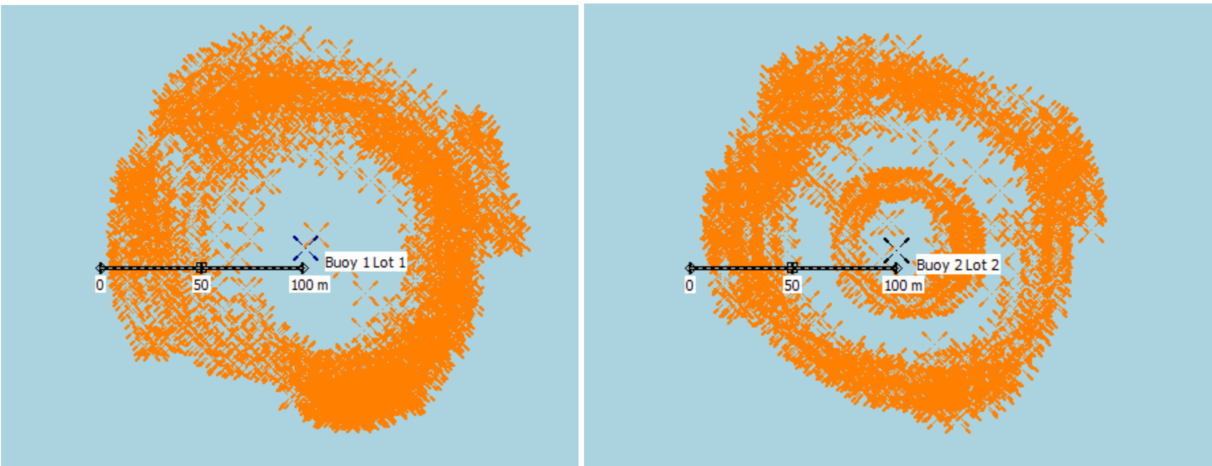


Figure 4. Section of position logs from the two buoys confirm a drift within 100 m of stated location (marked as dark X).

4.2 Instrumentation

The Fugro Seawatch buoy and instrumentation is described in the measurement plan [9].

The instrumentation on the WS170 and the WS181 is for all practical purposes identical. In the following, only instruments relevant for the analysis of the site wind conditions are described.

4.2.1 LiDAR

The LiDAR mounted on both buoys is a ZX300M LIDAR from ZXLiDARs Ltd. This LiDAR model is classified by DNV [17].

Both LiDARs (ZX585 on WS170 and ZX759 on WS181) were verified at the Pershore, UK, an onshore test site operated by DNV-GL [12] [13].

Once mounted on the buoys, the LiDARs were verified again by DNV. WS170 was verified at the TNO Lichteiland Goeree Offshore Test Site against a Windcube V2 LiDAR mounted on a platform, NL [14] and WS181 was verified at Frøya Norway [15] against an onshore LiDAR of the brand ZephIR Z300 ground-mounted on the island of Frøya.

WS170 was deployed for a period at the TNO site prior to deployment at the North Sea Energy Island site, but a technical note from DNV confirms that re-verification is not required [16].

The information from the classification and the verification was used to assess the measurement uncertainty of the LiDAR.

The LiDAR window is located at the top of the buoy and is as such elevated above sea level. This difference is compensated for in the provided data files, so that the stated height is height above sea level, not height above buoy.

4.2.2 Wind Direction

The Fugro buoys are equipped with three different wind direction sensors:

- A magnetic compass giving direction relative to magnetic north.
- The DGPS system giving the direction relative to true north.
- The LiDAR met station wind direction signal.

The DGPS is the main wind direction source, with the magnetic compass being used as backup - in case the DGPS in unavailable. The LiDAR met station signal is only used as third choice. Data are checked against the Gill wind sensor to resolve potential 180-degree direction ambiguities. This means that the wind direction signal from the buoys should be considered as relative to true north.

4.2.3 Additional Instrumentation

The Fugro buoys are equipped with additional meteorological stations. These are a Gill WindSonic ultrasonic wind sensor package, a Vaisala PTB330A pressure sensor and a Vaisala HMP155 temperature and humidity sensor.

Specifications are described by [9].

Temperature, humidity and wind speed are measured at 4.1 m height, pressure at sea level. However, as they are not used for shear or wind model analysis, they are by EMD assigned a generic height of 4 m.

4.3 Operation History

The measurement campaign started on 15/11/2021. Fugro has submitted event logs, tracking faults and flaws with the buoys [11]. Of these, only a single event has had impact on the LiDAR data:

A power supply failure caused data loss on WS170 from 06/04-2022 until 20/05-2022, where the power supply was replaced. The period remains a gap in the dataset.

4.4 Post-Processing of Data

4.4.1 Quality Control and Filtering Performed by Fugro

Fugro has provided some information on the post-processing of the LIDAR data [6]. ZX LiDARs provide a standard data filter for their LiDAR instruments, known as an industry filter, optimized to secure high quality data. This filter will remove data points with a low signal-to-noise ratio. Fugro has disabled the industry data filter on the LiDAR data and replaced it with a simple filtering algorithm (source: direct communication with Fugro). Fugro processes the LiDAR data as following:

- Of the 36-37 data packages produced every 10 minutes, 9 of these (25%) are required to qualify as a valid measurement.
- Check for duplicates.
- Filter for min and max wind speed values (0.001 m/s, 58 m/s).
- Filter for min and max wind direction values (0˚, 360˚).
- Check for 180˚ ambiguity.

Beyond the 9-data-package filter already provided by Fugro, EMD does not find that a higher package limit improves the quality of the remaining data. No further filtering using the package count has been done.

The resulting data were provided by Fugro in monthly data files:

- Wind speed, wind direction and turbulence data were provided in files labelled *xxxxxwindSpeedDirectionTI.csv*.
- The package counter was provided in files labelled *xxxxxWindStatus.csv.*
- Temperature, humidity and pressure data were provided in files labelled *xxxxxMetOceanData.csv*.

These files are provided in the data package (section 10).

It is understood that this is identical to the verification setup and that the verification is therefore valid with these filter settings.

4.4.2 Quality Control and Filtering Performed by EMD

EMD has undertaken a qualitative, manual filtering by comparing signals from the two buoys and data from several mesoscale derived datasets. Only when data differs in a substantial manner has wind speed and direction from those records been disabled. Given that the industry filter has been disabled, it is suspected that a number of faulty data points are accepted by the Fugro filtering. However, EMD finds that the dataset is remarkably good and only few such events were identified.

Fugro reports [9] that the primary wind direction sensor is measuring relative to true north. EMD has compared the wind direction signal against two independent mesoscale derived datasets (EMD-WRF and NORA3) and finds the average difference within 1˚. The difference between the two buoys is also within 1˚. EMD therefore finds the wind direction data correct with no need for adjustment.

At very low wind speed some remnants of the 180˚ ambiguity remain, but as wind direction at those wind speed is highly uncertain, no corrections to these data are made.

4.4.3 Recovery Rate and Data Substitution

As the industry filter has been disabled, the recovery rate on the data is substantially higher than sometimes experienced for ZX LiDAR measurements. Still, the LiDAR dataset suffers data loss as a result of above filtering. The recovery rates of the LiDAR are decreasing with height ASL. The recovery rates are documented in Table 10 and Table 11.

To recover some of this loss data substitution procedures were performed, one based on the measured shear, one based on the second buoy (referred to as horizontal repair). Because the expected uncertainty of the shear repair procedure is expected to be smaller than the one from the horizontal repair, the shear repair has been prioritised.

The synthesized data replaces gaps and disabled data in the recorded dataset (wind speed and direction). The TI (Turbulence Intensity) signal is not repaired, but simply copied from the lower height.

A second horizontal repair exercise is done by transferring data from WS170 to WS181 and vice versa. With this procedure data from each LiDAR measurement height is moved to the other LiDAR at the same height using a sectorial linear regression function. As source data only original data is allowed. Data generated through the shear matrix process described above are excluded from a potential transfer from one to the other location. The correlation between datasets from the two buoys is very high, giving high confidence in the transferred data. To avoid thermal stability distortions data are moved across same heights (e.g. 150 m to 150 m).

For each transfer, a transfer function is created for 360 1˚-direction bins based on data from a 30˚ direction window. The wind speed functions are first order function and direction functions are zero-order functions (constants). No residual resampling is used to avoid the random scatter from such a model. Only wind speed and wind direction are repaired. The turbulence intensity is missing in repaired time steps.

Table 10 and Table 11 list the results of each repair procedure. The heights 30 and 40 m are only repaired using horizontal repair. The results are not shown in the table.

Table 8. Example of shear matrix, here for 150 m height ASL (WS181). Values are shear exponents α. The shear matrix is constructed from data from height 120 m, 150 m and 180 m.

Hour	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
00-02	0.03	0.01	0.08	0.03	0.13	0.14	0.12	0.09	0.12	0.09	0.08	0.03
02-04	0.04	-0.01	0.08	0.10	0.10	0.15	0.14	0.10	0.11	0.12	0.07	0.08
04-06	0.05	0.03	0.08	-0.03	0.08	0.13	0.16	0.13	0.12	0.11	0.08	0.10
06-08	0.02	0.00	0.01	0.00	0.08	0.06	0.05	0.09	0.12	0.12	0.07	0.06
08-10	0.04	-0.09	0.09	-0.04	0.05	0.11	0.07	0.10	0.14	0.12	0.06	0.06
10-12	0.05	0.00	0.08	0.04	0.04	0.10	0.09	0.07	0.10	0.11	0.07	0.05
12-14	0.03	-0.08	0.09	0.06	0.06	0.12	0.06	0.12	0.08	0.09	0.06	0.06
14-16	-0.03	0.00	0.01	0.09	0.11	0.09	0.07	0.11	0.10	0.08	0.09	0.05
16-18	0.04	0.03	0.00	0.07	0.11	0.10	0.05	0.11	0.12	0.12	0.09	0.05
18-20	0.04	-0.05	0.00	0.00	0.09	0.07	0.13	0.12	0.13	0.09	0.10	0.04
20-22	0.04	0.07	0.00	0.09	0.13	0.06	0.07	0.16	0.13	0.07	0.10	0.05
22-24	0.01	0.01	0.15	0.05	0.10	0.12	0.12	0.09	0.11	0.09	0.09	0.06
All	0.03	0.03	0.05	0.03	0.09	0.11	0.10	0.11	0.11	0.09	0.08	0.06

Table 9. Correlation coefficient, r, between WS170 and WS181 measurements at the same height.

MEASUREMENT HEIGHT [M]	CORRELATION COEFFICIENT, R [%]
30 – 60	95
100 - 270	96

Table 10. Data substitution, WS170

REPAIRED HEIGHT [M]	60	90	100	120	150	180	200	240	270
Source height [m]	40	60	90	100	120	150	180	200	240
Shear matrix heights [m]	40, 60, 90	60, 90, 100	90, 100, 120	100, 120, 150	120, 150, 180	150, 180, 200	180, 200, 240	200, 240, 270	200, 240, 270
Recovery rate before repair	87.7%	86.9%	86.8%	86.5%	86.2%	85.9%	85.7%	85.3%	85.1%
Recovery rate after shear repair	88.0%	87.7%	87.0%	86.8%	86.6%	86.3%	86.0%	85.8%	85.4%
Recovery rate after horizontal repair	99.7%	99.2%	98.8%	98.6%	98.4%	98.1%	97.9%	97.8%	97.6%
Share of repaired data	12.0%	12.4%	12.1%	12.3%	12.4%	12.4%	12.5%	12.8%	12.8%

Table 11. Data substitution, WS181

REPAIRED HEIGHT [M]	60	90	100	120	150	180	200	240	270
Source height [m]	40	60	90	100	120	150	180	200	240
Shear matrix heights [m]	40, 60, 90	60, 90, 100	90, 100, 120	100, 120, 150	120, 150, 180	150, 180, 200	180, 200, 240	200, 240, 270	200, 240, 270
Recovery rate before repair	99.0%	95.9%	95.8%	95.6%	95.3%	94.9%	94.7%	94.2%	94.1%
Recovery rate after shear repair	99.3%	99.1%	96.2%	96.1%	95.9%	95.7%	95.3%	95.0%	94.7%
Recovery rate after horizontal repair	99.7%	99.6%	98.8%	98.6%	98.4%	98.2%	98.0%	97.8%	97.6%
Share of repaired data	0.7%	3.7%	3.0%	3.0%	3.2%	3.4%	3.4%	3.7%	3.6%

4.5 Data Analysis

EMD has combined the datafiles, forming time series of wind speed, wind direction, turbulence intensity and data package count for each measurement height. For 4 m height ASL, temperature, relative humidity and pressure is added. The signals for maximum wind speed and vertical wind speed are only added to the 150 m dataset.

4.5.1 Wind Speed

The mean wind speed on the LiDAR measurements is calculated both as arithmetic mean wind speed and through a Weibull fit as Weibull-derived mean wind speed. The Weibull fitting is done in windPRO using an energy conservation condition.

The following table summarizes the resulting wind speeds before and after data substitution.

Table 12. Weibull parameters of the repaired datasets, WS170.

HEIGHT [M]	PERIODS [MONTHS]	ARITHMETIC MEAN WIND SPEEDS, BEFORE DATA SUBSTITUTION [M/S]	ARITHMETIC MEAN WIND SPEEDS AFTER DATA SUBSTITUTION [M/S]	WEIBULL MEAN [M/S]	WEIBULL – A PARAMETER	WEIBULL – K PARAMETER
4	12	8.20	8.20	8.20	9.25	2.41
30	12	9.75	9.54	9.52	10.74	2.38
40	12	9.97	9.77	9.77	11.02	2.39
60	12	10.35	10.14	10.17	11.47	2.43
90	12	10.75	10.55	10.62	11.97	2.48
100	12	10.85	10.67	10.74	12.11	2.49
120	12	11.04	10.86	10.95	12.34	2.50
150	12	11.27	11.08	11.17	12.59	2.46
180	12	11.46	11.26	11.34	12.79	2.42
200	12	11.57	11.36	11.44	12.9	2.40
240	12	11.74	11.52	11.58	13.06	2.37
270	12	11.85	11.62	11.66	13.15	2.33

Table 13. Weibull parameters of the repaired datasets, WS181.

HEIGHT [M]	PERIODS [MONTHS]	ARITHMETIC MEAN WIND SPEEDS, BEFORE DATA SUBSTITUTION [M/S]	ARITHMETIC MEAN WIND SPEEDS AFTER DATA SUBSTITUTION [M/S]	WEIBULL MEAN [M/S]	WEIBULL – A PARAMETER	WEIBULL – K PARAMETER
4	12	8.17	8.17	8.19	9.23	2.43
30	12	9.45	9.45	9.43	10.64	2.35
40	12	9.67	9.67	9.67	10.91	2.37
60	12	10.05	10.04	10.07	11.36	2.41
90	12	10.48	10.42	10.50	11.84	2.46
100	12	10.58	10.55	10.64	12.00	2.47
120	12	10.77	10.74	10.84	12.22	2.48
150	12	11.00	10.96	11.06	12.47	2.45
180	12	11.18	11.14	11.23	12.66	2.41
200	12	11.28	11.24	11.32	12.77	2.39
240	12	11.43	11.39	11.45	12.92	2.35
270	12	11.53	11.48	11.53	13.02	2.32

Further details on the directional wind speed and Weibull distribution can be found in Appendix C.

4.5.2 Turbulence Intensity

Standard deviation of wind speed and hence turbulence intensity from LiDAR measurements are not immediately comparable to those of cup anemomters. The standards reffered to in this study do not recognize turbulence intensity mesurements from LiDARs and the observed turbulence data from WS170 and WS181 are therefore not used or documented here. They are however included in the datapackage produced as part of the deliverables.

4.5.3 Wind Direction

The wind direction distribution for the 12 months of measurements is presented in Figure 5. There is a rotation of the wind direction clockwise with increasing height of 6.5˚ from 30 m to 270 m, amounting to a rate of 0.027 deg/m.

The direction distribution for each height can be found in Appendix C.

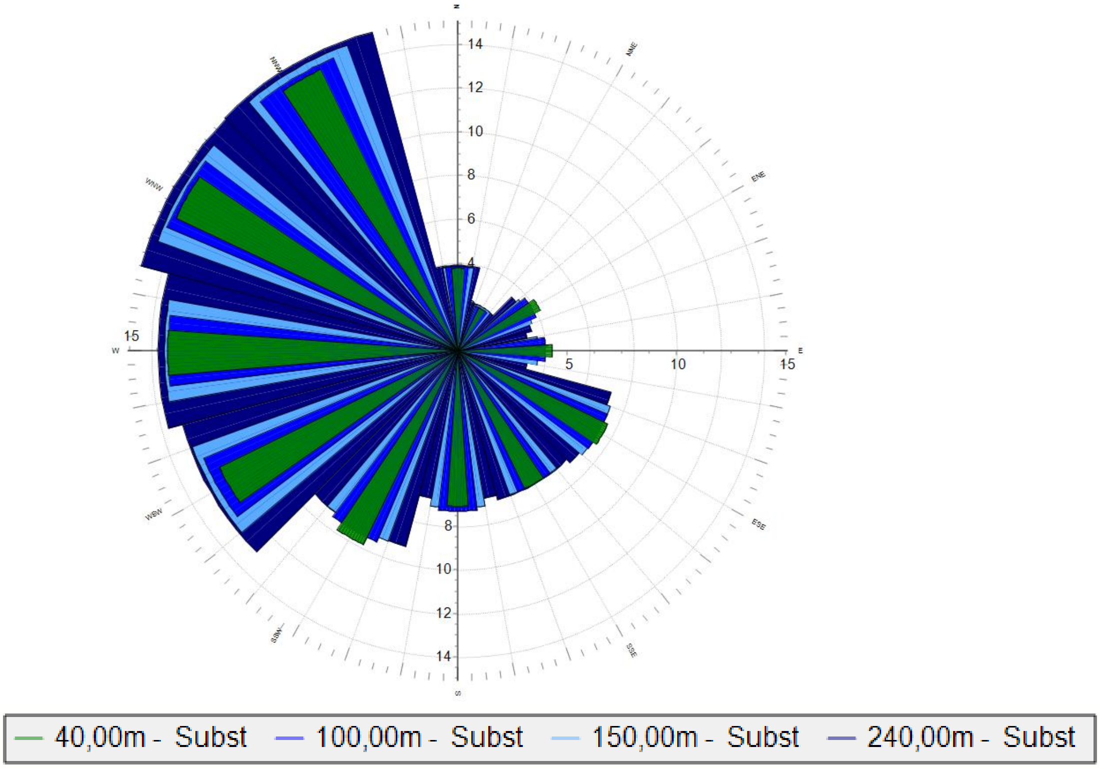


Figure 5. Directional distribution at selected heights of LiDAR measurements, WS170.

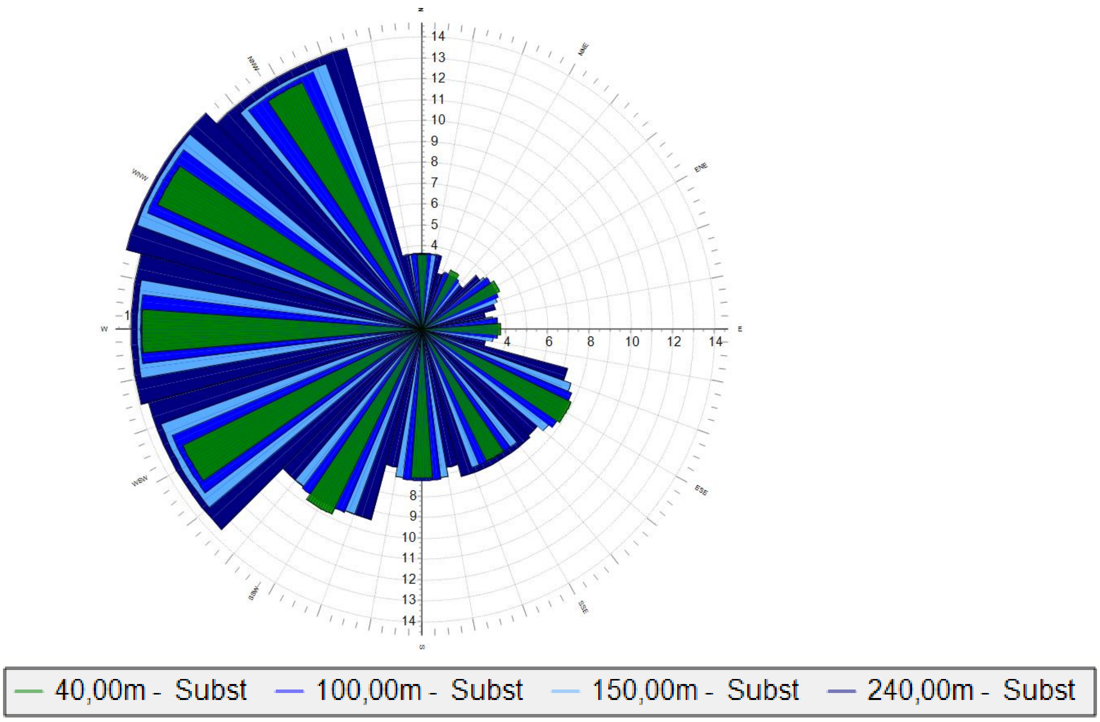


Figure 6. Directional distribution at selected heights of LiDAR measurements, WS181

4.5.4 Diurnal Variations

There is a minor variation in wind speed across the day with marginally higher wind speed at night and lower wind speed at daytime. The pattern is identical for the two buoys.

The temperature at the buoy is almost uniform across the day.

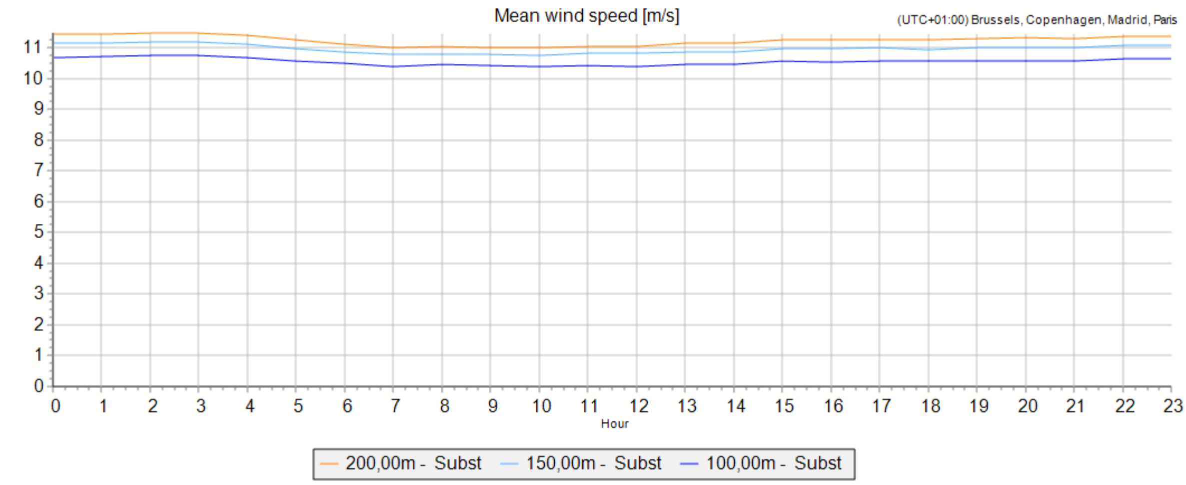


Figure 7. Diurnal wind speed variation, WS181.

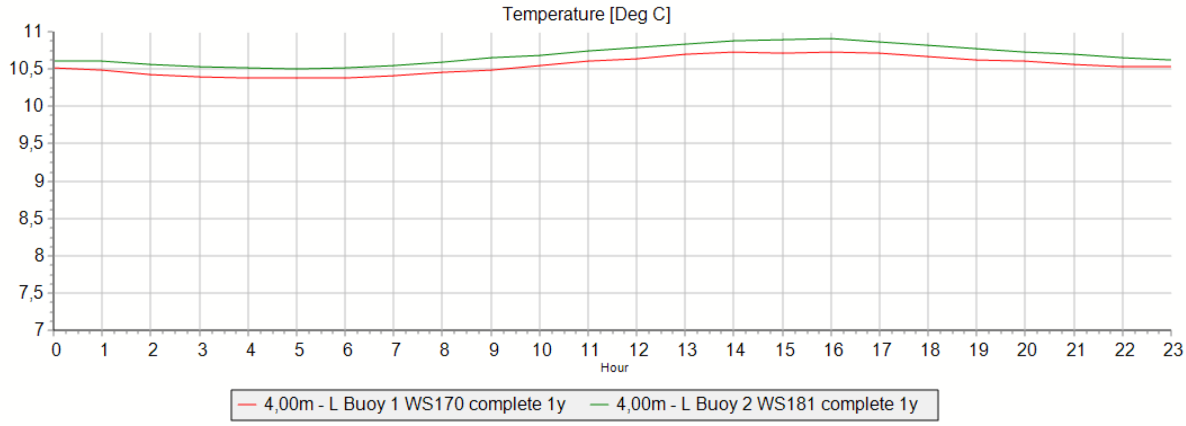


Figure 8. Diurnal temperature variation, WS170 (red) and WS181 (green).

4.5.5 Seasonal Variations

The specific year of measurement has the typical pattern for the region with higher wind speed during winter than during summer.

The temperature varies across the year from a mean temperature in March of 6˚C to 17.1˚C in August.

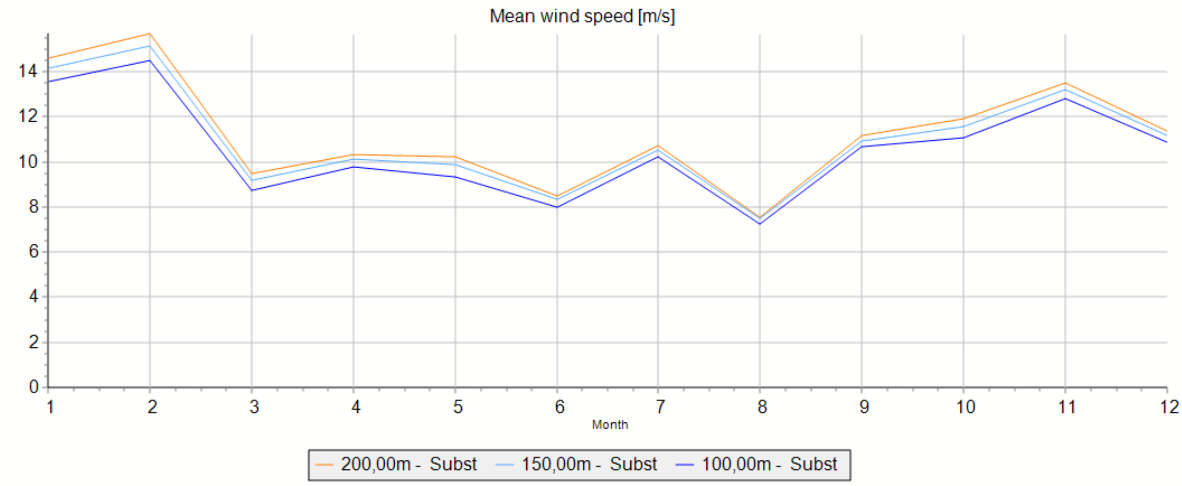


Figure 9. Monthly mean wind speed, WS181

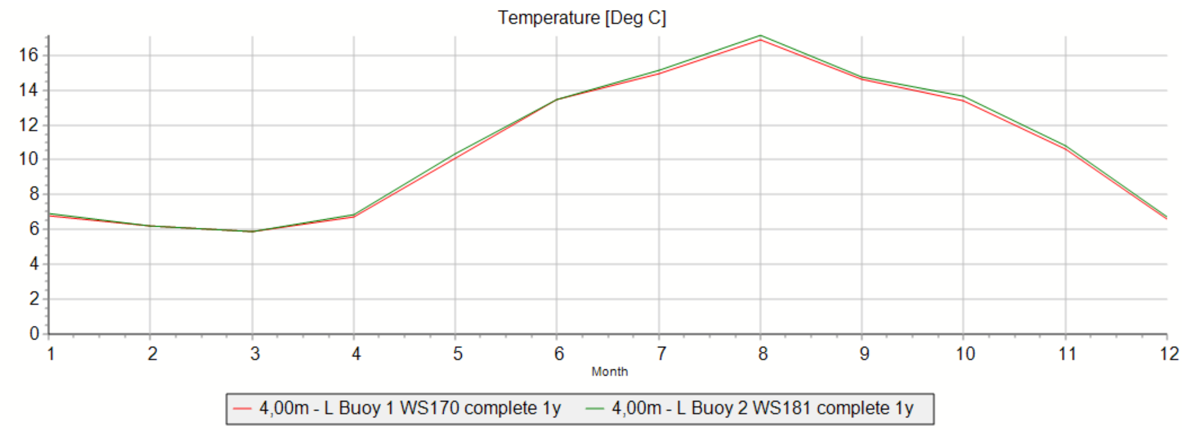


Figure 10. Monthly mean temperature, WS170 (red) and WS181 (green)

4.6 Measurement Uncertainty

The classification uncertainty, giving the maximum expected uncertainty, is obtained from the ZX300 classification document [17] as 1.41% (average at 130 and 135 m height). These heights are the tallest heights reported and are here considered representative of the 150 m measuring height. The classification table is included in Appendix B.

The verifications of the WS170 and WS181 buoy-mounted LiDARs were provided [14] [15] [12] [13]. The two test sites were at the TNO Lichtland Goeree Offshore Test Site, The Netherlands (WS170) and Frøya, Norway (WS181).

In these studies the Key Performance Indicators (KPI) according to the OWA Roadmap [19] are tested and the verification uncertainty is here calculated according the method suggested by the CT/OWA LiDAR Uncertainty Standard Review [20]. All KPI's were successfully fulfilled.

The verification uncertainties from the verification reports are included in Appendix B for the closest height to 150m. Note that the verification uncertainty from the Lichtland verification is substantially higher than at Frøya due to a higher reference uncertainty of the reference instrument against which the buoy LiDAR has been verified. It can therefore not be concluded that WS170 is poorer than WS181.

The uncertainty from data repair is found by assuming a 20% uncertainty on the wind speed change from source to destination height. With a 2% wind speed difference (from 120 to 150 m), this results in an uncertainty of 0.4% on wind speed of the synthesized data. At 150 m the synthesized data contribute 12.4% of the dataset on WS170, resulting in a total 0.05% uncertainty on the wind speed at this height and 3.2% on the dataset on WS181, resulting in a total 0.01% at 150 m.

The verification and classification uncertainty is combined together with a small contribution from the data repair to a combined uncertainty on the LIDAR measurements at 150 m.

Table 14. Wind speed measurement uncertainty at 150 m ASL.

BUOY	CLASSIFICATION UNCERTAINTY	VERIFICATION UNCERTAINTY	DATA REPAIR UNCERTAINTY	TOTAL MEASUREMENT UNCERTAINTY
WS170	1.41%	3.28%	0.05%	3.57%
WS181	1.41%	2.05%	0.01%	2.49%

5 Reference Data

Mesoscale data have been obtained for the dual purpose of long-term correcting the onsite measurements and calculating a wind speed gradient across the wind farm zone. The period length is limited by the data availability and has afterwards, through a consistency analysis, been curtailed to an appropriate length.

Different mesoscale and re-analysis products have been used as long-term data sources:

- 33 years of ERA5 [21] data, hourly data at a height of 100 m AGL have been obtained. ERA5 is a climate reanalysis dataset developed through the Copernicus Climate Change Service (C3S) and processed/delivered by ECMWF. The locations are the closest available data node to each of the buys.
- 20 years of EMD-WRF On-Demand [22], high resolution mesoscale data have been obtained. The mesoscale model developed by EMD (http://www.emd.dk) has been run for the location of the North Sea Energy Island Lot 1 and Lot 2. ERA5 data from ECMWF (http://www.ecmwf.int) has been used as the global boundary data set. The temporal resolution is hourly. Similar datasets have been obtained for the locations of selected supporting datasets including the location of a third location for the site parameter analysis. The latest available data are from 01/01/2023.
- 5 years of EMD-WRF Europe+ [23] high resolution mesoscale data has been obtained in a grid with a spacing of 6 km. The model has been developed recently by EMD (http://www.emd.dk). The mesoscale model is at a spatial resolution of 0.03° x 0.03° or approximately 3 x 3 km with hourly temporal resolution. ERA5 data from ECMWF (http://www.ecmwf.int) has been used as the global boundary data set.
- 19 years and 9 months of NORA3 [24] data have been obtained. The NORA3 data have been sourced from the Norwegian Meteorological Institute. The NORA3 dataset uses a combination of ERA5 reanalysis data and an extensive surface model database. Instead of a WRF model, the NORA3 model is processed using the HARMONIE-AROME model. The model grid is 3 km, and the temporal resolution is hourly. The closest available nodes to Lot 1 and Lot 2 are used.

The location of the mesoscale reference data around Lot 1 and Lot 2 is presented in Figure 11, Figure 12 and Table 15. All data are extracted through windPRO.

Table 15. Mesoscale data position and period length.

	EMD-WRF LOT 1	EMD-WRF LOT 2	EMD-WRF POSITION 3	ERA5 LOT 1	ERA5 LOT 2	NORA3 LOT 1	NORA3 LOT 2
Position/Node	6.300°E 56.628°N	6.457°E 56.344°N	6.781° 56.627°	6.420°E 56.628°N	6.24°E 56.347°N	6.314°E 56.633°N	6.456°E 56.332°N
Start (data used)	01/01/2003	01/01/2003	01/01/2003	01/01/1990	01/01/1990	01/01/1999	01/01/1999
Stop (data used)	01/01/2023	01/01/2023	01/01/2023	01/01/2023	01/01/2023	01/10/2022	01/10/2022

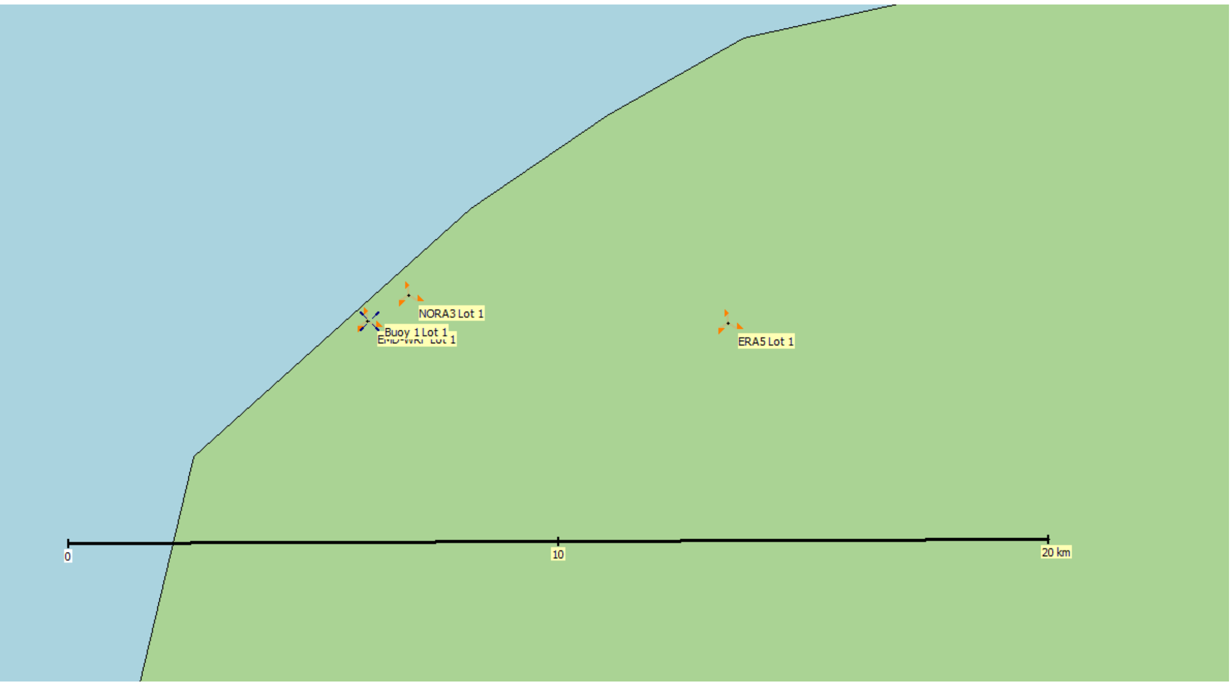


Figure 11. Location of mesoscale reference data near Lot 1.

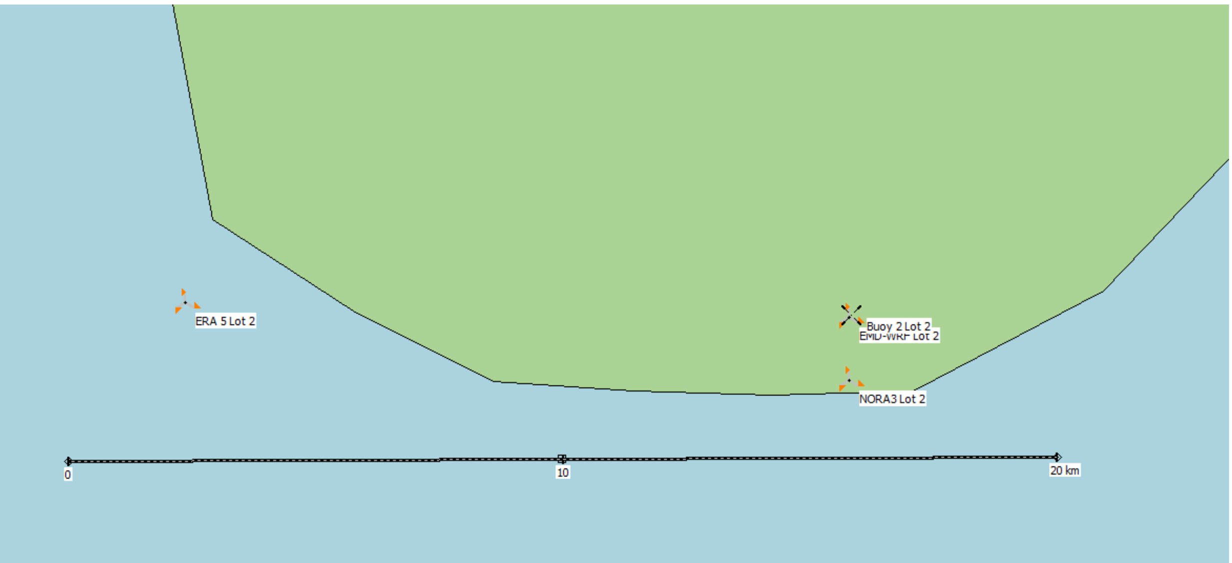


Figure 12. Location of mesoscale reference data near Lot 2.

6 Long-term Correction

6.1 Review of Reference Data

6.1.1 Long-term Consistency

The consistency of historical wind reference data is of vital importance when determining the long-term variation of wind speed. EMD has conducted consistency checks on the data sets in order to ensure that these would be suitable for use. These checks aim to identify trends and to establish a suitable baseline period. Two metrics have been used: The Mann-Kendall trend test and production indices.

Analysis of the ERA5 dataset using the Mann-Kendall trend test [25] indicated that a 20-year period from 2003-2022 may be slightly trended (test value 0.46). To avoid trends in the data set, EMD recommends, based on experience, a Mann-Kendall (MK) test value above 0.4, but preferably above 0.5. Extending the dataset to 1992 (31 years) results in a high MK value (0.92) with no trend in the time series.

The mean wind speed of the 31-year period 1992-2022 at 100 m in the ERA5 dataset is 10.24 m/s. This is exactly the same wind speed as for the 20-year period of 2003-2023. This means that this period can be used as a long-term consistent period.

EMD-WRF data and to some extent NORA3 data are derived from ERA5 and they can be expected to have similar consistency properties.

An alternative measure of considering consistency in long-term data is to compare windiness index. A windiness index can be constructed by scaling the wind speed to the expected long-term wind speed at the site, apply a power curve to each record and divide by the average of the records. The index value serves as an energy index value for each period considered. Annual energy indices have been constructed for a selection of datasets (Appendix A) including ERA5 and EMD-WRF.

A comparison of the ERA5-based energy index with the EMD-WRF-based energy index confirms that the above conclusions based on ERA5 are also valid for EMD-WRF. The production index of the ERA5 data for the period 1992-2022 is 99.8% of the period 2003-2022 conforming, that the selected 20-year period corresponds to the 31-year period.

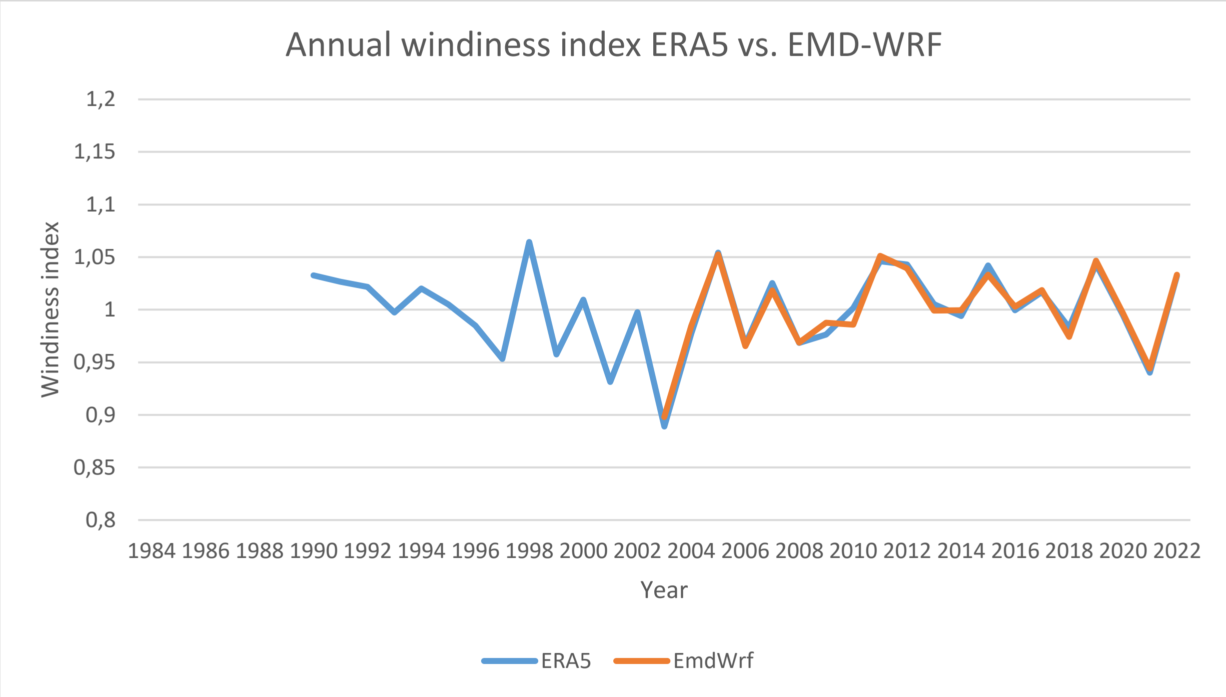


Figure 13. Annual windiness (energy) index for ERA5 and EMD-WRF data. Baseline period: 2003-2022.

Similar plots are made with six of the secondary ground stations described in Appendix A, where a long continuous time series are available (Figure 14). The match with ERA5 is not convincing with any of the meteorological stations, but that is most likely due to distance and difference in environment. The most concerning element in the ERA5 index is the sharp difference between 2003 and 2004, but that is confirmed in all the datasets that include this period. The general increase in the wind resource from 2003 to 2010 is also confirmed, ruling out that this trend is a data artifact.

The most interesting of the secondary data indices is that of Ekofisk. This oilrig is relatively close to the North Sea Energy Island and share similar conditions, being far from land. It also covers a very long period (39 years). This dataset confirms the large-scale variations on the ERA5 data, including a declining wind resource from 1990 to 2003. While we have no basis to confirm the index from 1984 to 1990, we can read from the index that the period 1990-2023 has an energy index of 99.2% of the period 2003-2022. For the entire record (1984-2022) the index is 99.6% of the selected 20-year period. A diagram superimposing the windiness index of progressively longer periods (Figure 15), show the trends of ERA5 imitated by the majority of the stations with Lista and Hvide Sande as notable outliers.

The analysis of windiness indices from secondary data therefore confirms the selection of the period of 2003 to 2022 as long-term representative and consistent.

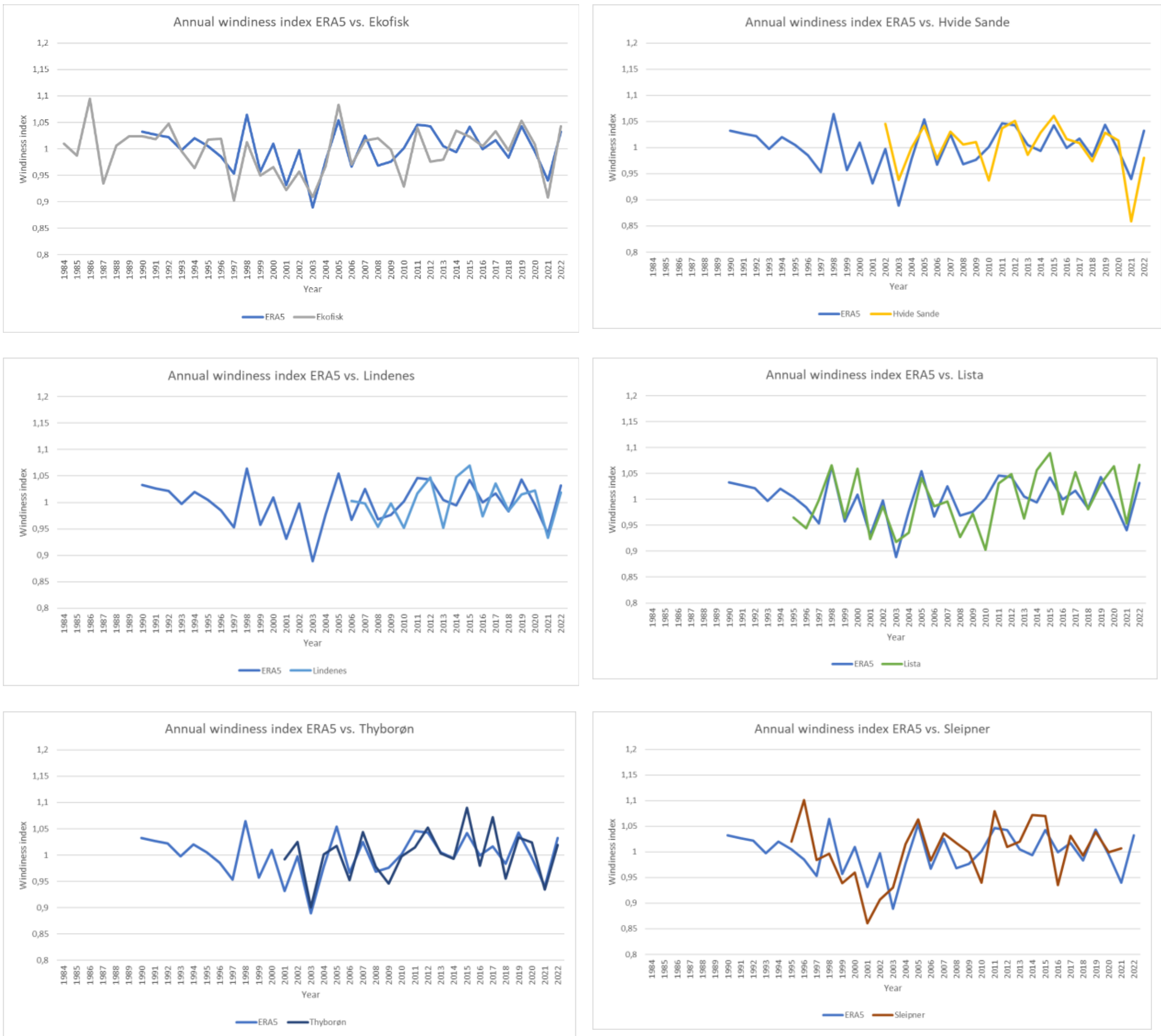


Figure 14. Annual windiness (energy) indices for a selection of secondary meteorological stations.

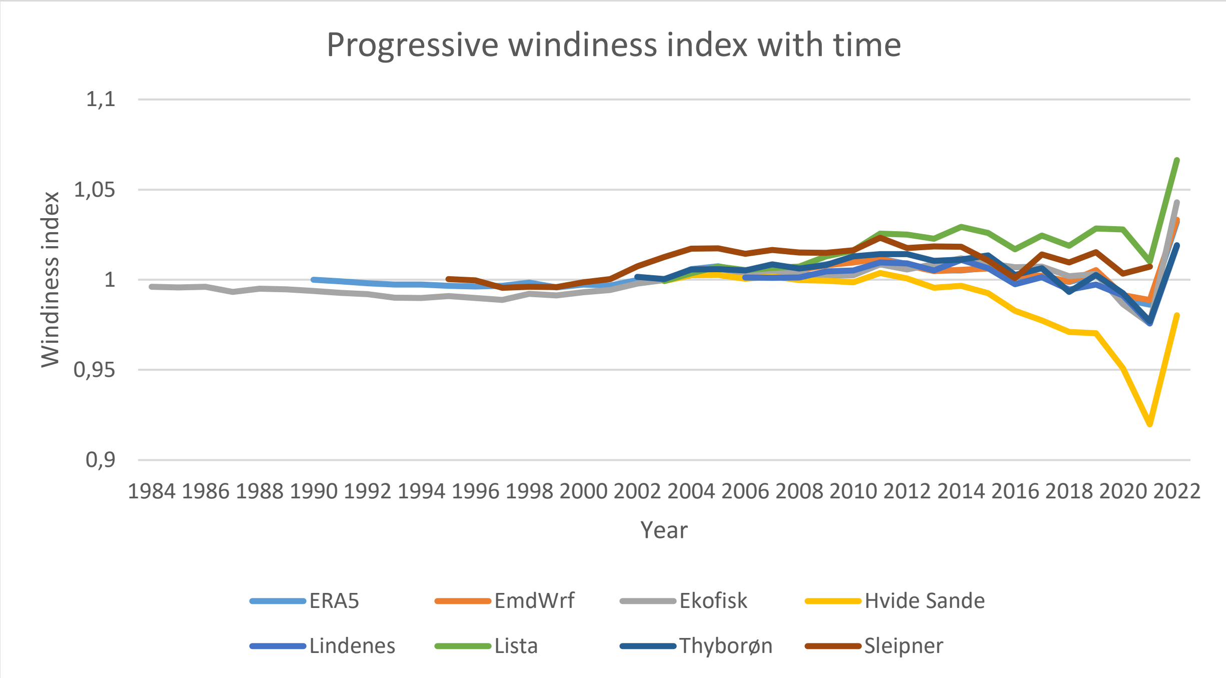


Figure 15. Progressive windiness (energy) index with time. The index of each year is the average of all following years.

6.1.2 Selection of Reference Data and Reference Period

Three potential reference datasets were considered for long-term correction of the LiDAR measurements from WS170 and WS181. These are the three datasets described in section 5: EMD-WRF, ERA5 and NORA3. These have all been successfully evaluated for use as long-term reference, passing all tests as described above. NORA3 does not yet cover the entire measurement period and the concurrent period is at present only 10.5 months. This places it for the present at a disadvantage. It remains useful though as validation of the long-term correction. For NORA3 data the reference period is 1/10/2002 to 1/10/2022.

The standard deviation on the resulting long-term wind speed across references and four different methodologies is 0.04 m/s on 150 m measurements on both LiDARs with no indication that any one reference or methodology increases or decreases the wind speed. EMD-WRF data therefore qualify as long-term reference as do the two other references. EMD has decided to proceed with EMD WRF as reference. The decision to prefer the EMD-WRF data is a combination of good performance with the long term correction methods described in section 6.2 and that the resulting long term corrected wind speed is the median value of the three considered reference datasets.

The reference dataset is 20 years of EMD-WRF data at WS170 and WS181 covering the period 01/01/2003 to 31/12/2022. The dataset is available in the data package.

6.2 Correlation between Onsite and Reference Data

6.2.1 Wind Speed and Energy Correlation

The concurrent period of LiDAR data and EMD-WRF data is 12 months (15/11/2021 to 15/11/2022).

The correlation of the wind speed between LiDAR measurements and EMD-WRF data is high.

Correlation coefficient, r, is calculated for each data point without averaging. That means that the 10-minute data of the LiDAR measurements are correlated with the hourly value of the reference data with the assumption that the hourly reference data value represents the last 10-minute period of the hour. That may not actually be the case, but the observed scatter is from the 10-minute measurements are important for the following long-term correction.

The wind energy dataset is calculated by applying a power curve (generic 10 MW turbine) to the measured and reference data time series and divide with the average production. This is a measure of what a turbine would produce in a given period relative to average. Correlation is calculated on monthly averages and represent the seasonal variation in production output.

Table 16. Correlation coefficient r between the reference data (EMD-WRF, 150 m) and the onsite floating LiDAR data at 150 m ASL.

REF: EMD-WRF	WS170	WS181
Wind Speed Correlation, r [%] hourly	95.4	95.2
Wind Energy Correlation, r [%] monthly	95.6	99.4

6.2.2 Wind Direction Correlation

According to the instrument description from Fugro [9], the wind direction of measurements is referenced to true north with a secondary compass oriented against magnetic north (see section 4.2.2). Upon verification with EMD-WRF data an average deviation in wind direction was found within 1˚, confirming that the measured wind direction is correct.

There is a good match of wind direction roses between the LiDARs (150 m) and EMD-WRF (150 m) concurrent data (Figure 16).

The 12 months of concurrent data does not represent a long-term representative directional distribution and it must be expected that a long-term correction of data will change the observed directional distribution (Figure 17).

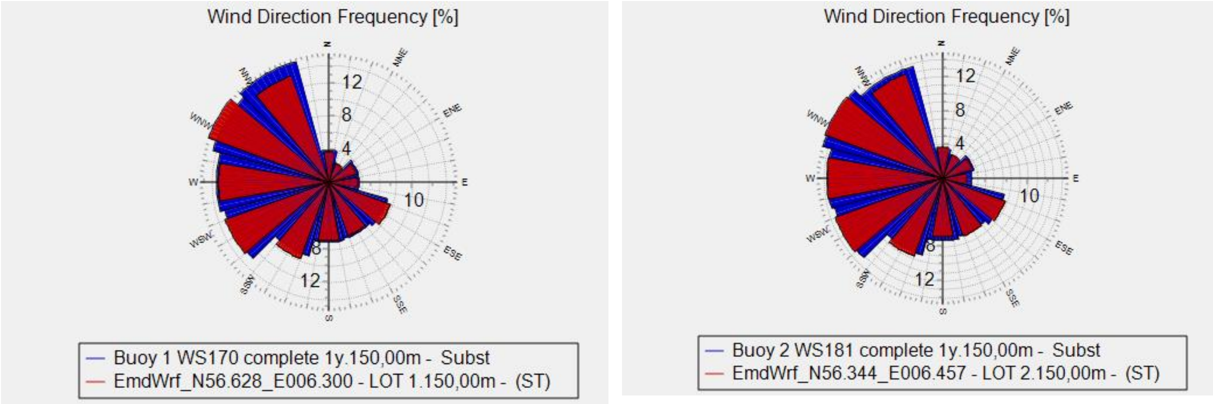


Figure 16. Wind direction roses for the concurrent period of LIDAR (blue) and EMD-WRF (red) data. Left: WS170, right: WS181.

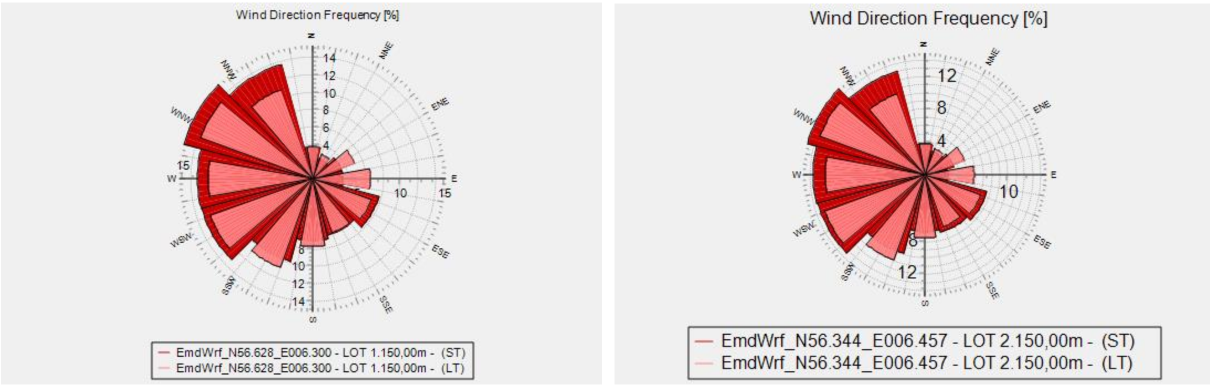


Figure 17. Wind direction roses for EMD-WRF data. Deep red represents the entire long-term period, light red represents the period concurrent with LIDAR measurements. Left: Concurrent period with WS170, right: Concurrent period with WS181.

6.2.3 Long-term Correction and Validation

EMD has several long-term correction methodologies at disposal. A full description of these can be found in the windPRO reference document on Measure-Correlate-Predict (MCP) methods [25].

With 12 month of data coverage and a high recovery rate, the risk of seasonal bias is limited. There is no need to curtail the period of the measured data.

The relevant windPRO methodologies that will correct for the wind direction are linear regression, neural network and the matrix method.

The performance of each method is tested through a 24-hour slicing test. In this, the transfer function is trained of every second day of the data set and used to predict a period consisting of every other day. The metric for comparison is the Mean Bias Error on production output, which is comparable to the difference in turbine production in percentage between using measured or predicted data. The result of this test is presented in Table 17 and Table 18.

A similar test is done using the entire concurrent period, which amounts to a self-test.

Additionally, in Table 17 and Table 18 are presented Kolmogorov-Smirnov (K-S) test metrics using each method. The K-S test measures the maximum difference between measured and predicted wind distribution and is an expression of how well the observed wind distribution is captured by the prediction [25].

The matrix method generally produces the smallest error, but all methods have good performance within normally accepted parameters. The matrix method also gives satisfying results in predicting the direction distribution and Weibull distribution shape (the K-S test) as well as provide the median predicted mean wind speed value.

The long-term correction has been performed using a wind speed/direction matrix. The windPRO Matrix MCP Method is described by developing a relationship matrix for the wind speed bins and direction bins between the wind data at the reference and a concurrent period of wind data from the local site and applying this relationship matrix to all the long-term wind data to determine the estimated site data wind climate. This method corrects for changes in both wind speed and direction.

Table 17. Prediction test using a 24-hour slicing method and a self-test using the entire concurrent period. The parameter presented is over-prediction of production in percent. (WS170 - 150 m data).

REFERENCE: EMD-WRF LOCAL DATA: WS170, 150M	LINEAR REGRESSION	NEURAL NETWORK	MATRIX
24-hour slicing test, % production	0.66	-0.74	-0.29
Concurrent period test, % production	0.78	-0.97	0.37
Kolmogorov-Smirnov test, %	1.81	2.65	1.39
Predicted long term mean wind speed, m/s	10.86	10.79	10.83

Table 18. Prediction test using a 24-hour slicing method and a self-test using the entire concurrent period. The parameter presented is over-prediction of production in percent. (WS181 - 150 m data).

REFERENCE: EMD-WRF LOCAL DATA: WS181, 150M	LINEAR REGRESSION	NEURAL NETWORK	MATRIX
24-hour slicing test, % production	1.19	-0.27	1.12
Concurrent period test, % production	0.88	-1.35	0.16
Kolmogorov-Smirnov test, %	2.82	2.13	1.44
Predicted long term mean wind speed, m/s	10.75	10.65	10.71

The artificially generated time series (30 m to 270 m) represent the long-term wind climate and the 150 m results are presented in the following.

6.3 Long-Term Wind Climate

6.3.1 Long-term Wind Speed Distribution

The long-term wind speeds for the two buoys in North Sea Energy Island OWF are summarized in the following tables. A detailed breakdown of the Weibull parameters can be found in Appendix D.

Table 19. Weibull parameters of the long-term wind data used, WS170.

WS170	PERIOD [Y]	ARITHMETIC MEAN WIND SPEEDS [M/S]	WEIBULL MEAN [M/S]	WEIBULL - A PARAMETER [M/S]	WEIBULL - K PARAMETER
30	20	9.41	9.39	10.6	2.328
40	20	9.60	9.61	10.85	2.348
60	20	10.00	10.03	11.32	2.389
90	20	10.35	10.43	11.76	2.414
100	20	10.47	10.55	11.9	2.413
120	20	10.67	10.77	12.15	2.416
150	20	10.83	10.91	12.31	2.355
180	20	10.94	10.99	12.4	2.293
200	20	11.05	11.1	12.53	2.281
240	20	11.21	11.22	12.67	2.227
270	20	11.31	11.31	12.77	2.198

Table 20. Weibull parameters of the long-term wind data used, WS181.

WS170	PERIOD [Y]	ARITHMETIC MEAN WIND SPEEDS [M/S]	WEIBULL MEAN [M/S]	WEIBULL - A PARAMETER [M/S]	WEIBULL - K PARAMETER
30	20	9.33	9.33	10.53	2.308
40	20	9.51	9.53	10.76	2.324
60	20	9.91	9.96	11.24	2.375
90	20	10.26	10.32	11.64	2.367
100	20	10.35	10.43	11.77	2.375
120	20	10.55	10.65	12.01	2.380
150	20	10.71	10.80	12.19	2.328
180	20	10.85	10.91	12.32	2.272
200	20	10.96	11.00	12.42	2.240
240	20	11.12	11.15	12.59	2.207
270	20	11.20	11.22	12.67	2.190

6.3.2 Long-term Wind Direction Distribution

The long-term frequency and energy distribution for the long-term corrected LiDAR data from WS170 and WS181 at 150 m ASL indicate a main wind direction from southwest to northwest.

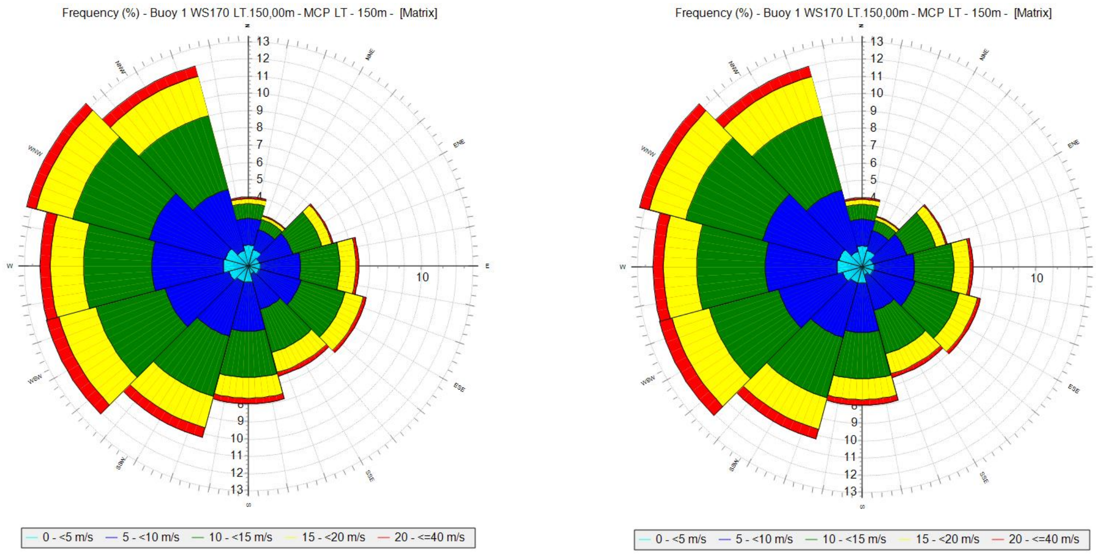


Figure 18. Left: wind direction distribution of long-term corrected LiDAR data (WS170) at 150 m. Right: Energy distribution of long-term corrected LiDAR data (WS170) at 150 m. Both are divided in wind speed intervals.

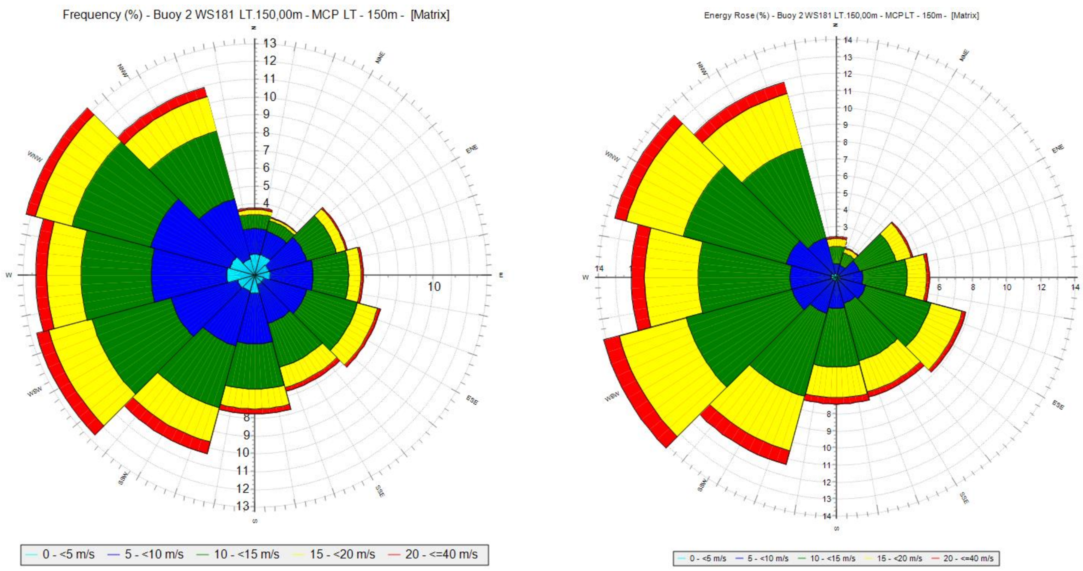


Figure 19. Left: wind direction distribution of long-term corrected LiDAR data (WS181) at 150 m. Right: Energy distribution of long-term corrected LiDAR data (WS181) at 150 m. Both are divided in wind speed intervals.

6.3.3 Long-term Diurnal Variations

The diurnal long-term wind speed is comparable to the observed diurnal wind speed. Figure 20 shows the diurnal variations for WS181. The pattern is identical for the two buoys. The variation is similar but adjusted to a lower wind speed for the long-term dataset.

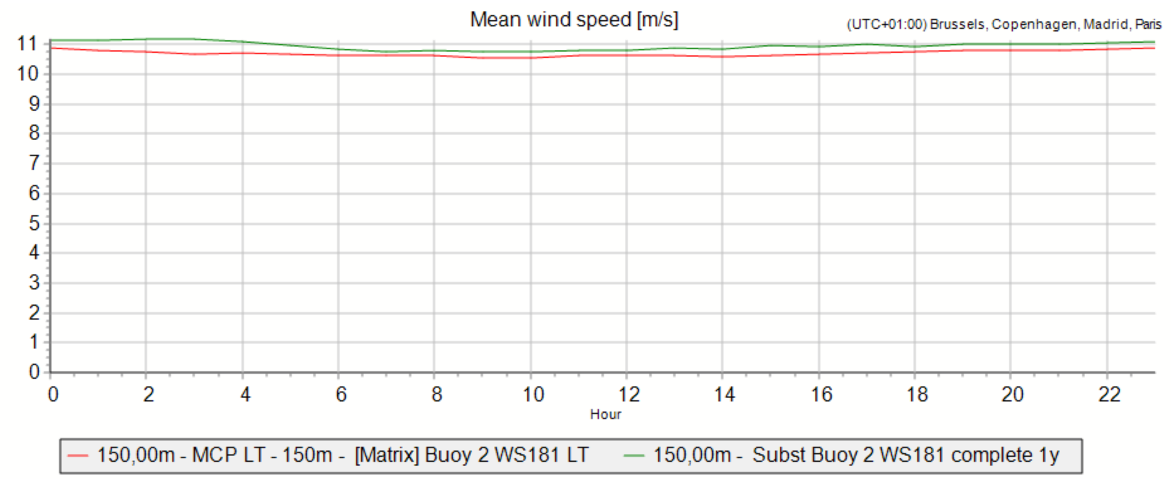


Figure 20. Diurnal wind speed, long-term corrected (red) and observed (green), WS181.

6.3.4 Long-term Seasonal Variations

The long-term seasonal variation of wind speed at 150 m is presented in Figure 21 for WS181 and compared to the actual year of observation. Whereas the seasonal variation of the measurements is based on a single year, the seasonal variation of the long term timeseries is an average of 20 years of data and therefore predictably more smooth.

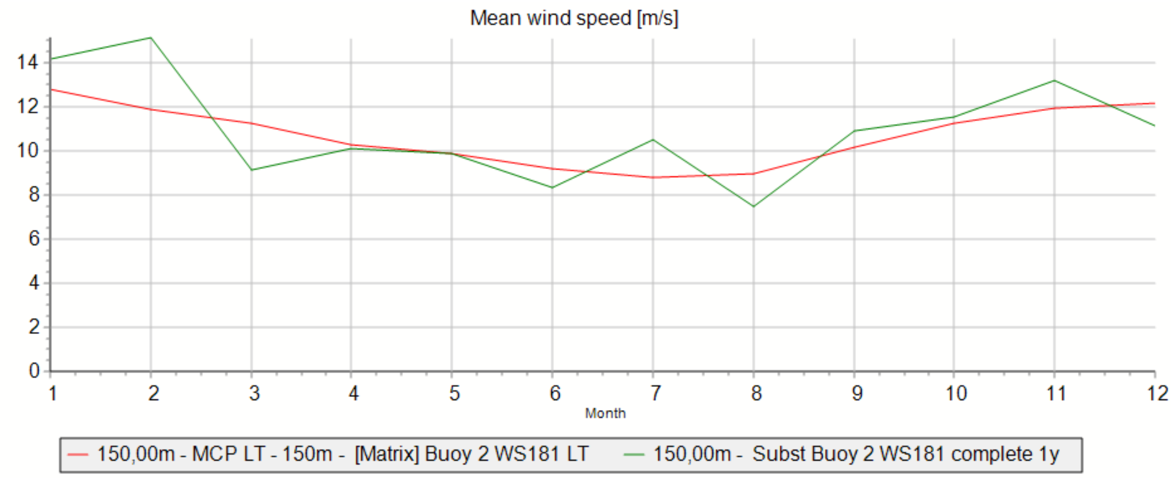


Figure 21. Seasonal variation of long-term corrected dataset (red) and observed dataset at 150 m, WS181.

7 Validation of Wind Model

7.1 Secondary Models

The wind resource at Position 1 (Lot 1) and Position 2 (Lot 2) were assessed through long-term correction of measured LIDAR data. This remains the primary model for the site.

Three secondary models were tested, translating secondary measured data from Thor, FINO3 and Harald B to the site. They each cover different directions from the North Sea Energy Island OWF. These were used to validate the primary wind model at North Sea Energy Island.

For the validation, the secondary data sets are transferred from their locations to WS170 and WS181 using the relative differences resulting from the comparison of mesoscale data. This transfer is based on the assumption that the difference between the two sites can be fully described by the difference observed in mesoscale data.

For each secondary data source a EMD-WRF dataset was extracted (section 6.1). The correlation in terms of wind speed, energy content and direction has been analysed for sufficiency. If mismatches are identified, a transfer function has been developed to mitigate the differences.

The datasets are described and adjusted to long-term wind climate in Appendix A.

7.1.1 Thor Floating LiDAR

Based on 1 year of LiDAR measurements on the buoy deployed for the Thor wind farm, a 20-year dataset was produced with the same reference period as for WS170 and WS181. The height of interest is at 150 m ASL.

The location of the Thor buoy relative to the WS170 and WS181 buoys is presented in Figure 22. The distance from the Thor buoy to WS170 is 43 km and to WS181 is 35 km.

For the validation of the wind model for WS170 and WS181, the long-term corrected dataset at Thor is transferred to the location and height of the two buoys following the above-described methodology.

An EMD-WRF dataset was extracted for the Thor buoy location (section 6.1). The correlation between the Thor LiDAR data and EMD-WRF is very high, both on wind speed, monthly energy content and directional distribution as discussed in Appendix A and the EMD-WRF data can therefore be said to capture the wind dynamics very well at Thor.

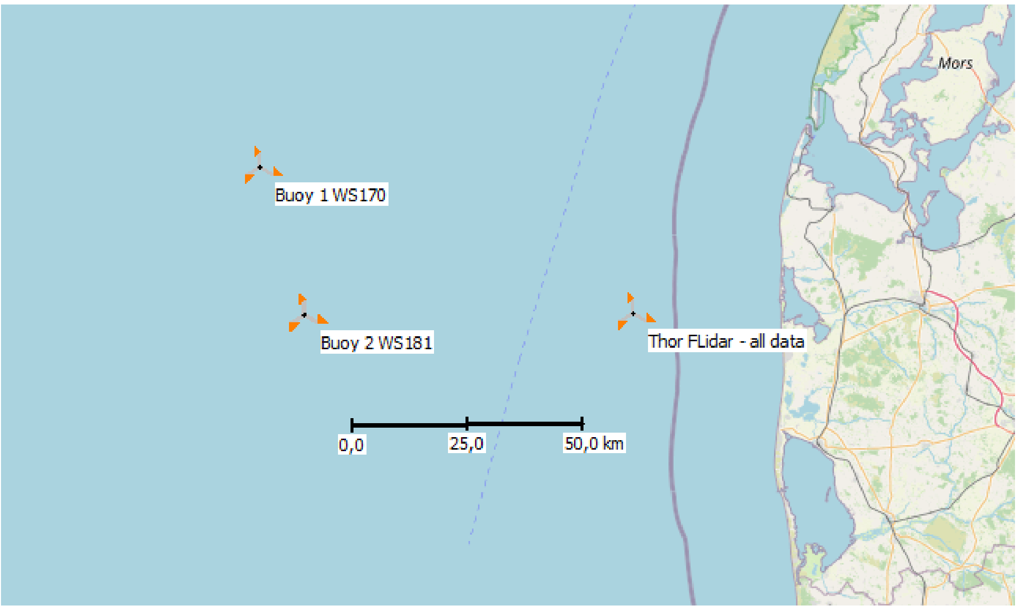


Figure 22. Location of Thor LiDAR buoy relative to WS170 and WS181.

Comparing the wind direction distribution between EMD-WRF data at Thor and EMD-WRF data at WS181 a difference in directional distribution and particularly energy distribution is noted (Figure 23). A transfer function is therefore required to both transfer the directions and the energy content in each direction.

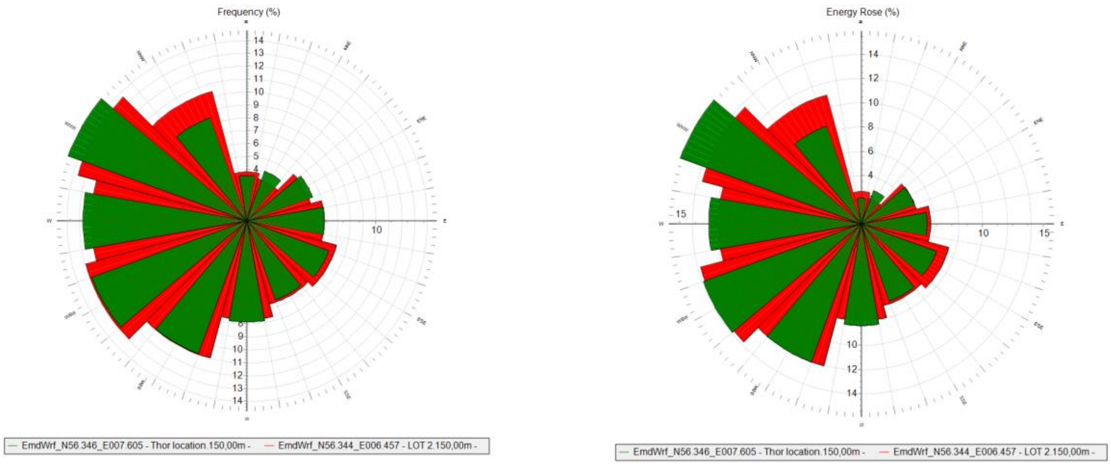


Figure 23. Left: directional distribution between EMD-WRF at Thor (green) and EMD-WRF at WS181 (red). Right: Energy rose of same two datasets.

A translation function is created using linear regression with a translation function for every 1° direction, used data in a +/-15° window, giving a scale and offset on wind speed as well as an offset on wind direction.

This translation function is then applied to the 20-year of long-term corrected 150 m Thor data, creating a 20-year dataset at WS170 and WS181.

A comparison of directional distribution of transferred Thor data at 150 m with long-term corrected WS170 and WS181 data is presented in Figure 24 and Figure 25. The match is reasonably good but with some deviation in north-north-western sector.

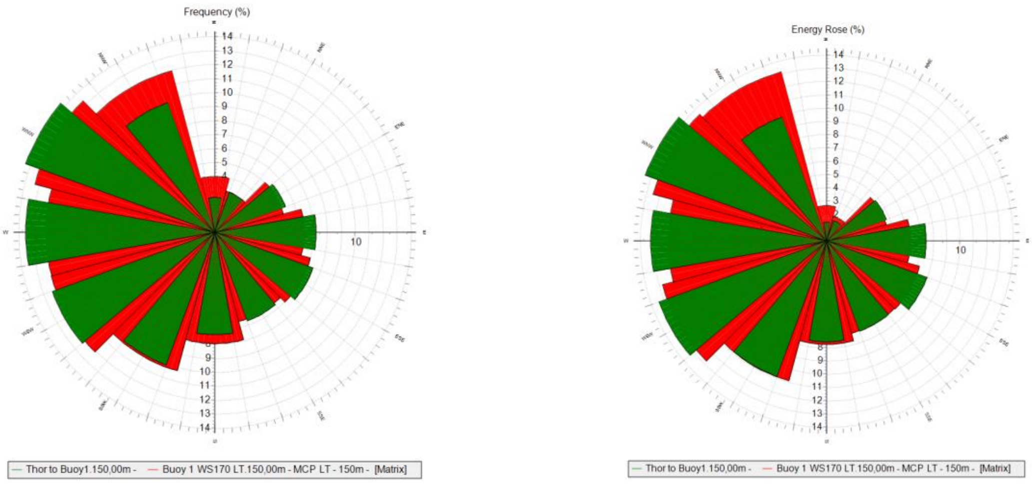


Figure 24. Comparison of directional distribution of transferred Thor data (green) with WS170 (red) (20 years). Left: by frequency, Right: by energy.

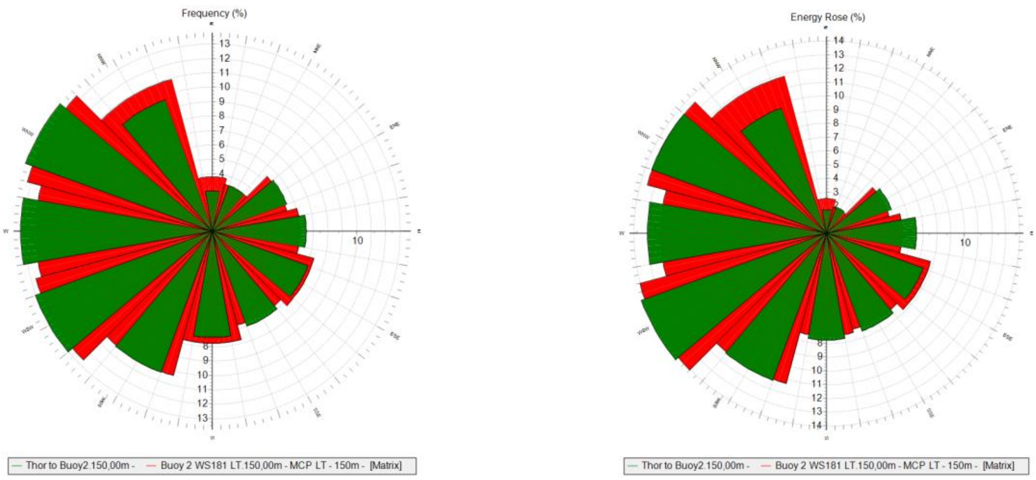


Figure 25. Comparison of directional distribution of transferred Thor data (green) with WS181 (red) (20 years). Left: by frequency, Right: by energy.

The mean wind speed through the steps can be followed in Table 21. The wind distribution and Weibull fit can be found in detail in Appendix F and G.

Table 21. Mean wind speed through the transfer stages, Thor data.

Stage	Arithmetic Mean Wind Speed [m/s]
1 years of measured mean wind speed, Thor, 151 m ASL	9.95
1 year, shear interpolated to 150 m, Thor	9.95
20 years, long-term corrected at 150 m, Thor	10.53
20 years, transferred to WS170, 150 m	10.85
20 years, transferred to WS181, 150 m	10.75

7.1.2 FINO3

Based on 4 years of mast measurements at FINO3, prior to the build-up of adjacent wind farms, a 20-year dataset was produced with the same reference period as for WS170 and WS171 (Appendix A). The measurement height of interest is at 91 m ASL.

The location of the FINO3 mast relative to the WS170 and WS181 buoys is presented in Figure 26. The distance from the FINO3 mast to WS170 is 168 km and to WS181 is 135 km.

For the validation of the wind model for WS170 and WS181, the long-term corrected dataset at FINO3, 91 m, is transferred to the location and height of the two buoys.

An EMD-WRF dataset was extracted for the FINO3 mast location (section 6.1). The correlation between the FINO3 data and EMD-WRF is very high, both on wind speed, monthly energy content and directional distribution as discussed in Appendix A and the EMD-WRF data can there be said to capture the wind dynamics very well at FINO3.

Comparing the wind direction distribution between EMD-WRF data at FINO3 and EMD-WRF data at WS181 a difference in directional distribution and particularly energy distribution is noted (Figure 27). A transfer function is therefore required to both transfer the directions and the energy content in each direction.

A translation function is created using linear regression with a translation function for every 1° direction, used data in a +/-15° window, giving a scale and offset on wind speed as well as an offset on wind direction.

This translation function is then applied to the 20 year of long-term corrected 91 m FINO3 data, creating a 20-year dataset at WS170 and WS181.

A comparison of directional distribution of transferred FINO3 data at 91 m with long-term corrected WS170 and WS181 data at 90 m is presented in Figure 28 and Figure 29. The match is reasonably good but with some deviation in eastern sectors.

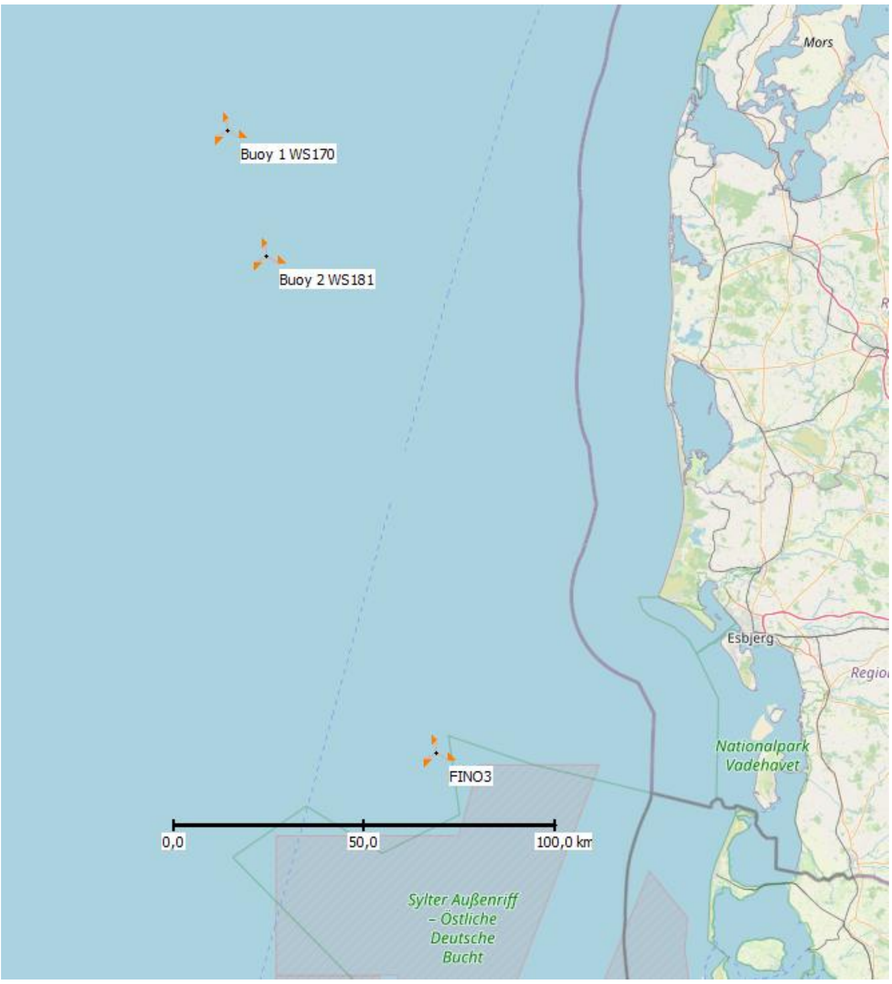


Figure 26. Location of the FINO3 mast relative to WS170 and WS181.

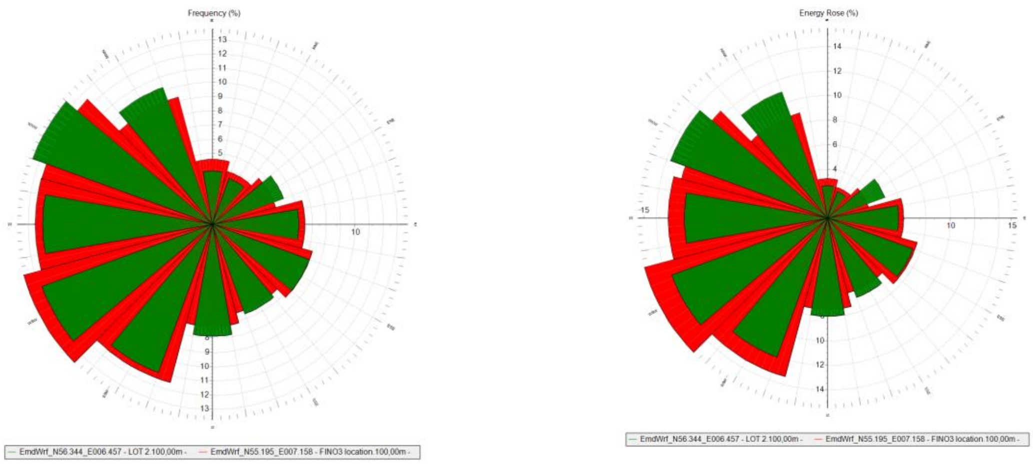


Figure 27. Left: directional distribution between EMD-WRF at FINO3 (green) and EMD-WRF at WS181 (red). Right: Energy rose of same two datasets.

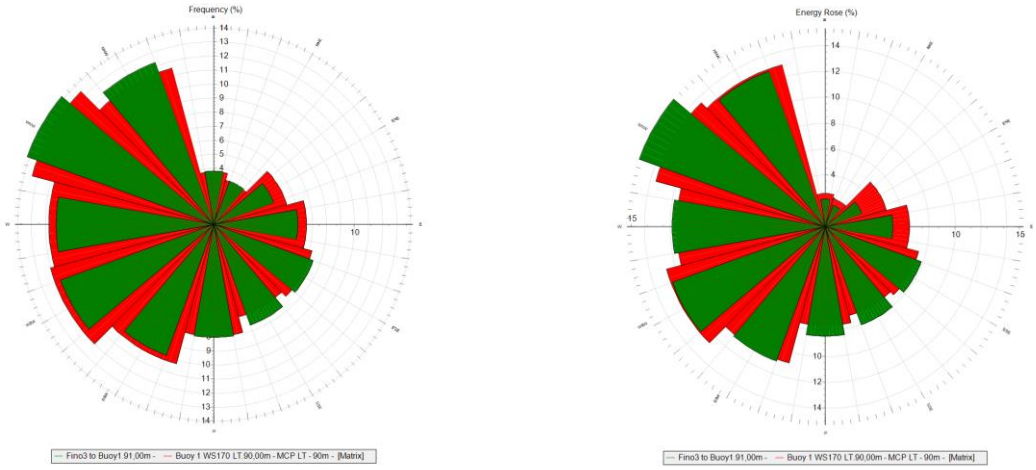


Figure 28. Comparison of directional distribution of transferred FINO3 data (green) with WS170 (red) (20 years). Left: by frequency, Right: by energy.

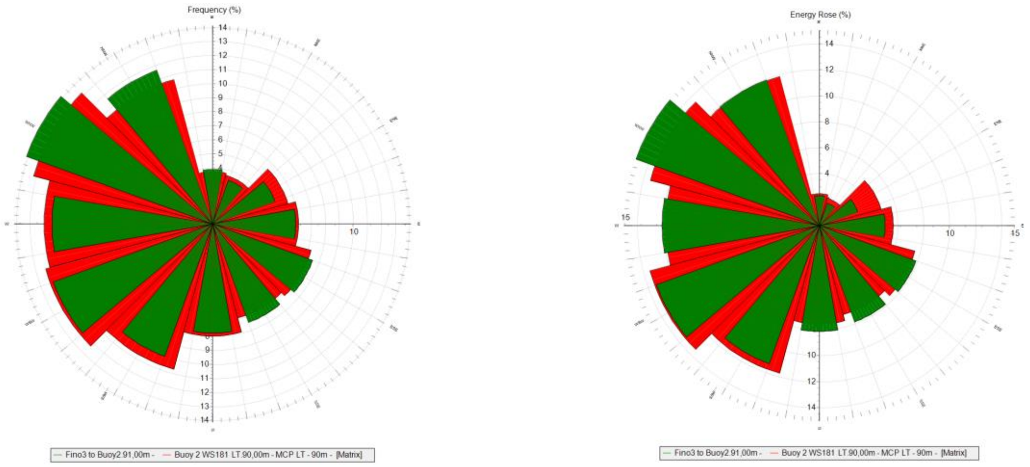


Figure 29. Comparison of directional distribution of transferred FINO3 data (green) with WS181 (red) (20 years). Left: by frequency, Right: by energy.

The datasets at 91 m translated to buoy locations are shear extrapolated to 150 m using a shear matrix based on 1 year of LiDAR observations. These are the final datasets described in section 4.5. The shear matrix is based on the interval from 90 m to 150 m. The rotation of wind direction from 90 m to 150 m is not included in the extrapolation.

The mean wind speed through the steps can be followed in Table 21. The wind distribution and Weibull fit can be found in detail in Appendix F and G.

Table 22. Mean wind speed through the transfer stages, FINO3 data.

Stage	Arithmetic Mean Wind Speed [m/s]
4 years of measured mean wind speed, FINO3, 91 m ASL	10.08
20 years, long- term corrected at 91 m, FINO3	10.13
20 years, transferred to WS170, 91 m	10.45
20 years, transferred to WS170, 150 m	10.97
20 years, transferred to WS181, 91 m	10.37
20 years, transferred to WS181, 150 m	10.86

7.1.3 Harald B

The Harald B dataset is a problematic dataset for several reasons.

- It contains large gaps that divide the dataset into three distinct chunks.
- There is a gap in data on most days from 21.10 to 00.00.
- The measurement setup and instrumentation is unknown and most likely non-compliant with IEC 12-1 [27], IEC 50-1 [28] and MEASNET standards [29].
- Some uncertainty remains as to the actual measurement height.

Yet, of the available oilrig datapoints, this remains the best qualified for wind resource validation, situated west of the North Sea Energy Island OWF. With a poorer data basis than FINO3 and Thor, the uncertainty is higher and it should carry less weight.

A 4-year period was pieced together, consisting of continuous full year period chunks. This was long-term corrected into a 20-year dataset with the same reference period as for WS170 and WS171 (Appendix A). The measurement height of interest is at 69 m ASL based on our information.

The location of the Harald B measurements relative to the WS170 and WS181 buoys is presented in Figure 30. The distance from the Harald B oilrig to WS170 is 129 km and to WS181 is 134 km.

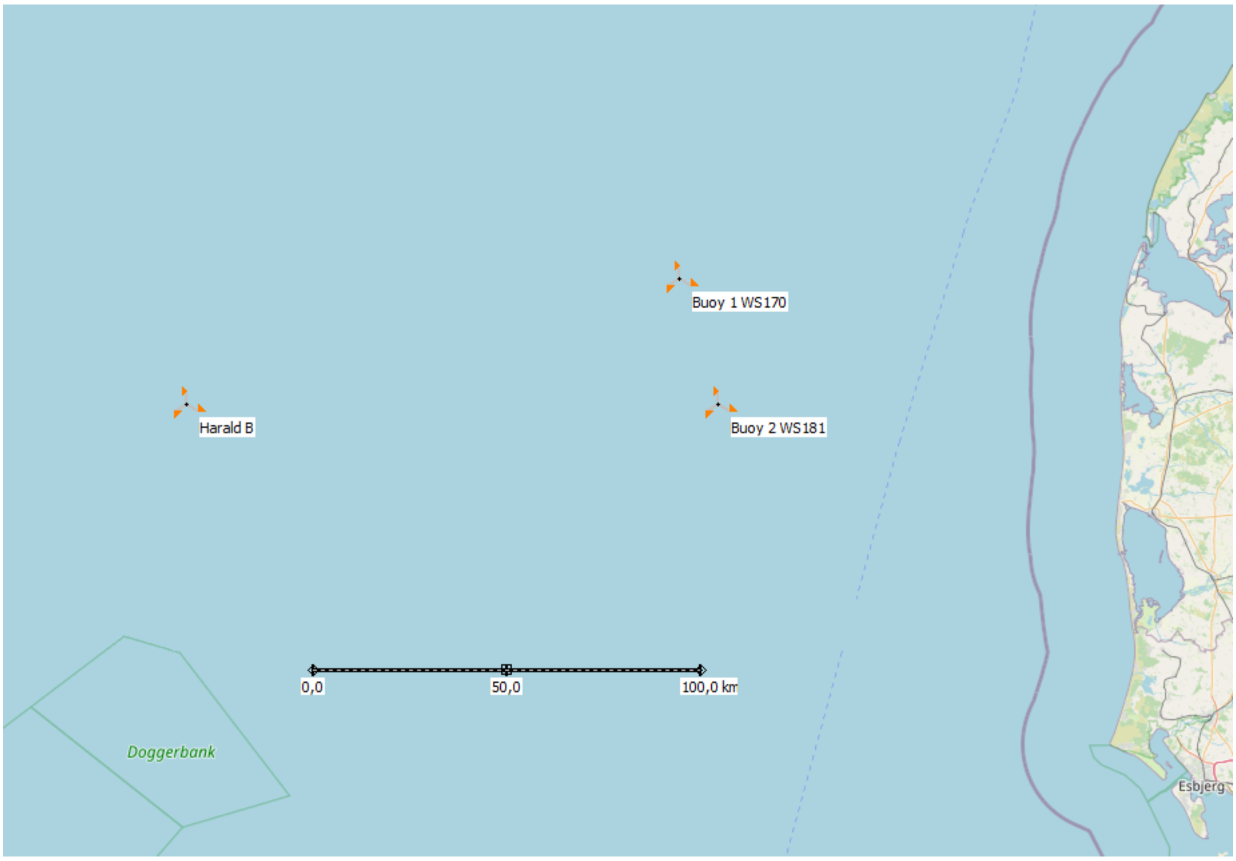


Figure 30. Location of the Harald B oilrig relative to WS170 and WS181.

For the validation of the wind model for WS170 and WS181, the long-term corrected dataset at Harald B, 69 m, is transferred to the location and height of the two buoys.

An EMD-WRF dataset was extracted for the Harald B location (section 6.1). The correlation between the Harald B data and EMD-WRF is very high, both on wind speed, monthly energy content and directional distribution as discussed in Appendix A and the EMD-WRF data can therefore be said to capture the wind dynamics well at Harald B.

Comparing the wind direction distribution between EMD-WRF data at Harald B and EMD-WRF data at WS181 a minor difference in directional distribution is noted (Figure 31). An attempt to use the regression method to transfer data as described for FINO3 and Thor failed (resulting in a direction distribution more different from the buoy distributions than before transformation) so a simpler transformation is made using A-parameter scaling. Given the relatively small difference between EMD-WRF data on the two locations, this is considered a valid method.

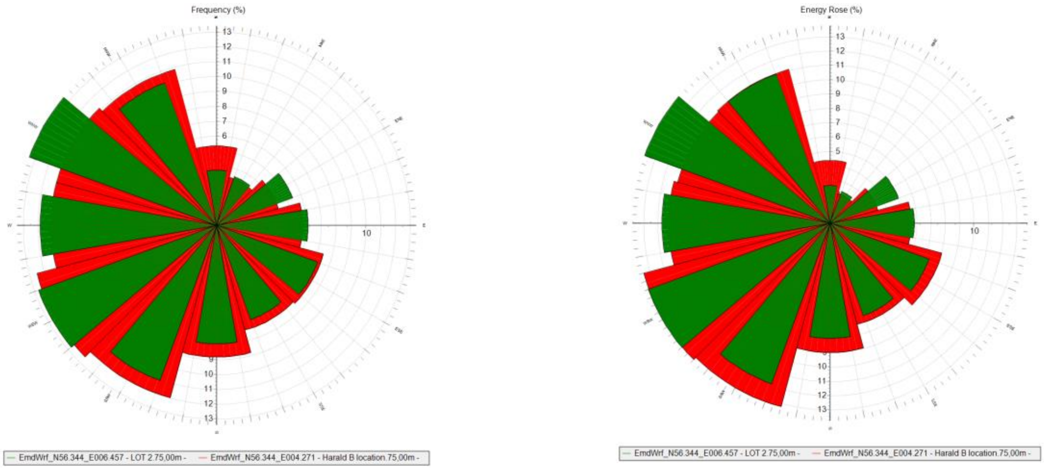


Figure 31. Left: directional distribution between EMD-WRF at WS181 (green) and EMD-WRF at Harald B (red). Right: Energy rose of same two datasets.

The A-parameter scaling method uses the relative difference in the A-parameter of the Weibull distribution in each sector between two mesoscale datasets to scale the wind speed of the data being moved. The wind direction is not being changed. The two mesoscale datasets are in this case EMD-WRF data at Harald B and at Lot 1 and Lot 2 respectively.

The results are time series at the location of WS170 and WS181 at 69 m height. The direction distribution is unchanged compared to the 20-year dataset at Harald B and is not a good match with WS170 and WS181, but better than using the regression transformation method (Figure 32 and Figure 33).

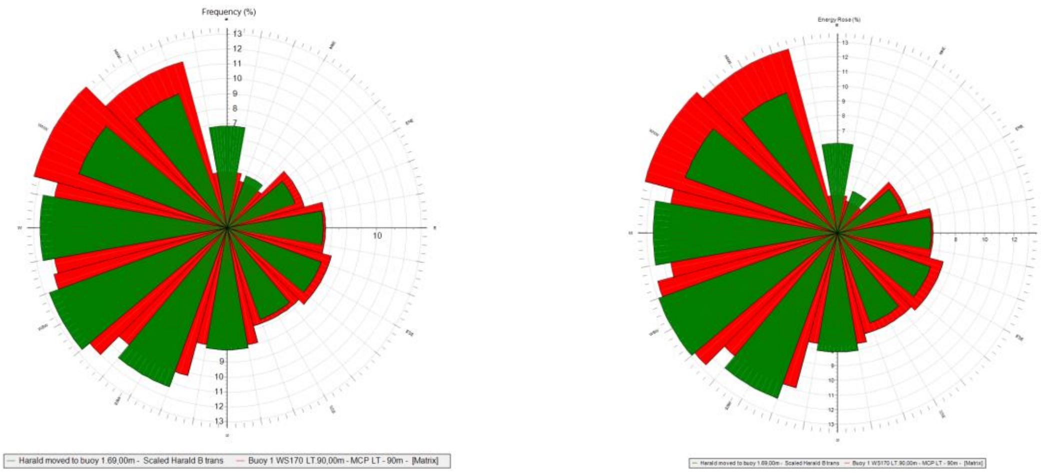


Figure 32. Comparison of directional distribution of transferred Harald B data (green) with WS170 (red) (20 years). Left: by frequency, Right: by energy.

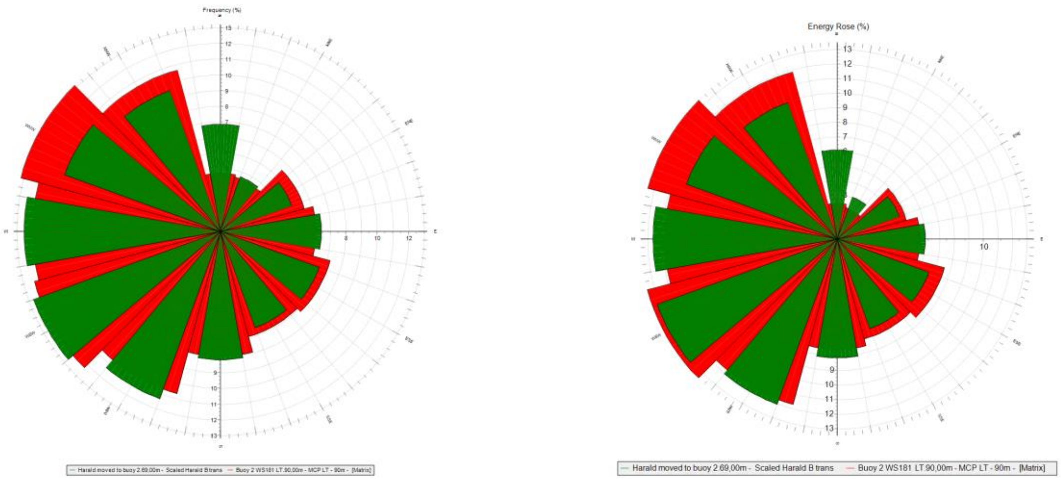


Figure 33. Comparison of directional distribution of transferred Harald B data (green) with WS181 (red) (20 years). Left: by frequency, Right: by energy.

The datasets at 69 m translated to buoy locations are shear extrapolated using a shear matrix based on 1 year of LiDAR observations. These are the final datasets described in section 4.5. The shear matrix is based on the interval from 60 m to 150 m. The rotation of wind direction from 90 m to 150 m is not included in the extrapolation.

The mean wind speed through the steps can be followed in Table 23. The wind distribution and Weibull fit can be found in detail in Appendix F and G. By comparison, with the regression translation method, the resulting wind speed at 150 m would be 11.13 m/s and 11.05 m/s at WS170 and WS181 respectively.

Table 23. Mean wind speed through the transfer stages, Harald B data.

Stage	Arithmetic Mean Wind Speed [m/s]
4 years of measured mean wind speed, Harald B, 69 m ASL	10.25
20 years, long-term corrected at 69 m, Harald B	10.20
20 years, transferred to WS170, 69 m	10.47
20 years, transferred to WS170, 150 m	11.23
20 years, transferred to WS181, 69 m	10.38
20 years, transferred to WS181, 150 m	11.15

7.2 Comparison of Primary Model with Secondary Models

The wind resource at Position 1 (Lot 1) and Position 2 (Lot 2) were assessed through long-term correction of measured LIDAR data. This remains the primary model for the site. Three secondary models were tested, translating measured data from Thor, FINO3 and Harald B to the site. They each cover different directions from the North Sea Energy Island OWF.

The results of these tests are summed up in Table 24 and Table 25.

The long-term corrected mean wind speeds are strongly supported by data from the Thor LiDAR. The uncertainty is far inside the expected uncertainty.

The result from the FINO3 mast deviate slightly more, at 1.3% and 1.4% of the wind speed from the primary model, but still well within the uncertainty. The difference may well be explained by the distance between FINO3 and the North Sea Energy Island OWF.

The Harald B oilrig is less supportive with a difference of 3.7% and 4.1% to the wind speed from the primary model. As the measurement uncertainty on these measurements are higher than for Thor and FINO3, the result is less reliable, and the magnitude of the deviation is within what can be expected.

There is a distinct difference in the shape of the Weibull distribution of the datasets, though the difference may to some extent be an artifact of the transfer methods. Because of this, it is strongly suggested to remain with the primary dataset as being less manipulated than the supporting datasets.

While the directional distributions are qualitative similar, they are not identical. This may have more to do with the distance across which they have been moved (Figure 35).

The secondary models support the primary wind model, but it also clear that the primary model is stronger than any of the secondary models. Therefore, only the primary model is submitted in the data package. The frequency distributions and Weibull parameters of the secondary model are submitted in Appendix F and G.

Table 24. Comparison of model results at Position 1 150 m ASL.

	PRIMARY MODEL	TRANSFERRED THOR MODEL	TRANSFERRED FINO3 MODEL	TRANSFERRED HARALD B MODEL
Wind speed [m/s]	10.83	10.85	10.97	11.23
Wind speed relative to primary model		100.2%	101.3%	103.7%

Table 25. Comparison of model results at Position 2 150 m ASL.

	PRIMARY MODEL	TRANSFERRED THOR MODEL	TRANSFERRED FINO3 MODEL	TRANSFERRED HARALD B MODEL
Wind speed [m/s]	10.71	10.75	10.86	11.15
Wind speed relative to primary model		100.4%	101.4%	104.1%

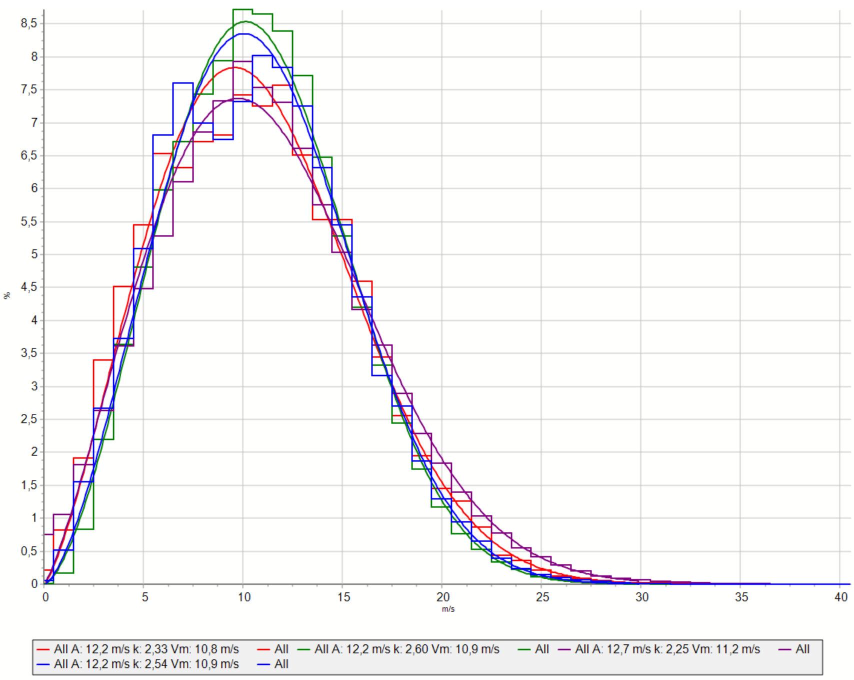


Figure 34. Wind speed probability function for the four datasets at Position 2, WS181. Primary model (red), Thor model (blue), Fino3 (green) and Harald B (purple).

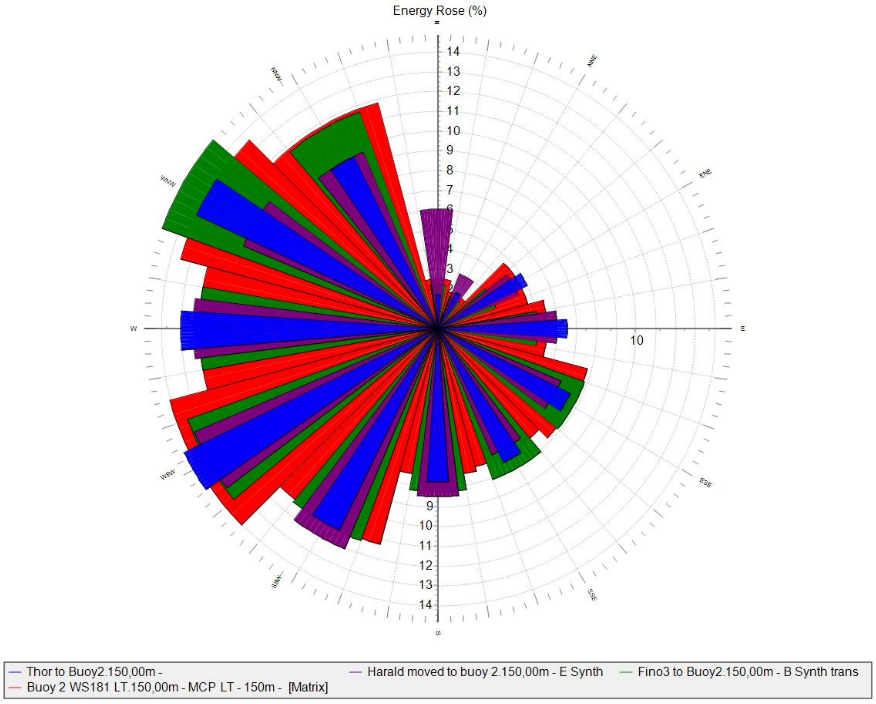


Figure 35. Directional distribution of the four long-term wind models at Position 2, WS181. Primary model (red), Thor model (blue), Fino3 (green) and Harald B (purple).

7.3 Uncertainty of Primary Wind Model

7.3.1 Measurement Uncertainty

Uncertainty on measurements was discussed in section 4.6. The results are summarized in Table 26.

Table 26. Measurement uncertainty.

BUOY	TOTAL MEASUREMENT UNCERTAINTY
WS170	3.57%
WS181	2.49%

7.3.2 Long-term Correction Uncertainty

The long-term correction uncertainty consists of components with very low uncertainty (correlation, reference consistency, reference period length) and one component with moderate uncertainty, which is the measurement period of 1 year. This is therefore the dominant uncertainty with very minor contributions from other components.

Based on [30], the combined long-term correction uncertainty of a 1-year period will range between 1.5% and 4%.

For the long-term correction three different references (EMD-WRF, ERA5 and NORA3) were tested using four different methods in a sensitivity analysis. The standard deviation on predicted wind speed of these was 0.4%. The references are, however, not entirely independent from each other which make this standard deviation unreliable. Instead, the range from minimum to maximum resulting wind speed can be used as an indicator of the uncertainty. This range is 1.3% for WS170 and 1.4% for WS181.

We therefore consider an uncertainty on long-term correction of 1.5% a reasonable value for long-term correction of the primary data from the buoys.

7.3.3 Very Long-term Uncertainty

The future climate uncertainty is the potential difference in mean wind speed of the next 20 years from the past period considered in the wind study. Northern Europe is subject to longwave oscillations meaning that a 20-year operation period can be quite different from the very long-term average. As suggested by [30], we estimate that for a 20-year dataset in this region this uncertainty is 1.5 % on wind speed.

This is supported by [31] who indicate 20-year multidecadal variability amplitude of the North Sea on yield around 3%. Given a yield to wind speed ratio near unity, this translates well to wind speed and results in an uncertainty of wind speed of 1.5%.

7.3.4 Year-to-year Variability

Based on the annual variation on the EMD-WRF data the inter-annual variability is 3.3% at WS170 and 3.4% at WS181. Over a 20-year lifetime this uncertainty is reduced to 0.62% and 0.65% respectively.

7.3.5 Total Uncertainty

The uncertainty components are combined to a total wind speed uncertainty. A total is given for 1- and 20-year period.

The results from the secondary data provide a standard deviation on the four reported wind speed results for each buoy at 1.7% at WS170 and 1.9% at WS181. Due to the horizontal extrapolation distortion and in some cases poorer measurement uncertainty than at the buoys, the uncertainty on the transferred secondary data should be considered higher than on the local data, however the standard deviation of the results from the four different models remain within the uncertain of the total wind speed uncertainty of the primary model (Table 27 and therefore confirm the primary model.

Table 27. Combined uncertainty on long-term wind data. Uncertainty given as one standard deviation wind speed.

	WS170		WS181	
WIND DATA UNCERTAINTY	1 YEAR	20 YEARS	1 YEAR	20 YEARS
Measurement uncertainty	3.57%	3.57%	2.49%	2.49%
Long-term correction uncertainty	1.5%	1.5%	1.5%	1.5%
Very long-term uncertainty	1.5%	1.5%	1.5%	1.5%
Annual variability	3.3%	0.62%	3.4%	0.65%
Total	**4.43%**	**3.52%**	**4.03%**	**2.87%**

8 Flow Modelling

8.1 Wind Resource Map

A wind resource map has been made for the North Sea Energy Island offshore wind farm zone. The map is based on the primary wind model (long-term corrected LiDAR data) and describe the horizontal change across the site.

The variation in wind speed distribution across the site is found with a grid of mesoscale data across the site. The mesoscale data used are EMD-WRF Europe+ data and the period for each datapoint is 5 years. The grid has a spacing of 6 km between each node. EMD-WRF Europe+ is a precalculated version of EMD-WRF using a much larger domain than the EMD-WRF data otherwise used in this study. Their ready availability makes them well-suited for a grid like this.

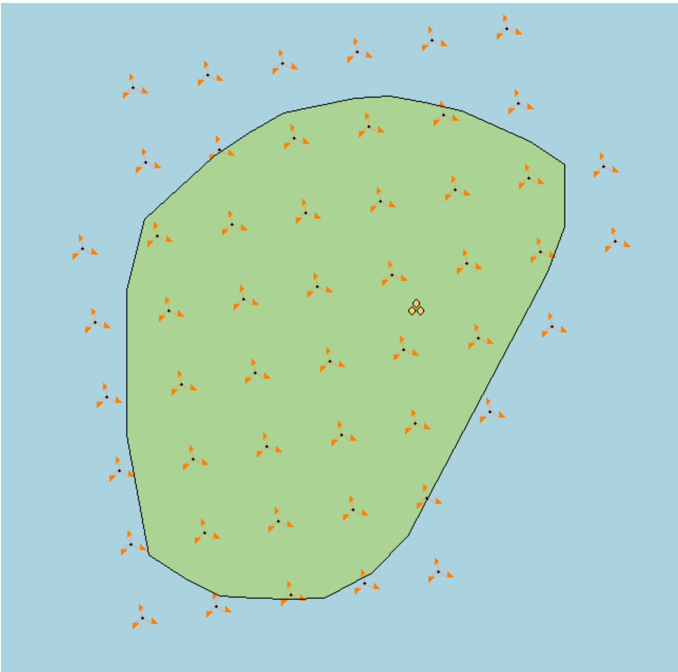


Figure 36. Grid of EMD-WRF Europe+ data

Based on this grid a wind resource map is produced through linear interpolation of data at 150 m height.

The wind resource map is then recalibrated with the long-term corrected measurements at WS170 and WS181 with weighted interpolation between the two measurement locations.

The resulting recalibrated wind resource map is presented in Figure 37 and is provided as a deliverable.

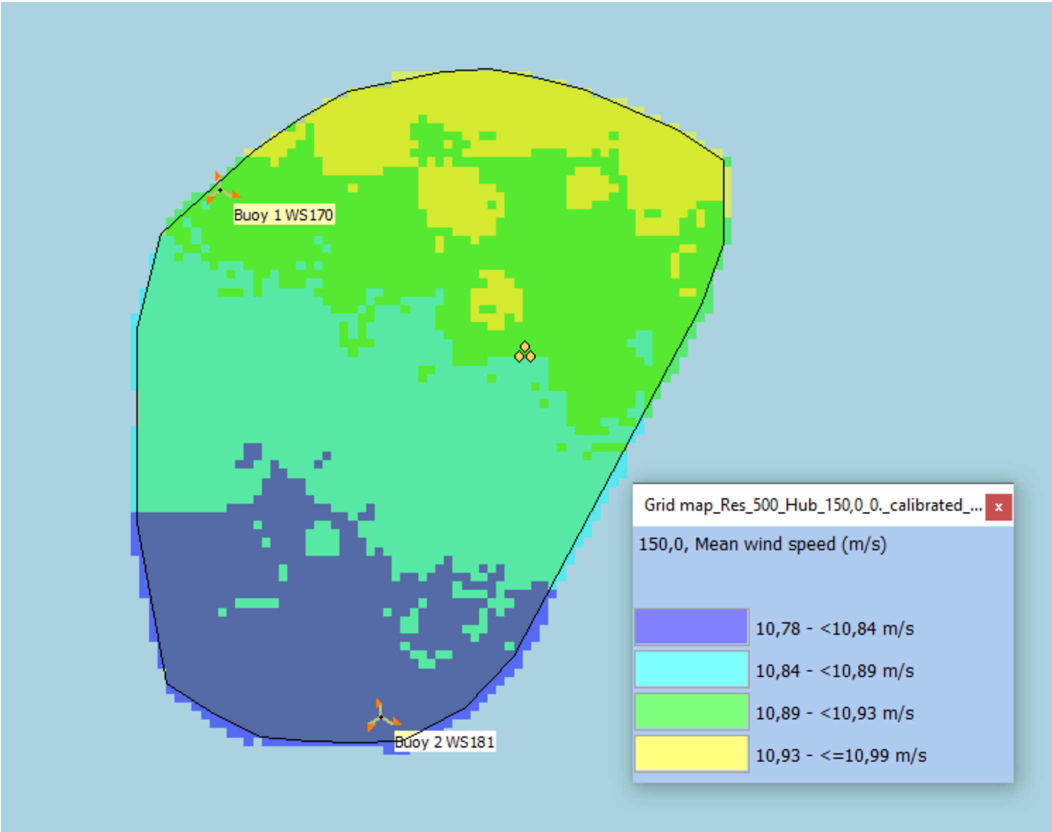


Figure 37. Wind resource map for the North Sea Energy Island OWF.

8.2 Wind Resource Model for Position 3

This site parameter assessment includes data for a third position beside the two measurement locations.

The location of Position 3 was selected as the most remote location from WS170 and WS181 within the OWF. Coordinates for Position 3 are presented in Table 28. The location is 29 km east of WS170 and 37 km northeast of WS181.

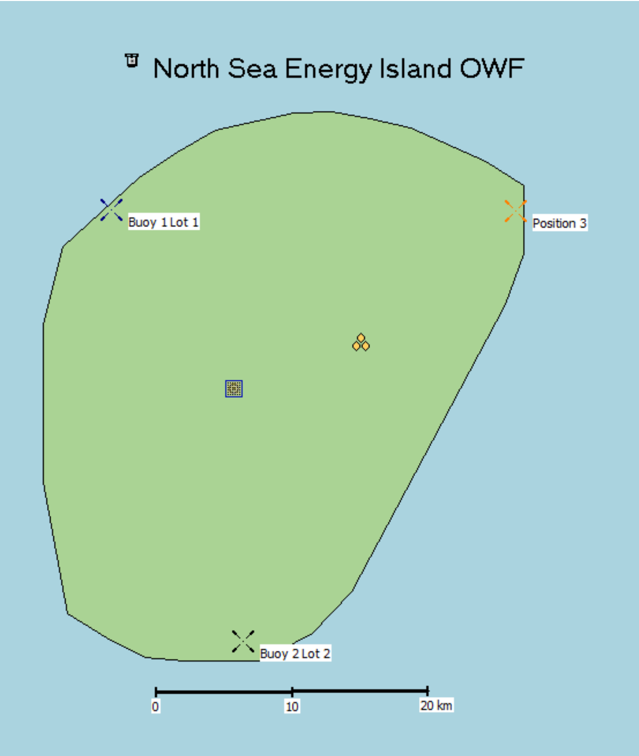


Figure 38. Location of measurement points and the selected Position 3.

Table 28. Coordinates for Position 3.

	UTM WGS84, ZONE 32		GEOGRAPHICAL COORDINATES **WGS84**	
Position 3	363,889	6,278,127	6.7813°	56.6275°

For Position 3 a long-term time series has been produced for 150 m ASL.

This is achieved through the gradient file method available in windPRO. With this method observed data are moved around the site using a wind resource map. From the wind resource map, the Weibull A parameter of the Weibull distribution is picked up from the location of the observed data and the prediction location and the ratio is applied to the observed time series. A specific ratio is found for each of 12 direction sectors. No change is made to the wind direction data.

The validity of this assumption is tested by comparing the directional distribution of EMD-WRF data for the locations of WS170 (Lot 1), WS181 (Lot 2) and position 3 (Figure 39). There is a marginal difference in wind direction, but small enough to assume of similar direction distribution valid.

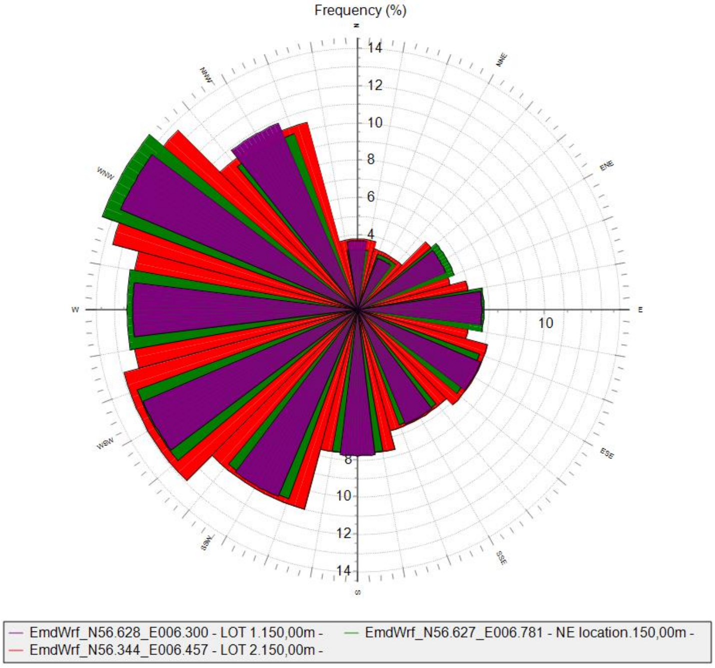


Figure 39. Comparison of direction distribution between EMD-WRF data extracted for the locations of WS170 (red), WS181 (purple) and Position 3 (green).

For Position 3 the resulting time series at 150 m was generated using the long-term corrected time series for WS170 at 150 m and the recalibrated wind resource map.

In principle, with this method, a time series can be extracted for any location on the site using the wind data time series and the gradient file. Both are included as deliverables.

The time series for Position 3 includes wind speed and wind direction for 20 years in an hourly resolution.

The arithmetic mean wind speed at Position 3 is 10.87 m/s. The Weibull distributions are presented in Table 29. Details can be found in Appendix D.

Table 29. Weibull parameters of the long-term wind data, Position 3.

POSITION 3	PERIOD [Y]	ARITHMETIC MEAN WIND SPEEDS [M/S]	WEIBULL MEAN [M/S]	WEIBULL - A PARAMETER [M/S]	WEIBULL - K PARAMETER
150 m	20	10.87	10.94	12.35	2.3544

9 Siting Parameters

This chapter outlines the requested siting parameters for assessment of structural integrity of wind turbines in accordance with the relevant design standards: IEC 61400-1 Ed. 4 [1], IEC 61400-3-1 Ed. 1 [2], IEC 61400-15-1 CD [6], DS 472 Ed 2. [5], and EN1991-1-4 including the Danish Annex DK NA EN1991-1-4 [3] [4].

For siting parameters that require turbine specific information, the following has been assumed.

Table 30. Turbine specific information used for siting parameters.

TURBINE SPECIFICATION	VALUE
Hub height	150 m
Rotor diameter	240 m
Cut-in wind speed	3 m/s
Cut-out wind speed	25 m/s
Wind turbine class	II

9.1 Normal Wind Conditions

Normal wind conditions have been derived in accordance with IEC 61400-3-1 Ed. 1 [2], IEC 61400-1 Ed. 4 [1] and IEC 61400-15-1 CD [6]. All parameters except for the wind speed distribution have been estimated as omnidirectional characteristic values. This is in line with the IEC 61400-3-1, which allows omnidirectional values to be considered for offshore sites that are far away from the coast where the environment generally exhibits little directional variation.

Due to the site location being offshore, the terrain is classified as “not complex” (terrain complexity factor is 1.0) and the wind flow is assumed without any inclination (flow inclination 0°).

9.1.1 Wind Speed Distribution

The 10-min mean wind speed probability distribution at hub height is modelled by a Weibull distribution for each direction [1]. The distributions are estimated based on long-term corrected data from the LiDARs. Note that the temporal resolution of this data is 1 hour but according to IEC 61400-3-1 the long-term probability distribution of mean wind speed may be assumed to be independent of averaging periods between 10 minutes and 3 hours. The results are summarized in the table below. Mean wind speed is derived from the Weibull distribution. Details can be found in Appendix D.

Table 31. Weibull distribution parameters based on long-term corrected LIDAR data at 150 m ASL, Position 1 - WS170. Wind speeds are derived from the Weibull distribution.

POSITION 1 – WS170 SECTOR	A PARAMETER [M/S]	K PARAMETER [-]	FREQUENCY [%]	MEAN WIND SPEED [M/S]
Mean	**12.31**	**2.36**	**100.00**	**10.91**
0-N	9.15	1.68	3.99	8.17
1-NNE	8.79	1.67	3.06	7.85
2-ENE	11.28	2.49	5.08	10.01
3-E	11.97	2.51	6.40	10.62
4-ESE	12.22	2.65	7.09	10.86
5-SSE	12.85	2.76	6.61	11.44
6-S	12.08	2.34	7.97	10.70
7-SSW	12.99	2.44	10.28	11.52
8-WSW	13.03	2.39	12.12	11.55
9-W	12.33	2.27	12.09	10.92
10-WNW	12.43	2.41	13.33	11.02
11-NNW	13.21	2.62	11.98	11.73

Table 32. Weibull distribution parameters based on long-term corrected LIDAR data at 150 m ASL, Position 2 - WS181. Wind speeds are derived from the Weibull distribution.

POSITION 2 – WS181 SECTOR	A PARAMETER [M/S]	K PARAMETER [-]	FREQUENCY [%]	MEAN WIND SPEED [M/S]
Mean	**12.19**	**2.33**	**100.00**	**10.80**
0-N	9.09	1.65	3.79	8.12
1-NNE	8.17	1.70	3.36	7.29
2-ENE	10.87	2.35	5.38	9.63
3-E	11.17	2.36	6.09	9.89
4-ESE	12.45	2.85	7.30	11.09
5-SSE	12.64	2.66	6.75	11.23
6-S	11.81	2.28	7.79	10.47
7-SSW	13.25	2.44	10.38	11.75
8-WSW	13.26	2.56	12.67	11.77
9-W	12.22	2.22	12.28	10.82
10-WNW	12.32	2.40	13.29	10.92
11-NNW	12.95	2.54	10.92	11.49

Table 33. Weibull distribution parameters based on long-term corrected LIDAR data at 150 m ASL, Position 3. Wind speeds are derived from the Weibull distribution.

POSITION 3 SECTOR	A PARAMETER [M/S]	K PARAMETER [-]	FREQUENCY [%]	MEAN WIND SPEED [M/S]
Mean	**12.35**	**2.35**	**100.00**	**10.95**
0-N	8.88	1.70	3.99	7.93
1-NNE	8.99	1.66	3.06	8.03
2-ENE	11.45	2.47	5.08	10.16
3-E	11.86	2.52	6.40	10.53
4-ESE	12.14	2.65	7.09	10.79
5-SSE	12.92	2.76	6.61	11.50
6-S	12.26	2.34	7.97	10.87
7-SSW	12.92	2.44	10.28	11.46
8-WSW	13.09	2.39	12.12	11.60
9-W	12.36	2.27	12.09	10.94
10-WNW	12.52	2.41	13.33	11.10
11-NNW	13.29	2.62	11.98	11.81

9.1.2 Normal Wind Profile (NWP)

The site-specific normal wind profile is characterised by the mean wind shear power law coefficient (α_c). According to IEC 61400-1 Ed. 4 [1] the site-specific omnidirectional characteristic wind shear should be evaluated as the energy-weighted average of the sectorwise values.

The repaired (final) 1 year LiDAR datasets were used to calculate the characteristic shear. Two values are offered: A power law coefficient based on heights 120 m, 150 m, and 180 m, the expected hub height range, and, secondly, the shear across to expected rotor range, based on 30 m, 100 m, 150 m, 180 m and 270m height data. As a full year is available, there is no need to long-term adjust the data to derive characteristic shear. The results are summarised in the table below.

For Position 3, the Position 1 shear can be assumed.

Table 34. Site specific omnidirectional wind shear exponent.

WIND SHEAR POWER LAW EXPONENT [-]	POSITION 1 – WS170	POSITION 2 – WS 181
Hub height range 120 m to 180 m	0.083	0.083
Rotor range 30m to 270m	0.093	0.092

WIND PROFILE CHARACTERISTICS.

The observed wind profile at WS170 and WS181 is presented as a function of heat flux (Table 35). The heat flux is obtained from EMD-WRF data at buoy location. Only the WS181 numbers are presented as the results are identical for the buoys and can be considered valid for all three positions. Three distinct zones can be found Figure 40:

1. Negative heat flux, typical for stable conditions, with a clear link between shear and heat flux,
2. A middle range, typical for neutral condition, with a well-defined shear
3. Positive heat flux with a substantial scatter in shear.

The different regimes are summarized in Table 35.

Table 35. Range of observed shear by heat flux, WS181

WS181	LOW HEAT FLUX	CENTRAL RANGE HEAT FLUX	HIGH HEAT FLUX
Heat flux range	<5 W/m^2	5 – 25 W/m^2	>25 W/m^2
Frequency of range	17%	51%	32%
Typical shear range	0.1 - 0.3	0.04 - 0.1	-0.08 - 0.08

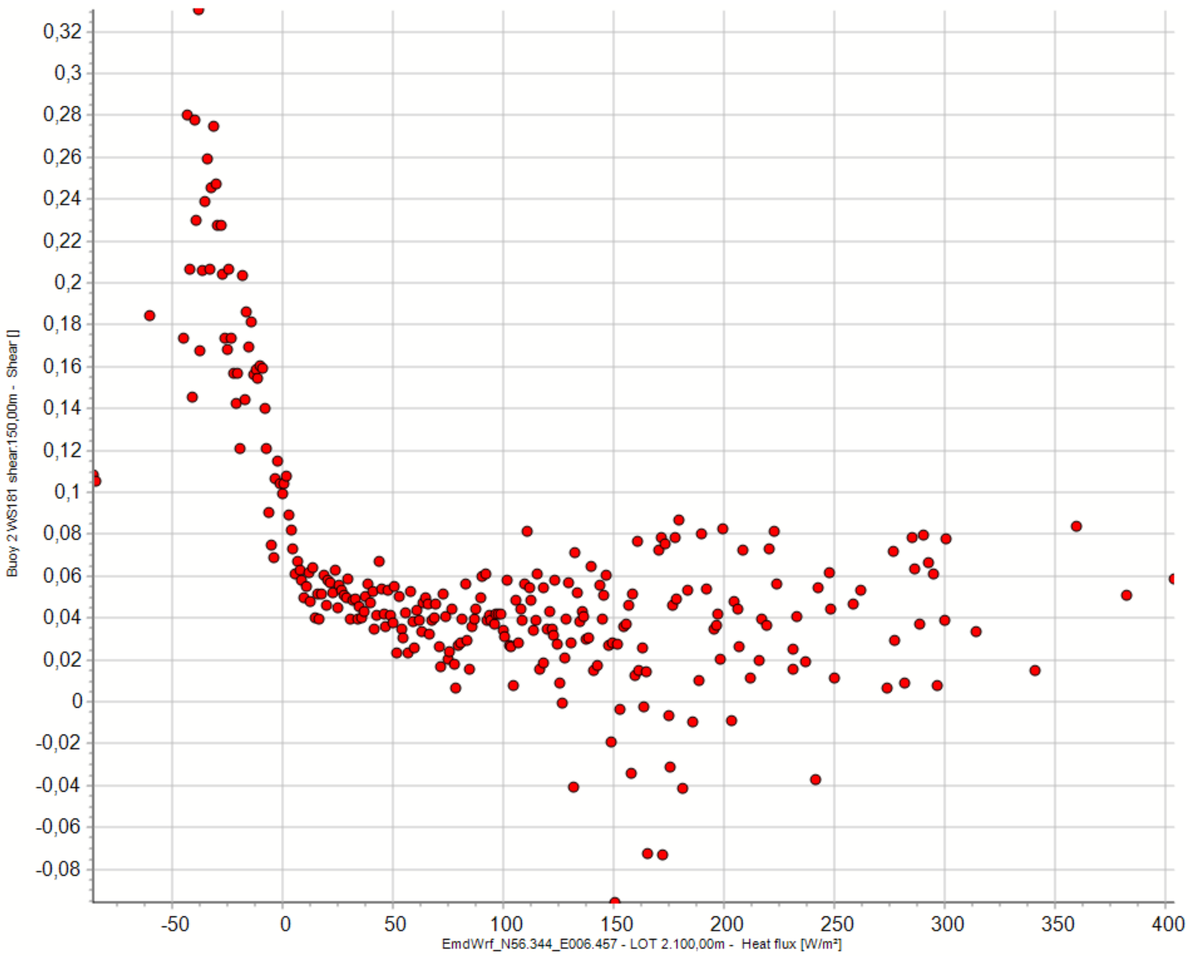


Figure 40. Shear power law coefficient as a function of heat flux at WS181.

Stability classes are defined though the Monin Obukhov length, here using three categories as described in

Table 36. The 1/L signal in the EMD-WRF data is used to describe stability at WM181 in Figure 41. Stable conditions are fairly rare and typical for the spring months. Both stable and unstable conditions are suppressed at high wind sped.

Table 36. Range of observed shear as a function of stability class.

WS181	Stable	Neutral	Unstable
Inverse Monin-Obukvov length [m]	1/L > 0.005	-0.005 > 1/L > 0.005	1/L < 0.005
Frequency	12%	41%	47%
Typical shear range	0.1 - 0.3	0.04 - 0.1	-0.08 - 0.08

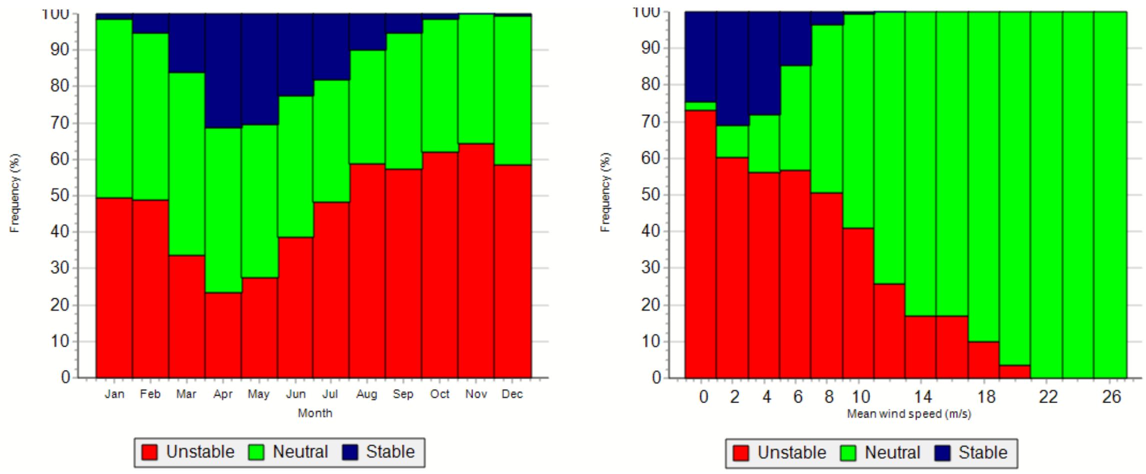


Figure 41. Frequency of stability classes as a function of month and wind speed, EMD-WRF at location of WM181.

Shear as a function of stability (1/L) at WS181 is presented in Figure 42. It is clear that unstable conditions result in low shear in the range of -0.05 to 0.05 while during stable conditions, much higher shear can occur.

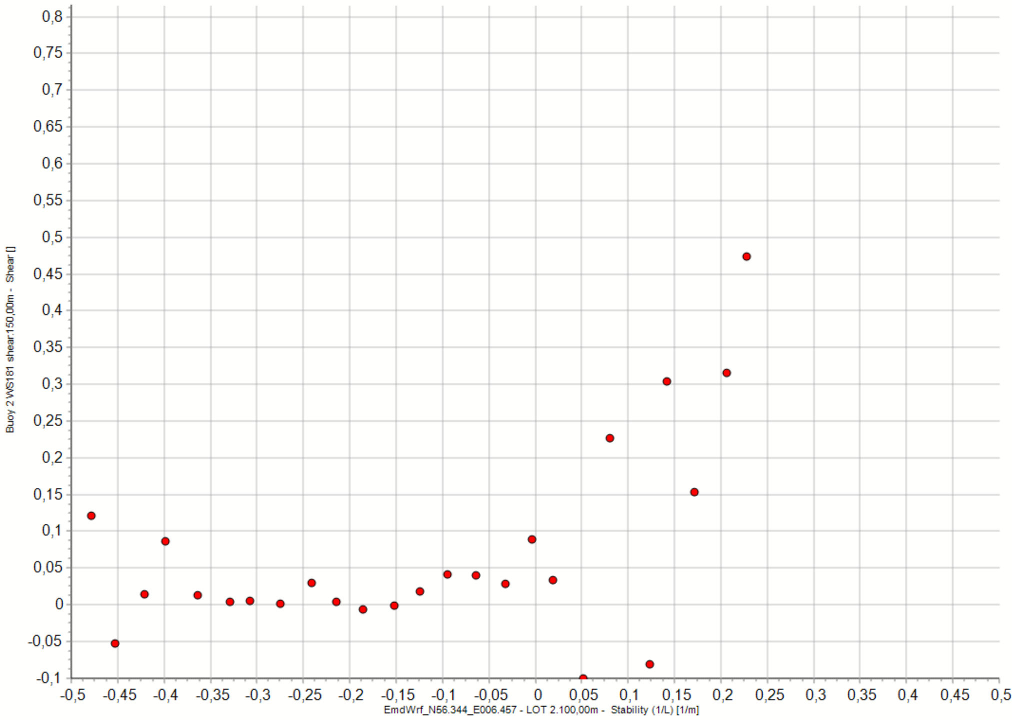


Figure 42. Shear coefficient as a function of stability (1/L), based om WM181 and EMD-WRF data.

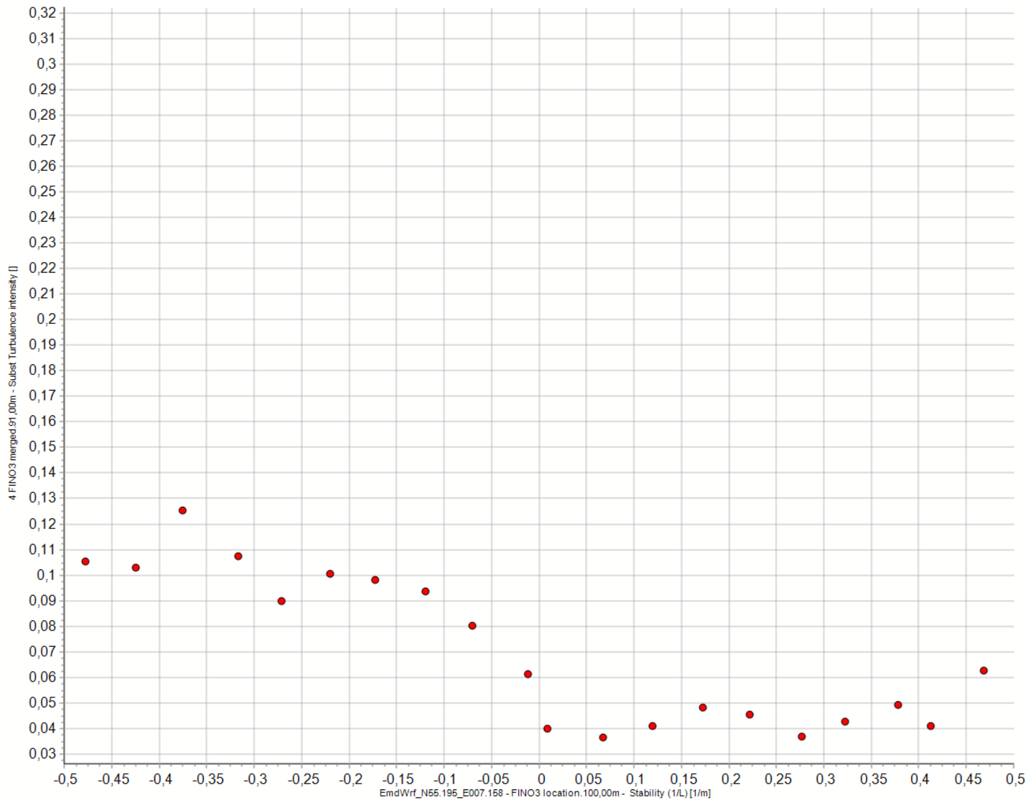


Figure 43. Turbulence intensity at FINO3, 91 m ASL, as a function of stability (1/L, EMD-WRF).

This is strongly linked to turbulence. Figure 43 presents turbulence intensity at FINO3 as a function of stability (at the EMD-WRF point associated with FINO3), where turbulence hover around 10% during unstable conditions and 4-5% during stable conditions.

At offshore locations, the main driver of the shear coefficient is seasonal rather than diurnal and a plot of rotor radius shear as a function of month (Figure 44) fits well with distribution of stability over the year and shear for different stability regimes with higher shear and stability in spring months.

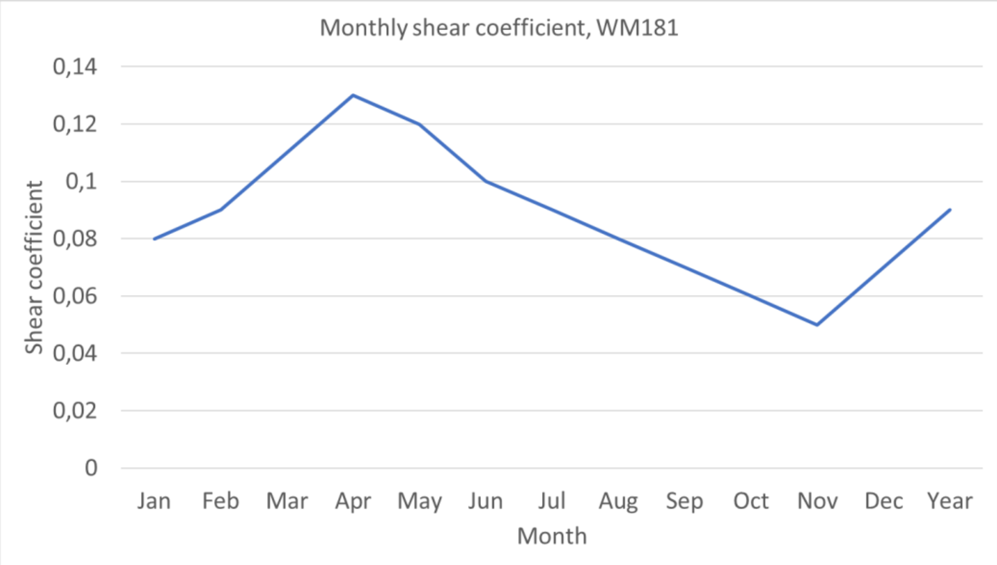


Figure 44. Monthly shear coefficient α across the rotor at WM181.

9.1.3 Normal Turbulence Model (NTM)

TURBULENCE MODEL AND FIT

The normal turbulence model in the IEC 61400-1 [1] standard defines a linear relationship between the characteristic 90% quantile of turbulence ($\sigma_{c,90}$) and wind speed. For offshore sites, this is not representative, due to the Charnock effect, which adds a second order effect to the turbulence increase with wind speed [2]. A special purpose offshore model is therefore considered where the turbulence mean value (σ_μ) is modelled as a second order function of wind speed, and the turbulence standard deviation (σ_σ) is modelled as a linear function of wind speed. The models are outlined by the equations:

$$\sigma_\mu(u) = A_{\sigma_\mu} + B_{\sigma_\mu} u + C_{\sigma_\mu} u^2$$

$$\sigma_\sigma(u) = A_{\sigma_\sigma} + B_{\sigma_\sigma} u$$

The characteristic turbulence required for structural design can be calculated by combining the two models as [1]:

$$\sigma_{c,90}(u) = \sigma_\mu(u) + 1.28\sigma_\sigma(u)$$

SELECTION OF TURBULENCE DATA

The models and safety factors forming the basis of the IEC 61400-1 and IEC 61400-3-1 are calibrated using turbulence measured by cup anemometers. LiDARs measure turbulence in a different way than cup anemometers, as they represent a volumetric average contrary to the point observation of a cup. No industry standard has yet been established to define corrections of LiDAR turbulence for use in site assessments and loads, although attempts are ongoing as e.g. CFARS. On top of this limitation floating LiDARs are exposed to wave movements which are amplified with increasing height. This movement appears as an additional contribution to the apparent turbulence seen by a floating LiDAR. As a consequence, floating LiDARs are not consistent with the requirements in IEC61400-1 or IEC61400-3 for assessment of turbulence and cannot be used to characterise the site turbulence.

Luckily, far offshore conditions are relatively uniform, at least regionally, which is documented in the highly relevant master thesis [32]. Causes of local variations are mainly due to coastal effects and changes in wave-seabed interaction in areas of shallow water affecting the waves. The closest alternative data sources based on cup anemometry, which are available to this study, are:

1) Høvsøre onshore masts (116 m)
2) Horns Reef mast M2 (62 m)
3) FINO3 mast (91 m, also 106 m but with mast shadowing)

The relative positions of the three masts are shown together with the bathymetry of the surrounding North Sea in Figure 45 below.

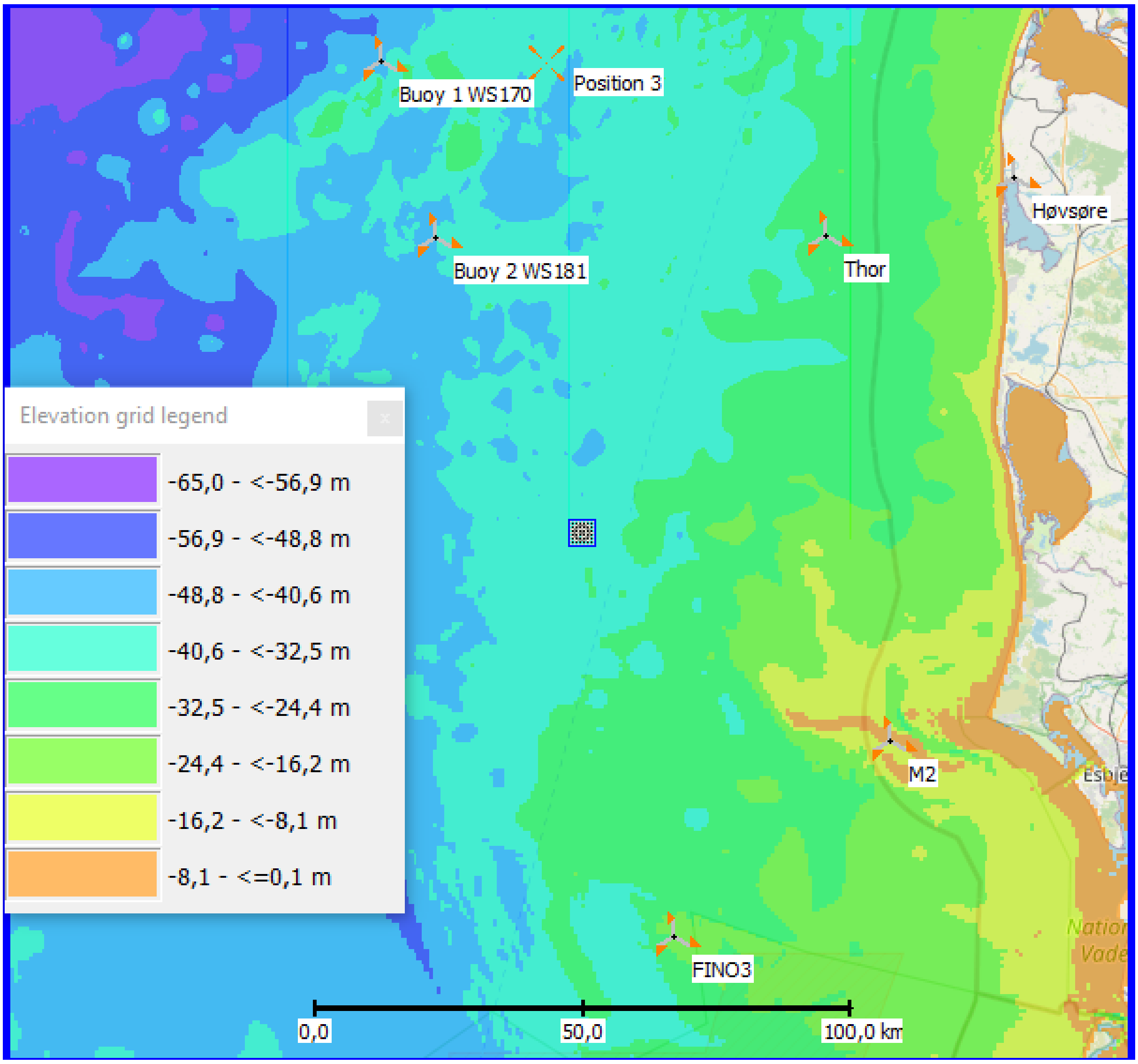


Figure 45. Plot showing the bathymetry of the North Sea and the relative positions of Høvsøre mast, Horns Reef M2 and FINO3.

The master thesis [32] documents that the turbulence level at a given height as a function of wind speed is surprisingly uniform and consistent across masts in the entire North Sea, even including the Irish Sea. The only exceptions are the masts at Horns Reef, M2 and M8, which show higher turbulence levels, particularly at wind speeds exceeding 10-15 m/s (mainly M8). Note, that the Høvsøre mast has not been included in the study.

Høvsøre is the closest mast, with the highest measurements above sea level, but being onshore it is least representative for offshore conditions. This can be partly compensated by considering only data from west, facing the sea. Still, the upstream fetch includes the marine foreland and the coastline, not representative of far offshore conditions.

M2 (and M8) only measure up to 62 m and is situated offshore in a particularly shallow region of the North Sea, with large stretches of water depth around 10 m or less upwind, towards west in main wind directions. It appears that the specific bathymetry around Horns Reef means that waves to a larger extend are affected by the seabed. The transition from deep water to shallow water waves starts at depth of 0.5 times the wavelength [33]. When exceeded, waves start shoaling, that is they shorten, the wave height increases and followingly the aerodynamic roughness increases too and, hence, also the resulting atmospheric turbulence of the wind [34]. For fully developed waves the average wavelength increases with wind speed, reaching around 34 m at 10 m/s [33] – this means that for higher wind speeds, resulting waves will clearly be affected by the bathymetry. This might explain the turbulence deviations at M8 in particular, and possibly also M2 (see Figure 46).

FINO3 is slightly more distant than M2 but has relatively high measurements (91m ASL) and is in an offshore setting with deeper waters, more similar to those at the site of the North Sea Energy Island. Turbulence levels at FINO3 are consistent with most other North Sea and Irish Sea measurements analysed in [32] (excluding M2 and M8).

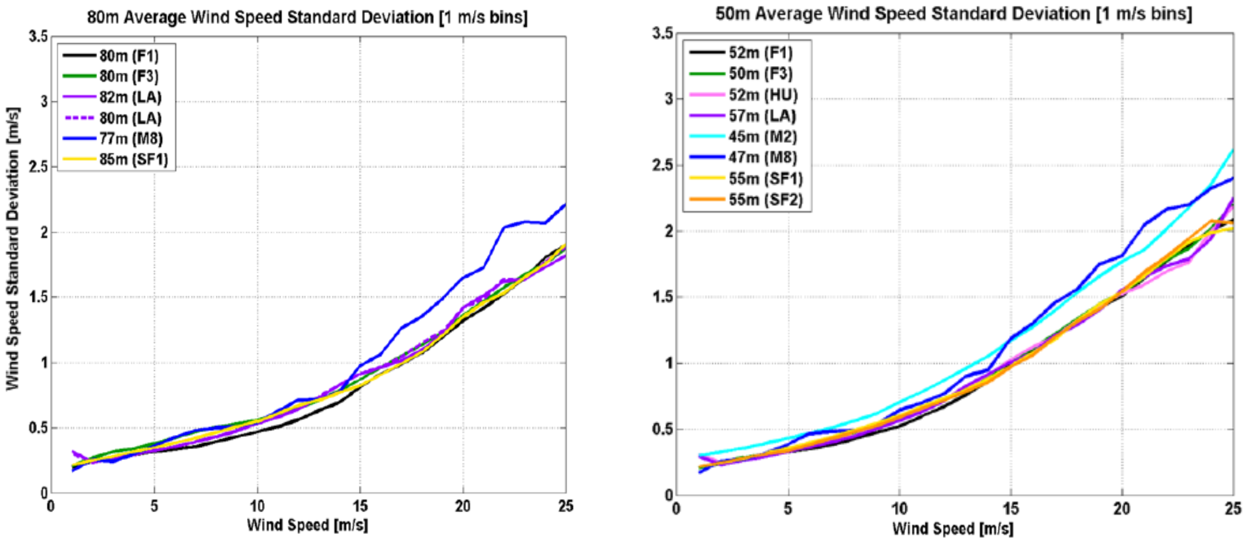


Figure 46. From [32], showing the turbulence mean (standard deviation of wind speed) for a number of masts in the North Sea and Irish Sea at ca. 80 m above sea level (left) and at ca. 50 m (right). Note, how M2 and M8 stand out on the right plot and how M8 stands out on the left plot (M2 does not measure to 80 m).

Given the above FINO3 is clearly most representative of the conditions at the site of the North Sea Energy Island. A weighted average of the turbulence levels across the three masts would yield a turbulence climate very close to that of FINO3, as turbulence levels at M2 are generally higher and levels at Høvsøre generally lower compared to FINO3. However, using FINO3 directly on its own is the preferred solution, as it is generally considered most representative of the far offshore conditions, has higher measurement levels, and limited mast distortion due to triple anemometry at each level. Figure 47 shows the mean turbulence at the three masts for similar measurement levels.

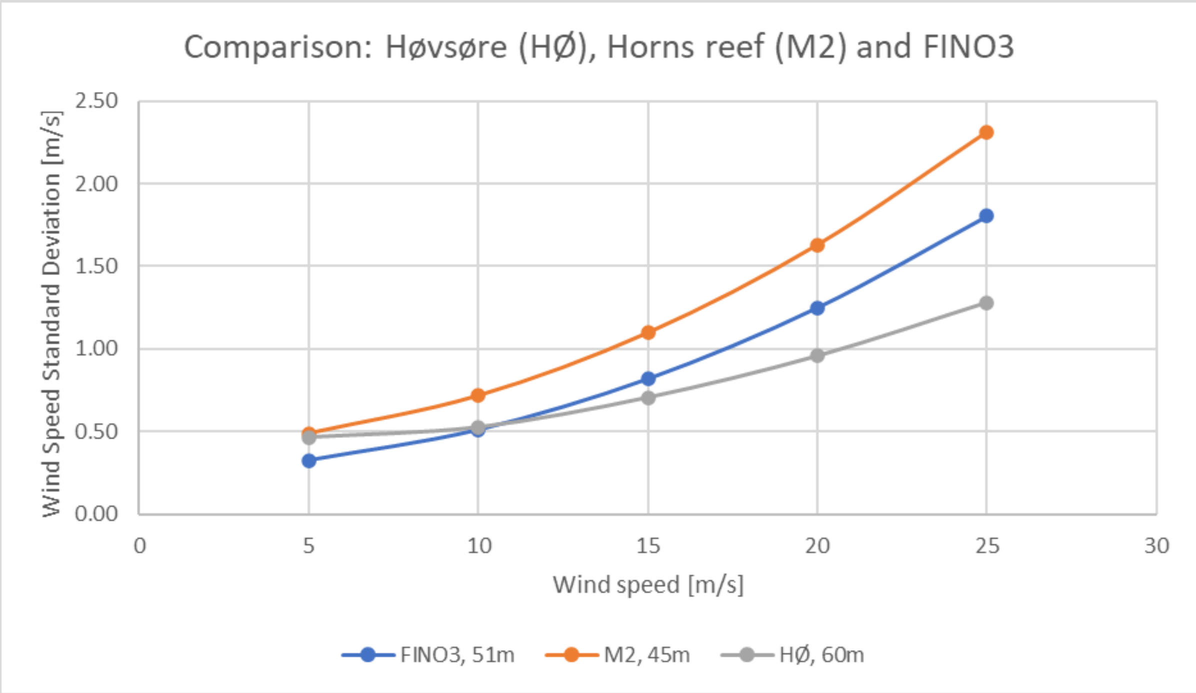


Figure 47. Comparison of the mean turbulence (standard deviation of wind speed in m/s) for the three masts considered at comparable heights above sea level, as top levels across the three masts are too different. M8 (not shown) shows similar levels to M2 from 15 m/s and up, but has lower values similar to FINO3 at 5-10 m/s. The curves are based on fits according to section 9.1.3 evaluated in steps of 5 m/s.

VARIATION OF TURBULENCE AT FINO3

For variations of turbulence versus time of year and stability see section 9.1.2 on wind shear, which shows the variation of both parameters.

FIT OF THE TURBULENCE AT FINO3

As described earlier a second-order fit is required to fit the mean turbulence offshore whereas a linear fit is sufficient for the offshore standard deviation of turbulence. According to [2] turbulence may be considered omnidirectional far offshore, which is the setting for the FINO3 data and Energy Island site, hence, the turbulence data are fitted independently of direction.

Figure 48 shows the turbulence observations and associated omnidirectional fits for the 91 m level at FINO3. Notice the clear non-linear effects for the mean turbulence due to wave interaction (i.e. the 'Charnock' effect).

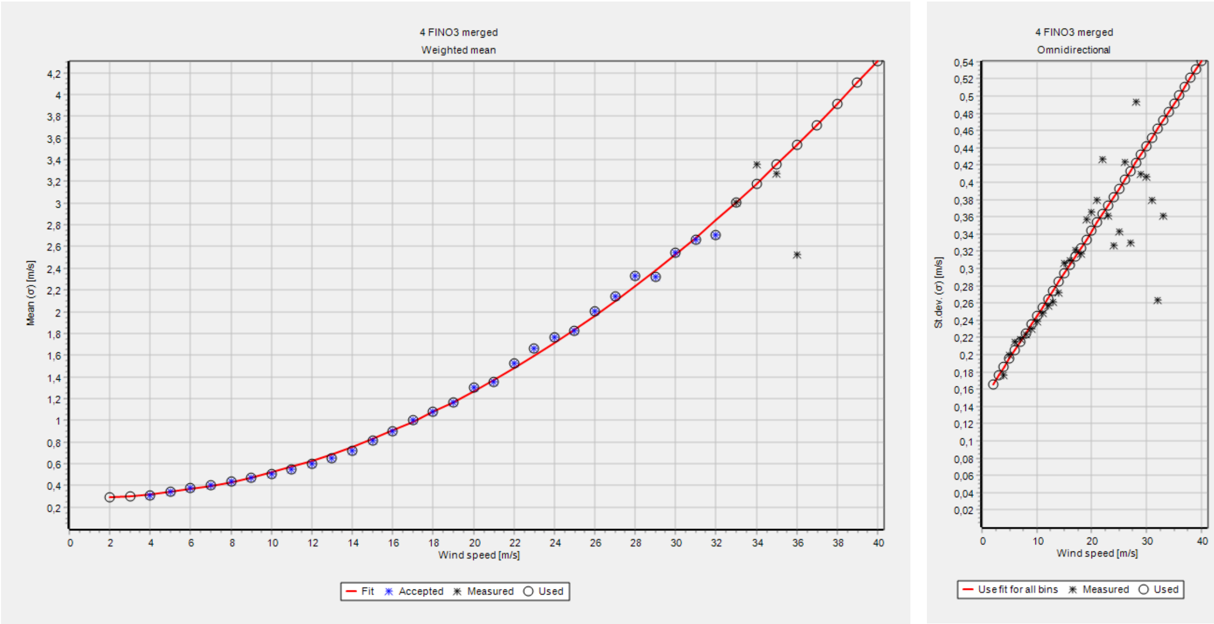


Figure 48. Left: observed mean turbulence versus wind speed at FINO3 91 m including the second order fit. Stars are observations and circles are model values. If the bin has enough samples the star is inside the circle and the bin will contribute to the fit. Right: observed standard deviation of the turbulence versus wind speed at FINO3 91 m including the first order fit.

VERTICAL EXTRAPOLATION AT FINO3

The target height of 150 m for the North Sea Energy Island site means more than 50% extrapolation from the 91 m turbulence data at FINO3. Utilizing the variation of turbulence across the three measurement heights 51 m, 71 m, and 91 m has been considered for the vertical extrapolation model. Figure 49 shows the turbulence data (parameterized) at winds speeds from 5 m/s to 25 m/s as a function of height. For each wind speed a fit modelling the variation with height has been added as dashed lines. For the mean turbulence the best fit type is linear and shows as expected a decrease with height. The decrease with height increases with wind speed. For the standard deviation of turbulence a second order fit is a better match, showing a slightly increasing positive gradient with wind speed but also an increasing nonlinearity.

Due to the large extrapolation, there is a high risk that turbulence gradients or fits for heights between 51 m and 91 m are not representative of the conditions from 91 m to 150 m. In particular, for the mean turbulence the fits predict a very strong decrease for large wind speeds, with an associated risk of non-conservatism for the resulting loads. Therefore, a simpler and more conservative vertical extrapolation model has been chosen for the mean turbulence. This model bases the extrapolation on the local wind shear as a function of wind speed ($\alpha(u)$) estimated at the Energy Island site, and reproduces the patterns of variation with height and wind speed seen in [32]. For the mean turbulence the wind speed in the expressions for mean and standard deviation of turbulence is scaled by the speed-up factor relative to 91 m due to the local wind speed dependent shear. This is consistent to assuming a constant wind speed standard deviation (i.e. turbulence mean) with height and assuming only the wind speed changes due to shear. This is in line with the proposal in IEC 61400-15-1 CD [6] that the wind speed standard deviation may be kept constant while wind speed is extrapolated upwards to hub height.

For the standard deviation of turbulence, the behaviour is opposite that for the mean as it increases with height, again showing stronger gradients at larger wind speeds. Hence, pragmatically the reverse model is adopted as it reproduces the general patterns in [32]. Both models lead to less adjustment of the original 91 m turbulence data and their expressions are given below, with *f(u)* representing the speed-up from 91 m to height *h* due to shear.

$$f(u) = \left(h/_{91m}\right)^{\alpha(u)}$$

$$\sigma_{\mu,h}(u) = A_{\sigma_\mu} + B_{\sigma_\mu}(u/f(u)) + C_{\sigma_\mu}(u/f(u))^2$$

$$\sigma_{\sigma,h}(u) = A_{\sigma_\sigma} + B_{\sigma_\sigma} u\, f(u)$$

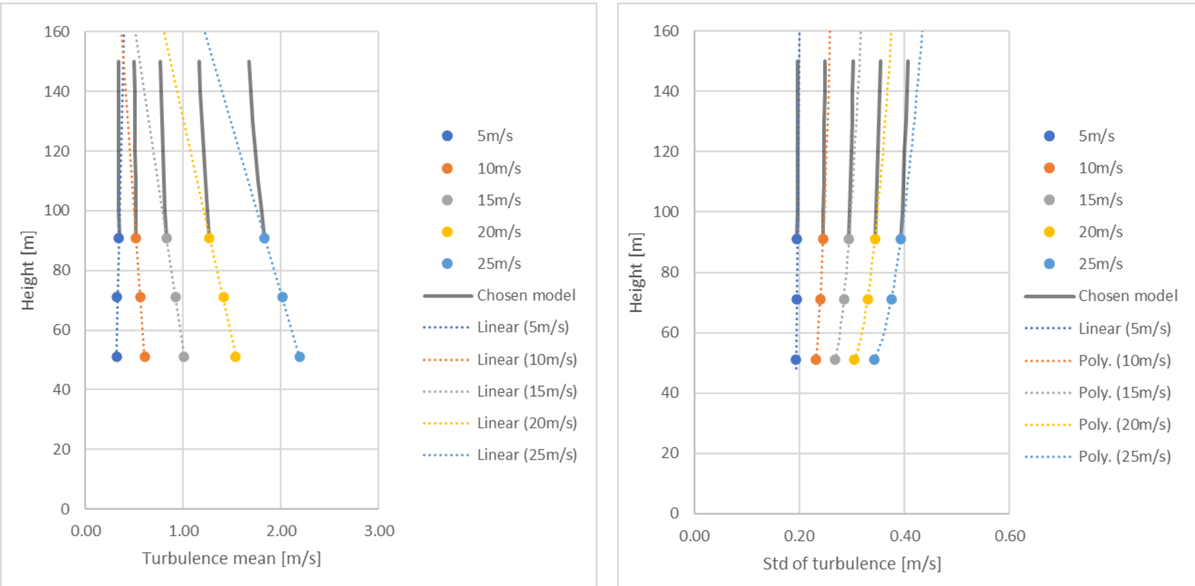


Figure 49. Variation of turbulence with height (y-axis) shown for wind speeds 5, 10, 15, 20 and 25 m/s. Turbulence mean (left) and standard deviation of turbulence (right), shown for the three heights at FINO3: 51 m, 71 m and 91 m, together with possible fits to extrapolate across heights as well as the chosen model based on scaling using the wind speed dependent shear.

The consequence of choice of vertical extrapolation model is shown in Table 37, which compares the mean, standard deviation and characteristic turbulence values at 15 m/s. As the table shows the extrapolation based on the fitting the height variation at lower heights ('extrapolation') leads to considerably lower turbulence levels.

Table 37. Comparison of the extrapolation models at 150 m with observations at 91 m for the different turbulence values at a wind speed of 15 m/s. The shear scaling is chosen as the final model.

at 15 m/s	TURBULENCE MEAN VALUE	STANDARD DEVIATION OF TURBULENCE	TURBULENCE CHARACTERISTIC VALUE
91m observation	5.5%	2.0%	8.1%
150m shear scaling	**5.1%**	**2.0%**	**7.7%**
150m extrapolation	3.7%	2.1%	6.4%

Coefficients of the final turbulence model at the North Sea Energy Island site are presented in Table 38. The chosen final model is based on the 91 m at FINO3, and vertical extrapolation based on the wind speed dependent shear exponent. A, B and C represent the zeroth, first and second order terms, respectively.

Table 38. Turbulence model parameters at the North Sea Energy Island site (150 m) for the chosen model. See equations at top of section.

TURBULENCE MODEL PARAMETERS AT THE SITE	TURBULENCE MEAN VALUE	STANDARD DEVIATION OF TURBULENCE	TURBULENCE CHARACTERISTIC VALUE
A [m/s]	0.2874	0.1464	0.4748
B [-]	-0.0026	0.0099	0.0100
C [s/m]	0.0026		0.0026

9.1.4 Air Density

Air density during normal wind conditions is characterised by its average value at hub height, which is here set to 150 m. Two sources for air density information have been used.

Based on long-term mean temperature found in section 9.1.5, air density is calculated at 150 m elevation assuming standard pressure at this height of 996 hPa. The resulting air density is for both Position 1 and 2 1.229 kg/m^3. This is used as primary result.

Alternatively, the air density at 150 m elevation is estimated based on the recent Global Atlas and Siting Parameters (GASP). GASP is the outcome of an EUDP sponsored project by DTU and EMD [7] where site parameters such as air density are defined for the heights 50m, 100m and 150m. The air density based on GASP data is found to be 1.223 kg/m^3 for position 1, 2 and 3. This secondary result corroborates the primary result.

Hence the air density average value at 150 m ASL of 1.23 kg/m^3 is henceforth assumed.

Mean air density (150 m)	**1.23 kg/m^3**

9.1.5 Air Temperature

Air temperature has been measured on buoy WS170 (Position 1) and WS181 (Position 2) for 12 months. The average temperature measured during that period was 10.6°C at WS170 and 10.7˚C at WS181. The temperature has been long-term corrected with EMD-WRF data from the buoy locations to 9.3°C and 9.4°C. These temperatures conform with temperatures at surrounding meteorological stations (Table 41).

The temperature at 150 m has been found using the atmospheric lapse rate of -6.43 K/km derived from the EMD-WRF data. The result is 8.9˚C at WS170 and 9.0˚C at WS181 at 150m ASL.

The EMD-WRF timeseries at 100 m has been calibrated to represent the LiDAR position at 150m height by applying and offset 0.2˚C (difference between EMD-WRF and measurements). The resulting timeseries has then been used to estimate how many hours the temperature is outside the normal and extreme temperature ranges defined in the IEC 61400-3-1 as -10°C to 30°C and -15°C to 40°C, respectively. The results are summarized in Table 39. The probability of temperatures falling outside the defined ranges is assessed by Gaussian distributions fitted to either the 10% highest or lowest temperatures [18].

For Position 3, temperature at Position 1 can be assumed.

Table 39. Temperature assessment at Position 1 – WS170 (150m).

CHECK	TMIN [°C]	TMAX [°C]	< TMIN [H/YEAR]	> TMAX [H/YEAR]	TOTAL HOURS OUTSIDE RANGE [H/YEAR]
Normal range	-10.0	30.0	0.112	0.012	0.124
Extreme range	-15.0	40.0	0.000	0.000	0.000
Mean air temperature				8.9°C	
Standard deviation air temperature				4.9°C	
Maximum temperature				26.5°C	
Minimum temperature				-6.8°C	

Table 40. Temperature assessment at Position 2 – WS181 (150m).

CHECK	TMIN [°C]	TMAX [°C]	< TMIN [H/YEAR]	> TMAX [H/YEAR]	TOTAL HOURS OUTSIDE RANGE [H/YEAR]
Normal range	-10.0	30.0	0.164	0.021	0.185
Extreme range	-15.0	40.0	0.001	0.000	0.001
Mean air temperature			9.0°C		
Standard deviation air temperature			5.0°C		
Maximum temperature			26.6°C		
Minimum temperature			-6.9°C		

Table 41. Temperature measurements from surrounding stations

STATION	HEIGHT ASL [M]	PERIOD LENGTH [Y]	TEMPERATURE [°C]
Ekofisk	10	43	9.4
Valhall	10	8	9.9
Harald B	unknown	8	9.9
Lista Fyr	~20	28	8.4
Lindesnes Fyr	~30	17	8.9
Sleipner	10	26	9.5
Hvide Sande	12	21	9.7
Thyborøn	12	22	9.5
FINO3	91	4	9.1

9.2 Extreme Wind Conditions

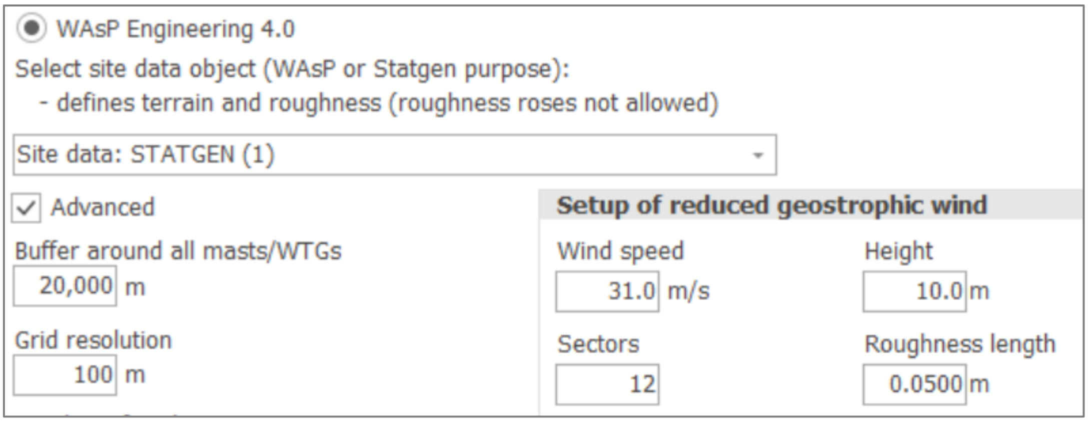
9.2.1 Extreme Wind Speed Model (EWM)

The site-specific extreme wind speed model is characterized by the extreme wind speed with a 50-year return period [1], which for offshore conditions is supplemented by the extreme wind speed with a 1-year return period [2].

Typically, more onsite data is required to reliably estimate extreme events, than what is currently available to this project. The site-specific extreme wind speeds have therefore been estimated using the approach recommended by the Eurocode for wind loads on structures EN1991-1-4 [3] including its Danish Annex DK NA EN1991-1-4 [4] as well as the Danish Standard DS 472 [5]. This result is supplemented with alternative methods/data.

EN1991-1-4 [3] defines a fundamental value of the basic wind speed ($v_{b,0}$) which corresponds to a 50-year extreme wind speed at 10 m height, independent of direction and time of year and with with a standard surface roughness length of $z_{0,II} = 0.05\ m$. Inland in Denmark this basic wind speed is set to 24 m/s [4] and at the west coast it is set to 27 m/s with a linear transition over 25 km from the 24 m/s inland [4]. In the North Sea more than 50 km from the coast the basic wind speed is 31 m/s [5], with a linear transition from the coast out to 50 km offshore.

Instead of the simplified method to vertically extrapolate extreme winds in EN 1991-1-4 [3], the dedicated flow model WAsP Engineering (WEng) has been used for this purpose. WEng includes the effects of waves, formulated by Charnock, including the effect of upstream fetch on wave development and resulting roughness and vertical speed-up. It is noted that atmospheric conditions are assumed neutral in WEng which matches with high wind speed conditions [35]. The analysis was performed through Site Compliance in windPRO with settings as shown below:



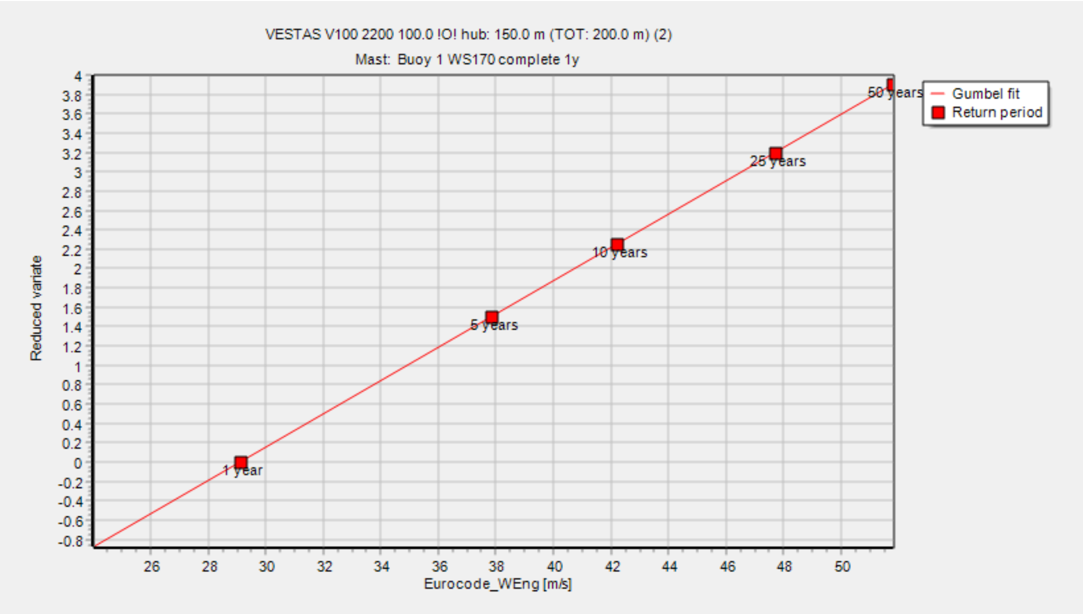


Figure 50. WAsP Engineering settings and output from modelling in windPRO, Site Compliance.

The resulting 1-year and 50-year extreme wind speeds are summarized in the table below:

Table 42. Extreme wind speed results (150 m).

TIME HORIZON	EXTREME WIND SPEED [M/S]
1-year	29.1
50-year	51.8

For comparison, we also include two alternative estimates of the onsite extreme wind speeds based on mesoscale data and the annual maximum method (AM) combined with a spectral correction to compensate for the use of mesoscale data, see e.g. [7]. For the method details of AM, see [36]. The spectral correction may be based either on a theoretical assumption about the slope of an undampened spectrum at high frequencies or on a site estimate of the actual spectral slope using onsite measurements. Below we include both spectral correction estimates, the theoretical and the site specific for both buoys.

Finally, as a fourth option the peak-over-threshold (POT) method is used based on the onsite buoy data.

Table 43. Extreme wind speed alternative results using different methods (150 m).

EXTREME WIND METHOD	50-YEAR EXTREME WIND SPEED [M/S]
EN1991-1-4 + WEng + DS472	51.8 (main result)
AM Mesoscale (20y) + Spectral correction (theoretical)	42.2 (WS170 & WS181)
AM Mesoscale (20y) + Spectral correction (site specific)	43.2 (WS170), 43.6 (WS181)
POT (N=20, Δt_{min}=4 days)	43.1 (WS170), 44.1 (WS181)

It is noted that the alternative estimates are surprisingly consistent around 43m/s-44m/s even if they are based mostly on different data and statistical methods. However, using the Danish Standard [5] directly focused on offshore design conditions for wind turbines is still considered the best alternative as it is based on decades of building experience and knowledge of regional extremes condensed into the building codes.

9.2.2 Wind Shear at Extreme Wind Speed

The site-specific wind profile associated with extreme wind speed events has been estimated based on the on-site LiDAR data at the buoys WS170 and WS181. The plot below shows the wind shear exponent versus wind speed at 150 m above sea level for the two buoys. The wind shear exponent is estimated for each time step and then averaged in 0.5 m/s bins. Notice the linear increase in shear from around 0.03 at 3 m/s, to 0.11 around 15 m/s. Above 15 m/s wind shear appears to remain stable at 0.11 but with a noticeable scatter. However, observed shear data are typically quite noisy as they are based on measurement across multiple heights and accumulate errors from multiple sources.

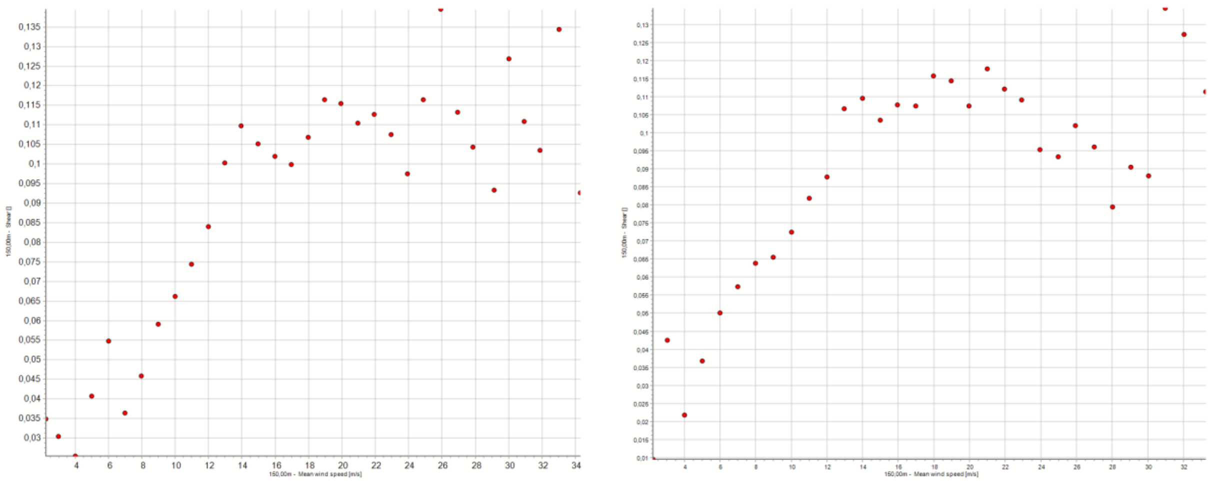


Figure 51. Observed wind shear versus wind speed (0.5 m/s bins) at the two North Sea Energy Island buoys, WS181 (right) and WS170 (left). For both buoys the wind shear clearly levels off at around 0.11 for wind speeds above ca. 15m/s. At lower wind speeds the wind shear increases linearly.

Given these observations the expected wind shear at extreme wind speeds is summarized below.

Expected wind shear at extreme wind speeds	**0.11**

9.2.3 Extreme Wind Shear (EWS)

To estimate the site-specific extreme wind shear, it is recommended to use equations (27) and (28) in section 6.3.3.7 of the IEC 61400-1 [1] with site-specific values for the ambient turbulence standard deviation together with the site-specific wind shear exponent.

9.2.4 Turbulence at Extreme Wind speed

In addition to the extreme turbulence model, the IEC 61400-3-1 [2] requires that the site-specific turbulence for extreme wind speed is defined. Using the turbulence model defined in section 9.1.3 the turbulence is estimated at the site estimate of the 50-year extreme wind speed as shown below:

Table 44. Turbulence at extreme wind speed.

50-YEAR WINDSPEED (@HUB HEIGHT) [M/S]	TURBULENCE INTENSITY MEAN [%]	STD. DEV OF TURBULENCE INTENSITY [%]	TURBULENCE INTENSITY CHARACTERISTIC [%]
51.8	11.3	1.3	13.0

Wave development and growth is limited, such that, for a given wind speed, the significant wave height and peak wavelengths stop growing above a certain wind speed. In effect, this means that the sea surface roughness will eventually saturate as the wind speed becomes increasingly extreme, and the Charnock effect (second order effect) will cease to grow. In [37] and [38] it was reported that the 10 m wind speed required for saturation of the surface roughness is in the range 33-40 m/s while [34] indicates saturation at 35 m/s in 10 m height. In this work the latter saturation value of 35m/s at 10m height is adopted. The saturation estimates correspond to a virtually infinite fetch, and prolonged wind duration for full wave development, it is therefore expected that the wind speed required for saturation at the real sites will be lower than 35 m/s, making this assumption conservative.

9.2.5 Extreme Turbulence Model (ETM)

The site-specific extreme turbulence model as function of wind speed (σ_{ETM}) is assessed using the peak factor method described in the IEC 61400-1 footnote 32 [1]:

$$\sigma_{ETM}(V_{hub}) = \sigma_{mean}(V_{hub}) + k_p(V_{hub}) \cdot \sigma_{stddev}(V_{hub}),$$

$$k_p = 0.01\left(\frac{V_{ave}}{(m/s)} - 21\right)\left(\frac{V_{hub}}{(m/s)} - 5\right) + 5$$

Omnidirectional values are used for the mean wind speed (V_{ave}) as well as the mean and standard deviation of turbulence. The extreme turbulence values are plotted below:

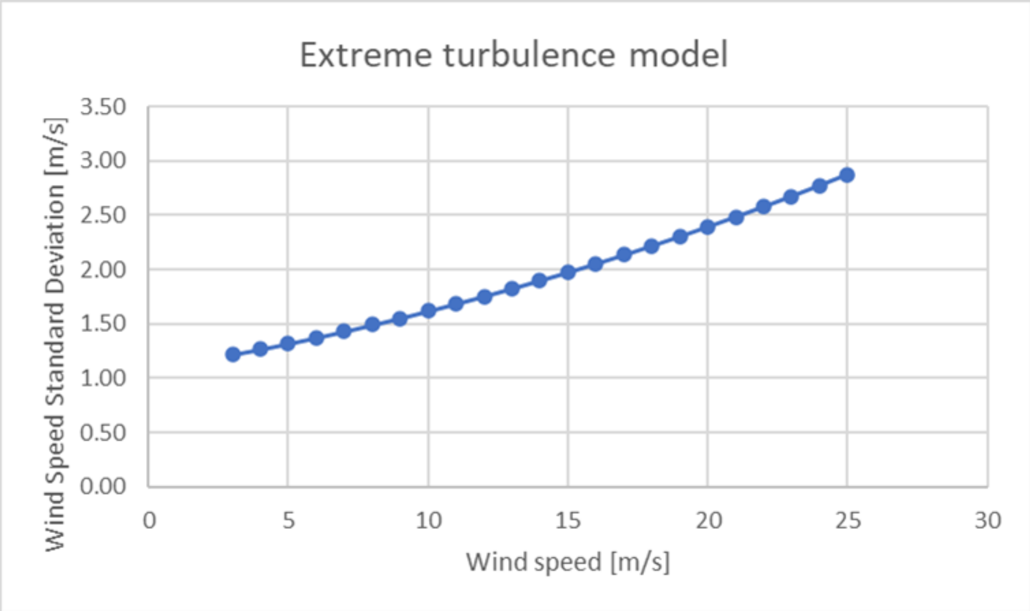


Figure 52. Extreme turbulence model. Turbulence is standard deviation of wind speed.

9.2.6 Air Density for Extreme Wind

The air density for extreme wind conditions is found based on average temperature at high wind speed events. This is calculated as 1.24 kg/m^3 for both Position 1 and 2. Alternatively the air density for extreme wind conditions can be taken from GASP [7], which results in a value of 1.22 kg/m^3.

It was decided to proceed with the air density for extreme wind speeds from the buoys.

Air density for extreme wind speeds (150 m)	**1.24 kg/m^3**

9.3 Summary Table of Siting Parameters

The requested omnidirectional siting parameters are summarized in the table below.

Table 45. Summary table of siting parameters (150m).

Parameter	Position 1	Position 2	Position 3
Mean wind speed	10.91 m/s	10.80 m/s	10.95 m/s
Weibull distribution, A parameter (scale)	12.31 m/s	12.19 m/s	12.35 m/s
Weibull distribution, k parameter (shape)	2.36	2.33	2.35
Normal wind profile power law exponent	0.093	0.092	0.093
Turbulence intensity mean value (TI_{μ}) at a 10-min average wind speed of 15m/s*	5.1%	5.1%	5.1%
Turbulence intensity standard deviation (TI_{σ}) at a 10-min average wind speed of 15m/s*	2.0%	2.0%	2.0%
Turbulence intensity 90% quantile at a 10-min average wind speed of 15m/s*	7.7%	7.7%	7.7%
Mean air density	1.23 kg/m^3	1.23 kg/m^3	1.23 kg/m^3
Mean air temperature	8.9°C	9.0°C	8.9°C
50-year extreme wind speed	51.8 m/s	51.8 m/s	51.8 m/s
1-year extreme wind speed	29.1 m/s	29.1 m/s	29.1 m/s
Wind shear for extreme wind speed extrapolation	0.11	0.11	0.11
Characteristic turbulence intensity at 50-year extreme wind speed	13.0%	13.0%	13.0%
Air density for extreme wind	1.24 kg/m^3	1.24 kg/m^3	1.24 kg/m^3

*Turbulence values at other wind speeds can be found in Appendix H.

10 Data Package

EMD has submitted datasets in support of this study. These are as far as it is possible provided in accessible formats.

10.1 Raw Buoy Data

The raw data from the two buoys, WS170 (Lot 1) and WS181 (Lot 2) are provided as presented to EMD. These are the monthly data conforming to the description in this report.

The files are located in the folder Raw buoy data.

Four sets of data files are provided for each buoy. These the files used in this study:

- LiDAR buoy other parameters

  Containing temperature data

- LiDAR buoy position data

  Containing a time series record of the buoy location.

- LiDAR buoy wind parameters

  Containing wind speed and wind direction data

- LiDAR buoy wind stats

  Containing a record of returned data packages (data quality signal)

Please refer to Fugro's documentation for details on the content and data structure of the files [9]

For convenience, the raw data files are combined in a single text file. The text file can be imported directly into windPRO, but as an open format, it is generally accessible. Please note that maximum wind speed and vertical wind speed are only prepared for 150 m height data series. The datasets include a manual quality filtering by EMD.

- Lot 1 WS170 raw data.txt
- Lot 2 WS181 raw data.txt

Both datasets are included as windPRO Meteo objects in an Object export file

- Raw buoy data.wpobjects

The object export files can be imported into windPRO 3.6 by right-clicking in the Object list and select Import -> Import from windPRO object import file.

10.2 Filtered and Repaired LIDAR Data

Datasets for the filtered and repaired datasets are provided. The filter and repair process is described in section 4.4.3. The two datasets represent one complete year of data. The text file can be imported directly into windPRO, but as an open format, it is generally accessible.

- Lot 1 WS170 1 year complete.txt
- Lot 2 WS181 1 year complete.txt

The text file includes measurements at all heights. Measurements on the buoy (non-LiDAR data) are for practical reasons set at 4 m. The dataset is organized in columns, grouped by height. Data for a given height with SampleStatus flagged as “1” is disabled by EMD.

The content of the columns is explained in Table 46.

Both datasets are included as windPRO Meteo objects in an Object export file

- Complete 1y buoy data.wpobjects

The object export files can be imported into windPRO 3.6 by right-clicking in the Object list and select Import -> Import from windPRO object import file.

Table 46. Column explanation for data time series.

COLUMN LABEL	DESCRIPTION
TimeStamp	Date and time, dd/mm/yyyy hh.mm
MeanWindSpeedUID_xx,xm	Mean wind speed at height xx.x m, m/s
DirectionUID_xx,xm	Wind direction at height xx.x m, m/s
TurbIntUID_xx,xm	Turbulence intensity at height xx.x m
OtherUID_xx	Number of datapackages received at height xx.x m, m/s
WindSpeedVerticalUID_xx,xm	Vertical wind speed at height xx.x m, m/s
MaxWindspeedUID_xx,xm	Maximum wind speed at height xx.x m, m/s
OtherUID_xx,xm	Info flag at height xx.x m
TemperatureUID_4.0m,xm	Temperature at 4m, ˚C
RelativeHumidity_UID_4.0m,xm	Relative humidity at 4m, %
PressureUID_4.0m,xm	Pressure at 4m, hPa
Comment_xx,xm	Comments for height xx.x m (not used)
TimeStampStatus_12,0m	Internal setting for WindPRO
SampleStatus_12,0m	Status flag on entire sample: 0: OK, 1: disabled, 2: below limit, 4: above limit, 8: duplicate, 16: null value, 32: missing, 128: other error
DataStatus_yyyy_xx,xm	Status flag for parameter yyyy flagged at height xx.x m. Settings as for Sample Status.
DataStatus…..	Datastatus for other parameters.

10.3 Long-term Corrected LiDAR data

The long-term corrected time series at Position 1, 2 and 3 are included in the data package. Position 1 and 2 (WS179 and WS181) include all LiDAR measurement heights. Position 3 only includes the 150 m height.

- Position 1 WS170 LTC.txt
- Position 2 WS181 LTC.txt
- Position 3 LTC.txt

Parameters included are wind speed and wind direction. Data format follows the format described above. The text file can be imported directly into windPRO, but as an open format, it is generally accessible.

All three datasets are included as windPRO Meteo objects in an Object export file.

- LTC Position 1-3.wpobjects

The object export files can be imported into windPRO 3.6 by right-clicking in the Object list and select Import -> Import from windPRO object import file.

10.4 EMD-WRF Dataset

The EMD-WRF datasets for the Position 1 (Lot 1, WS170), Position 2 (Lot 2, WS181) and Position 3 are included in the data package.

Text file export with selected parameters are included for each location

- EMD-WRF Position 1.txt
- EMD-WRF Position 2.txt
- EMD-WRF Position 2.txt

The data columns are described in Table 47.

All EMD-WRF datasets are included as windPRO Meteo objects in an Object export file

- EMD-WRF Position 1-3.wpobjects

The object export file can be imported into windPRO 3.6 by right-clicking in the Object list and select Import -> Import from windPRO object import file. The object export file includes more parameters than presented in the text file.

Table 47. Column explanation for EMD-WRF data time series.

COLUMN LABEL	DESCRIPTION
TimeStamp	Date and time, dd/mm/yyyy hh.mm
MeanWindSpeedUID_xx,xm	Mean wind speed at height xx.x m, m/s
DirectionUID_xx,xm	Wind direction at height xx.x m, m/s
TurbIntUID_xx,xm	Turbulence intensity at height xx.x m
TemperatureUID_100,0m	Temperature at height xx.x m
Comment_xx,xm	Comments for height xx.x m (not used)
TimeStampStatus_12,0m	Internal setting for WindPRO
SampleStatus_12,0m	Status flag on entire sample: 0: OK, 1: disabled, 2: below limit, 4: above limit, 8: duplicate, 16: null value, 32: missing, 128: other error
DataStatus_yyyy_xx,xm	Status flag for parameter yyyy flagged at height xx.x m. Settings as for Sample Status.
DataStatus	Datastatus for other parameters.

10.5 Turbulence Data

The FINO3 dataset was used as primary data for the turbulence analysis. Data for the measurement heights 91, 71 and 51 m are included in the data package.

- FINO3 4y combined anemometers.txt

Parameters included are wind speed, wind direction and turbulence intensity. Data format follows the format described above. The text file can be imported directly into windPRO, but as an open format, it is generally accessible.

The FINO3 dataset is included as windPRO Meteo objects in an Object export file.

- FINO3 4y combined anemometers.wpobjects

The object export file can be imported into windPRO 3.6 by right-clicking in the Object list and select Import -> Import from windPRO object import file. The object export file includes more parameters than presented in the text file.

10.6 Wind Resource Map/Gradient File

The wind resource map used as a gradient file in section 8.1 is provided as an .rsf file (recognized WAsP format).

- Grid map_Res_500_Hub_150,0_0._calibrated_Res map recalibrated buoy 1+2 linear_150,0m.rsf

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Appendix A. Supporting Data

Several data sources have been used to support the assessment of site wind conditions. These data are of different types and quality and have thus been used for different purposes. The description of the measurement setup, data quality check and processing are presented in a first section. The second section deals with data analysis from different parameters. Finally, the long-term correction of the relevant supporting data is described.

Appendix A.1. Available Data, Data Treatment and Quality Check

For an overview of the measurements station please refer to Table 4, Table 5 and Figure 3.

i. Thor FLS

Wind data from an offshore Floating LiDAR has been provided by Energinet. This LiDAR was deployed by AKROCEAN on a 13t buoy called WINDSEA. The Floating LiDAR System (FLS) was setup in the North Sea about 32 km west of Thorsminde town, on the Danish coast. It is located at about 77 km east of the North Sea Energy Island OWF. The LiDAR model on this FLS is a Leosphere Windcube WLS866.

The available measurements used are:

- Wind speed at 43, 46, 57, 65, 75, 86, 100, 114, 132, 151, 174 and 200 m as 10-minute values (mean, min, max and standard deviation);
- Wind direction at 43, 46, 57, 65, 75, 86, 100, 114, 132, 151, 174 and 200 m as 10-minute values (mean);
- Vertical wind speed at 43, 46, 57, 65, 75, 86, 100, 114, 132, 151, 174 and 200 m as 10-minute values (mean and standard deviation);
- Carrier to Noise Ratio (CNR) and Availability for all heights.

The WINDSEA buoy is also equipped with other sensors as: a compact weather station, a doppler current profile sensor, a wave sensor and an EchoRange sensor, thus there are other signals available from station, but they were not used in the evaluations.

The available data covers a period of 1 year from 18/05/2020 until 20/05/2021.

Figure 53. Picture from WINDSEA buoy and the LiDAR Thor, source: [39]

EMD has not been provided with any deployment report, but received a Calibration Certificate, a report with the Floating LiDAR verification prior to the installation on site, and some monthly reports about the operation and measured data.

In addition to the documentation, EMD has obtained access to the measured data in different formats. The data used were with ".sta" file extension, which according to the documentation is the data corrected by the buoy motions and with direction relative to the magnetic north. Thus, the direction data was corrected considering the magnetic declination of 2.7°.

The LiDAR data has been filtered according to the following assumptions:

- Data availability <80%
- Carrier to noise ratio – CNR < -23 dB
- Absolute Vertical wind speed > 2 m/s
- Vertical wind speed standard deviation > 2 m/s

In general, the data quality is good. The correlation of the wind directions data and wind speed data at different heights correlates as expected.

The data from the 151 m is the primary data considered in the study. The recovery rate of the data for 1 year period is 86.4%. The following major gaps (consecutive days with missing or erroneous data) in the wind data (wind speed and direction at 151 m) can be noted:

- 5 days from 03/11/2020
- 5 days from 22/01/2021

In order to match the observations on the North Sea Energy Island buoys, the 151 m dataset has been shear interpolated to 150 m.

Based on the Classification document [40] and on the Verification report [41], a combined uncertainty of 3.5% is estimated on the Thor floating LiDAR measurements.

ii. FINO3

Wind data from the FINO3 offshore measurement mast has been used to assess the expected turbulence conditions on the Energy Island site and to validate the wind model.

The data was made available by the FINO (Forschungsplattformen in Nord- und Ostsee) initiative, which was funded by the German Federal Ministry of Economic Affairs and Climate Action (BMWK) on the basis of a decision by the German Bundestag, organised by the Projektträger Jülich (PTJ) and coordinated by the German Federal Maritime and Hydrographic Agency (BSH).

The FINO3 mast is mounted on a platform and is part of the FINO research project. The met mast was setup in the North Sea about 84 km west of the island of Rømø, on the Danish coast. It is located at about 155 km southeast of the North Sea Energy Island OWF.

The collected measurements are:

- wind speed at 107, 101, 91, 81, 71, 61, 51, 41 and 31 m as 10-minute values (mean, min, max and standard deviation)
- wind direction at 101, 61 and 29 m as 10-minute values (mean, min, max and standard deviation)
- absolute temperature at 95 and 29 m, as 10 minutes values (mean values)

Besides the data obtained, the FINO3 mast was also equipped with relative humidity, air pressure, precipitation, and global irradiance sensors.

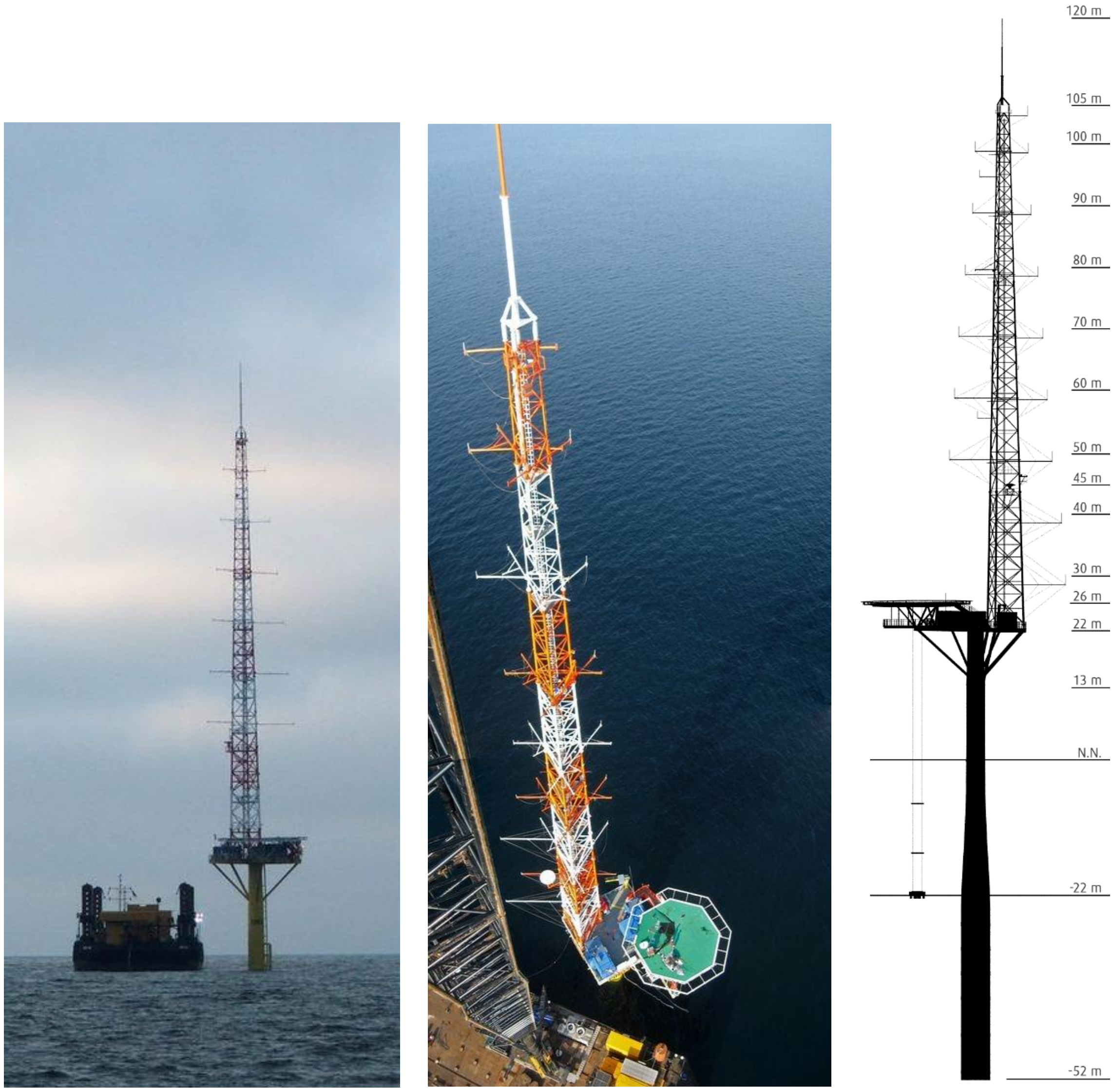

Figure 54. Pictures and details from FINO3, source: [42]

The available data covers a period of around 13.5 years, from September/2009 to February/2023. However, the series was trimmed to 4 full years, from 01/01/2010 to 31/12/2013, in order to avoid the influence of wakes from the neighbouring wind farm installed after 2014 (DanTysk OWF).

EMD had access to a mast report [43] describing the equipment installed and mast details. EMD has not received any anemometer calibration reports. The data obtained was considered to be logged with the right calibration factors. According to the documentation available [43], FINO3 design and installation has not been conducted according to the IEC standards [27], especially in relation to the sizes of the mast and booms.

Table 48. Mounting of sensors on the FINO3 mast

HEIGHT ASL [M]	INSTRUMENT IDENTIFICATION	DESCRIPTION	MOUNTING AND ORIENTATION	HORIZONTAL BOOM LENGTH [m]	VERTICAL BOOM LENGTH [m]
107	AN 107m - B	Cup anemometer - Vector A100L2	345°	3.5	1.75
101	AN 101m - B	Cup anemometer - Vector A100L2	345°	3.2	1.75
101	Sonic 101m - A	Ultrasonic anemometer - RM Young Mod 81000	225°	3.2	1.50
91	AN 91m - B	Cup anemometer - Vector A100L2	345°	3.9	1.75
91	AN 91m - A	Cup anemometer - Vector A100L2	225°	3.9	1.50
91	AN 91m - C	Cup anemometer - Vector A100L2	105°	3.9	2.00
81	AN 81m - B	Cup anemometer - Vector A100L2	345°	4.6	1.75
81	AN 81m - A	Cup anemometer - Vector A100L2	225°	4.6	1.50
71	AN 71m - B	Cup anemometer - Vector A100L2	345°	5.4	1.75
71	AN 71m - C	Cup anemometer - Vector A100L2	105°	5.4	2.00
71	AN 71m - A	Cup anemometer - Vector A100L2	225°	5.4	1.50
61	AN 61m - B	Cup anemometer - Vector A100L2	345°	6.2	1.75
61	Sonic 61m - A	Ultrasonic anemometer - RM Young Mod 81000	225°	6.2	1.50

HEIGHT ASL [M]	INSTRUMENT IDENTIFICATION	DESCRIPTION	MOUNTING AND ORIENTATION	HORIZONTAL BOOM LENGTH [m]	VERTICAL BOOM LENGTH [m]
51	AN 51m - C	Cup anemometer - Vector A100L2	105°	6.7	2.00
51	AN 51m - B	Cup anemometer - Vector A100L2	345°	6.7	1.75
51	AN 51m - A	Cup anemometer - Vector A100L2	225°	6.7	1.50
41	AN 41m - B	Cup anemometer - Vector A100L2	345°	7.5	1.75
31	AN 31m - B	Cup anemometer - Vector A100L2	345°	8.4	1.75
101	Dir 101m	Wind vane - Friedrichs 41211000	105°	3.2	2.00
81	Dir 81m*	Wind vane - Friedrichs 41211000	105°	4.6	2.00
61	Dir 61m*	Wind vane - Friedrichs 41211000	105°	6.2	2.00
29	Dir 29m	Wind vane - Vector W200P	180°	8.4	-
95	Temp 95m	Thermometer – Thies 1.10005.54.241	180°	3.9	-
55	Temp 55m	Thermometer – Thies 1.10005.54.241	180°	6.7	-
29	Temp 29m	Thermometer – Thies 1.10005.54.241	180°	8.4	-

*Although those instruments are listed on the mast description, they were not included in the data files EMD had access to.

EMD has obtained access to the data as csv files. Therefore, the conversion of the raw data could not be verified.

As FINO3 is a large offshore mast, the observed mast disturbance on the wind speed measurements is significantly. Only for the data at 91, 71 and 51 m it has been possible to remove most of the tower shadowing thanks to the 3 cup anemometers in different direction for each height, as shown in Table 48 and Figure 55. The data has been merged based on the detected distortions (Figures 56 and 57).

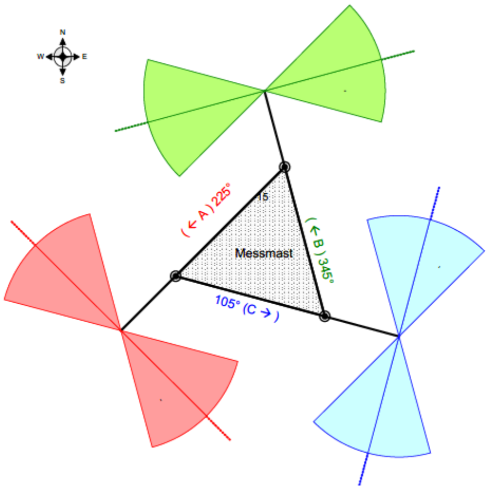

Figure 55. Representation of the boom's positioning in FINO3 and the undisturbed inflow directions, source: [43]

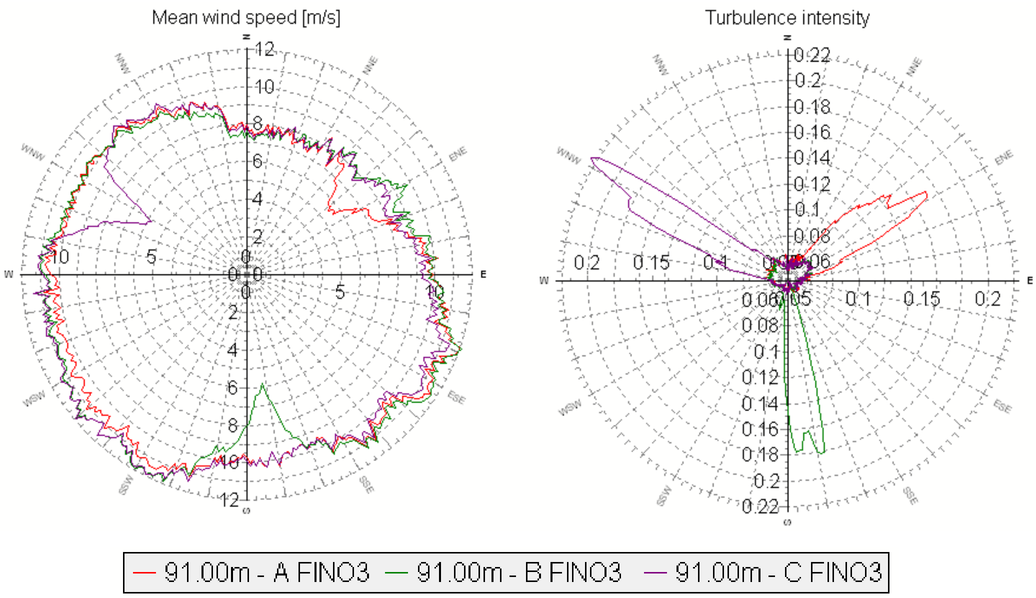

Figure 56. Directional Mean wind speed (left) and Turbulence Intensity (right) for the 3 cup anemometers at 91 m, before merging.

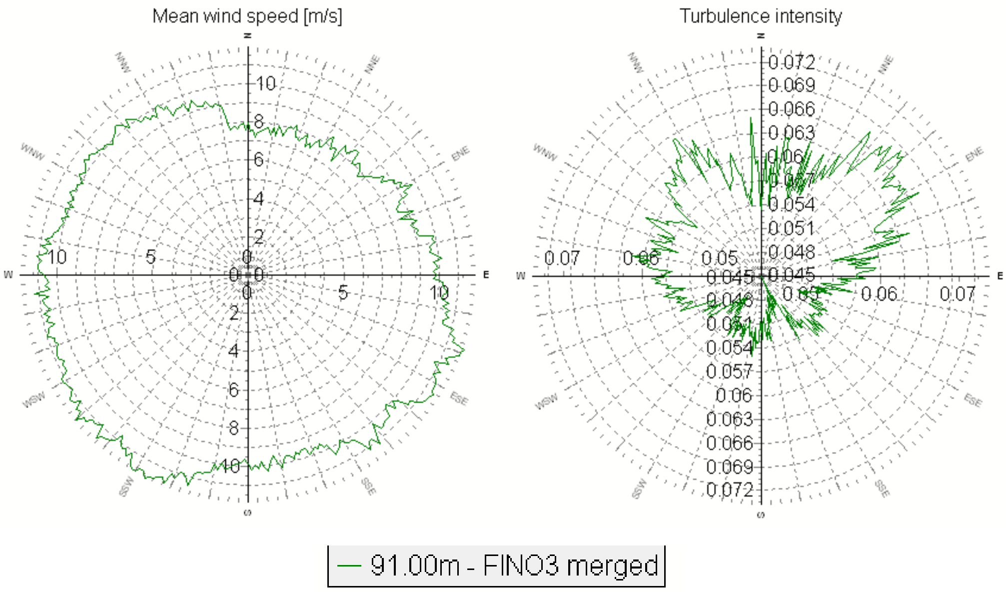

Figure 57. Directional Mean wind speed (left) and Turbulence Intensity (right) at 91 m, after merging.

In general, the data quality is good. The wind directions data at each height correlates well with wind direct at the other heights and wind speed data at each height correlates well with wind speed data at the other heights. The data has been filtered for faulty equipment and failures.

4 full years have been selected from 01/01/2010-31/12/2013. The data from the 91 m anemometer is the primary data from the FINO3 met mast considered in the study. It is deemed more reliable than the 101 and 107 m data, heavily impacted by the mast shadowing. The recovery rate of the merged data for the 4-year period is 92.2%. The following major gaps (consecutive days with missing or erroneous data) in the wind data (wind speed at 91 m-B and wind direction at 101 m) can be noted:

- 50 days from 14/01/2013
- 35 days from 03/07/2013
- 17 days from 08/11/2010, gap concerning all channels.
- 11 days from 01/01/2011, gap concerning all channels.
- 9 days from 11/01/2012, gap concerning all channels.
- 8 days from 27/07/2011, gap concerning all channels.

Due to the unavailability of some information, as mast's maintenance and instrument certification, it was not possible to precisely assess an uncertainty on FINO3's measurements. The uncertainty on FINO3 measurements was estimated to be in the magnitude of 3.5%, taking into account the lack of information, the noncompliance to the standards [27] and compensating for the possibility to correct the mast distortion.

iii. M2 Met Mast

Wind data from the offshore measurement mast M2 has been used to validate the wind model.

The data has been provided by Energinet.

The met mast was setup in the North Sea about 18 km west of the town of Oksby on the Danish coast. It is located at about 140 km southeast of the North Sea Energy Island OWF.

The available measurements are:

- wind speed at 62, 45, 30 and 15 m as 10-minute values (mean, min, max and standard deviation)
- wind direction at 60, 43 and 28 m as 10-minute values (mean)
- absolute temperature at 55 m, as 10 minutes values (mean)

The M2 mast was installed in 1999, but the data considered in this study covers a period of 1 year, from 01/05/2005 to 30/04/2006, which was the full year period available. Ideally, the data period to be used should end in 2002 or before, due to the installation of the Horns Reef 1 wind farm in the vicinity of the mast. Since the period prior to 2002 was not accessible, the alternative carried out was to disable all the data coming from the disturbed sectors (100° – 180°). Horns Reef 2 and Horns Reef 3 wind farms were constructed after 2008, thus they were not present in the period evaluated.

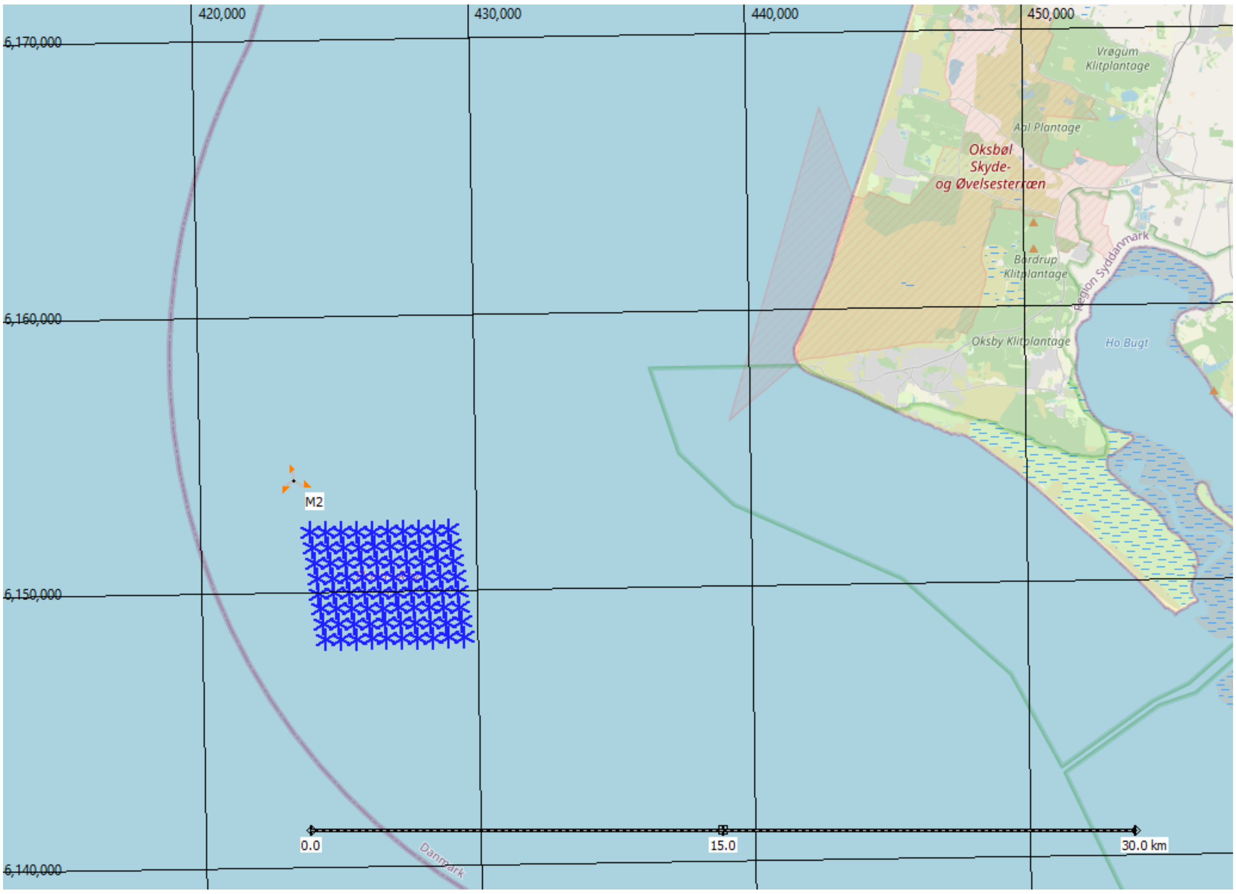

Figure 58. M2 mast position, wind farm Horns Reef 1 (in blue) and the Danish coast on the east side.

EMD has received calibration reports of the instruments but no installation report describing the details of the mounting (boom orientation, length, distance to lightning finial). It has thus not been possible to check if the installation has been conducted according to the IEC standards [27].

Table 49. Mounting of sensors on the M2 met mast.

HEIGHT AGL [M]	CHANNEL NAME	DESCRIPTION	MOUNTING AND ORIENTATION	HORIZONTAL BOOM	VERTICAL BOOM
62	CUP62M	Cup Anemometer - Risø	Assumed Top	Unknown	Unknown
45	CUP45SV	Cup Anemometer - Risø	SW	Unknown	Unknown
45	CUP45NO	Cup Anemometer - Risø	NE	Unknown	Unknown
30	CUP30SV	Cup Anemometer - Risø	SW	Unknown	Unknown
30	CUP30NO	Cup Anemometer - Risø	NE	Unknown	Unknown
15	CUP15SV	Cup Anemometer - Risø	SW	Unknown	Unknown
15	CUP15NO	Cup Anemometer - Risø	NE	Unknown	Unknown
60	DIR60SV	Wind Vane ED	SW	Unknown	Unknown
43	DIR 43SV	Wind Vane ED	SW	Unknown	Unknown
28	DIR28NO	Wind Vane ED	NE	Unknown	Unknown
55	TEMPA55NO	Thermometer - ED-PT100		Unknown	Unknown

EMD has obtained access to the data as csv files. Therefore, the conversion of the raw data could not be verified.

As the M2 mast has two anemometers in the heights of 45 and 35 m, it was possible to evaluate the mast influence on the measurements. In Figure 59 it is shown the difference between the two anemometers at 45 m.

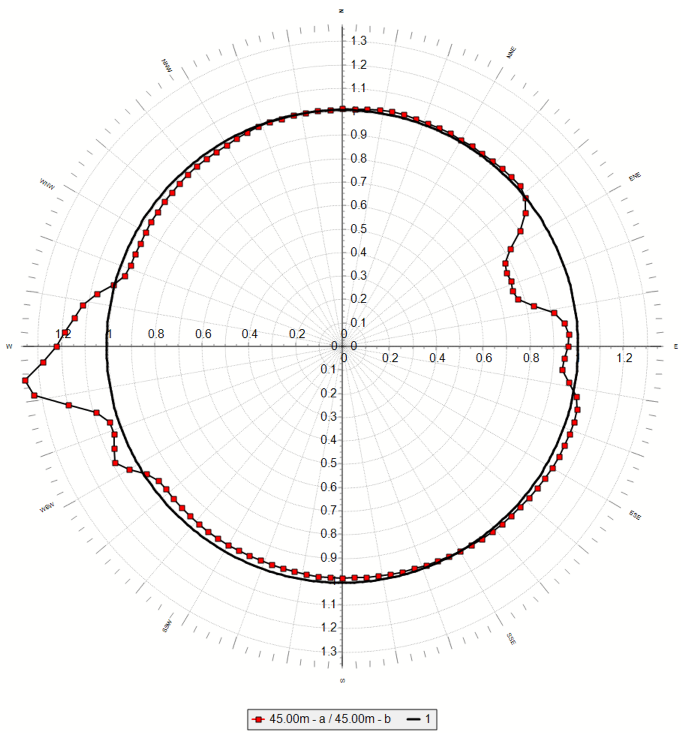

Figure 59. Wind speed difference between 45 m SW and 45 m NE, binned by direction at M2.

The data at 45 and 35 m have been merged to remove the tower shadowing, based on the observed distortions.

In general, the data quality is good. The wind directions data at each height correlates well with wind direct at the other heights and wind speed data at each height correlates well with wind speed data at the other heights. The data has been filtered for faulty equipment and failures.

1 full year has been selected from 01/05/2005-30/04/2006. The data from the 62 m anemometer is the primary data from the M2 met mast considered in the study. The recovery rate of the data for this period is above 99% for all instruments, except for the 62 m anemometer (disregarding the sectors disabled to avoid the wake effects from Horns Reef 1 wind farm).

The following major gaps (consecutive days with missing or erroneous data) in the wind data (wind speed at 62 m and wind direction at 43 m) can be noted:

- 76 days from 12/11/2005

iv. Høvsøre Met Mast

The data from Høvsøre met mast is relevant in the context of this study to provide an input on turbulence intensity. The met mast belongs to the Høvsøre national test centre for wind turbines. The data has been provided by DTU through Energinet.

The met mast is located on land, but turbulence intensity can be retrieved in wind direction sectors where offshore conditions can be assumed. Offshore conditions can be assumed at the measurement height (116.5 m AGL) within the western sector due to a land fetch of 1.8 km characterized with flat terrain and low roughness.

The mast is placed in the alignment of the test turbines, between position 4 and 5. The selected sector of data does not seem affected by the operation of the turbines. It is located at about 110 km east of the North Sea Energy Island OWF.

The available measurements considered are:

- wind speed at 40, 60, 80, 100 and 116.5 m as 10-minute values (mean, min, max and standard deviation)
- wind direction at 60 and 100 m 10-minute values (mean, min, max and standard deviation)

The available data covers a period of 15 years from 31/05/2004 until 31/05/2019.

The data has been provided as csv files. The conversion of the raw data could thus not be verified. It is assumed that the calibration factors have been correctly inserted in the data logger.

EMD has received calibration reports for each anemometer covering the measurement period. The type of anemometer is Risø P2546A. The anemometers have been recalibrated or exchanged every year.

The anemometer at 116.5 m is top mounted on a 2 m long boom which complies with the requirement from [27]. However, the top of the mast structure is estimated to exceed the 11:1 cone described in [27], implying that some distortion on the measurements is expected. The anemometers at lower heights are mounted on booms towards South. The length of the booms is not sufficient considering the width of the lattice tower in [27]. There will be distortion from the mast on the wind measured by the anemometers installed on horizontal booms.

The wind vanes are mounted on the same boom as the anemometers at 60 and 100 m, at a distance from the mast structure of approximatively half the length of the boom. The distance of the vane to the mast is not sufficient to comply with [27], but still acceptable for the purpose of the data.

In general, the data quality is good. The measured wind directions and wind speed at different heights correlates as expected. The data has been filtered for faulty equipment and failures. The turbulence intensity for wind speed less than 4 m/s are excluded from the analysis.

The data from the 116.5 m anemometer is the primary data from the Høvsøre met mast. Only data in the western sector (225˚ - 315˚) has been kept.

The recovery rate of the data for the whole 15 years period is 94.8 %. The selected data for the offshore sector corresponds to 38.5% of the whole data set.

The following major gaps (consecutive days with missing or erroneous data) in the wind data (wind speed at 116.5 m and wind direction at 100 m) can be noted:

- 9 days from 27/03/2017
- Several 3-4 days gap in August 2006

- 8 days from 29/11/2005
- several months with recovery below 70 % in 11/2004, 02/2005, 03/2005 and 05/2005.

Figure 60. Location map of Høvsøre met mast (source: KMS Ortofoto forår).

Figure 61. Picture of Høvsøre met mast (source: DTU)

v. Harald B

The observations made at Harald B oil rig have been provided by DMI (#06018). The data has been used to validate the wind model.

The Harald B platform was setup in the North Sea about 238 km west of Thorsminde town, in the Danish coast. It lies approximately 250 km from the Norwegian coast and about 130 km west of the North Sea Energy Island OWF.

The measurements obtained are:

- wind speed at 69 m as 10-minute values (mean)
- wind direction at 69 m as 10-minute values (mean)
- absolute temperature at 61 m, as 10 minutes values (mean)

The information about the measurement heights was not available on DMI's web page [44]. It was obtained through an exchange of e-mails with the platform owner (Total Energies), as the most probable height. But it was not possible to have a full confirmation on this matter, because the information of the height and the data come from diverse sources.

Figure 62. Instruments position on Harald B oil rig. Source: Total Energies.

EMD did not have access to calibration reports of the instruments nor to installation report describing the details of the mounting (boom orientation, length, distance to lightning finial). The installation does not seem to comply with IEC standards [27]. Also, the installation of the measurement device and how these can be affected by surroundings structures on the oil rigs is unknown. EMD has obtained access to the data as csv files. Therefore, the conversion of the raw data could not be verified.

In general, the data quality is reasonable, but it has a poor recovery rate. The data series obtained presents a strange behaviour in which most of the days the measurement stops at 21:10 h and re-starts again at 00:00 h in the next day. Apart from that, the data has been filtered for faulty equipment and failures. The complete dataset obtained covers 8 years and 11 months, from March/2014 to February/2023. After the bad data was filtered, the recovery rate of this series was 59.1%, which is too low. As the series presented long consecutive gaps and in order to ensure the best recovery rate possible, 4 non consecutive years, divided in 3 different periods, were selected to be used in the analysis:

- Period 1 - 01/10/2015 – 01/10/2017 – 2 years – Recovery rate:85.1%
- Period 2 - 15/01/2020 – 15/01/2021 – 1 year – Recovery rate:85.8%
- Period 3 - 01/11/2021 – 01/11/2022 - 1 year – Recovery rate:89.2%

These periods together comprise a final recovery rate of 86.3%.

Considering the 3 periods used, the following major gaps (consecutive days with missing or erroneous data) in the wind data can be noted:

- 6 days from 21/08/2016;
- 6 days from 28/06/2017;
- 3 days from 15/06/2020;
- 3 days from 16/08/2020.

Moreover, the data is missing between 21:10 and 00:00 for most days.

The data from Harald B are used to verify the wind resource model, but with low confidence due to the high measurement uncertainty. Due to the lack of information about the mast, instrument, influence from the platform's structure and cranes, the low recovery rate and the doubt about the measurement height, the uncertainty level of the Harald B's wind speed measurements is estimated to be in the magnitude of 6%.

vi. Secondary Oil Rigs

SLEIPNER

The observations made at Sleipner oil rig have been provided by MET Norway (#SN76926). The data has been used to check the long-term consistency of the reference data and the long-term temperature.

Wind speed and direction measurements are available for 10 m ASL. Temperature data is provided at 2 m ASL. The measurement devices are installed on one of the structures of the oil rig, so the actual measurement height is probably different than 10 m ASL. The transfer of data to 10 m ASL is performed by MET Norway with an unknown method.

The period of measurements used is 01/04/1995 until 31/03/2022, which corresponds to 26 full years. Data is available as 10 minutes mean value for every 3 hours.

The oil rig is located in the North Sea about 215 km from Norway and 250 km from Scotland. It is the most remote data source considered in this study with a distance of about 340 km to the North Sea Energy Island OWF.

The installation of the measurement device and how these can be affected by surroundings structures on the oil rigs is unknown.

In general, the data quality is fairly good. No filtering of erroneous data has been necessary. The recovery rate of the data for the selected period is good with 95 %.

EKOFISK

The observations made at Ekofisk oil rig have been provided by MET Norway (#SN76926). The data has been used to check the long-term consistency of the reference data and the long-term temperature.

Wind speed and direction measurements are available for 10 m ASL. Temperature data is provided at 2 m ASL. The measurement devices are installed on one of the structures of the oil rig, so the actual measurement height is probably different than 10 m ASL. The transfer of data to 10 m ASL is performed by MET Norway with an unknown method.

The period of measurements used is 01/01/1984 until 31/01/2022, which corresponds to 39 full years. Data is available as 10 minutes mean value for every 3 hours.

The oil rig is located in the middle of the North Sea about 250 to 300 km from land (Norway, Scotland and Denmark). It is located at about 195 km west of the North Sea Energy Island OWF.

The installation of the measurement device and how these can be affected by surroundings structures on the oil rigs are unknown.

In general, the data quality is fairly good. No filtering of erroneous data has been necessary. The recovery rate of the data for the selected period is very good with 98.3 %.

VALLHALL A

The observations from the Valhall A oil rig have been provided by MET Norway (#SN76939). The data has been used to as a source for long-term temperature.

Temperature data is provided at 2 m ASL. The measurement devices are installed on one of the structures of the oil rig, so the actual measurement height is probably different than 10 m ASL. The transfer of data to 10 m ASL is performed by MET Norway with an unknown method.

The period of measurements used is 01/01/2005 until 31/01/2022, which corresponds to 8 full years. Data is available as a 10 min mean value.

The oil rig is located in the middle of the North Sea roughly about 300 km from land (Norway, Scotland and Denmark). It is located at about 190 km west of the North Sea Energy Island OWF.

The installation of the measurement device and how these can be affected by surroundings structures on the oil rigs are unknown.

In general, the data quality is fairly good. No filtering of erroneous data has been necessary.

The recovery rate of the data for the selected period is very good with 98.3 %.

vii. Ground stations

HVIDE SANDE

The observations made at Hvide Sande come from a meteorological mast operated by DMI (#6058). The data has been used to check the long-term consistency of the reference data and the long-term temperature.

Wind speed and direction measurements are recorded at 10 m AGL. Temperature data is measured at 2 m AGL. The period of measurements used is 01/01/2002 until 31/12/2022, which corresponds to 20 full years. The time resolution is hourly.

The met mast is located to the east of the town of Hvide Sande, on a small peninsula extending into the Ringkøbing Fjord. The distance to the west coast is about 1.9 km. The elevation from the site is 2 m ASL. and the distance to the North Sea Energy Island OWF is 120 km.

A 75 m tall wind turbine (V52) is placed 100 m north of the met mast. The turbine has been in operation since December 2002. The wind turbine renders data collected before 2002 inconsistent with wind data after 2002. For temperature measurements, the influence of the wind turbine is irrelevant.

Prior to November 2001, the met mast was located in the town. The data for these periods have not been considered.

Figure 63. Location map of Hvide Sande met mast for the period of available data (DMI # 0658, [44]), (source: KMS Ortofoto forår).

In general, the data quality is good. No filtering of erroneous data has been necessary.

The recovery rate of the data for the selected period is very good with 99.3%.

THYBORØN

The observations made at Thyborøn come from a meteorological mast operated by DMI (#6052). The data has been used to check the long-term consistency of the reference data and the long-term temperature.

Wind speed and direction measurements are recorded at 10 m AGL. Temperature data is measured at 2 m AGL. The period of measurements used is 01/01/2001 until 31/12/2022, which corresponds to 21 full years. The time resolution is hourly.

The met mast is located to the north of the town of Thyborøn, almost at the tip of the land tongue between the North Sea and the Thyborøn channel leading to the Nissum Lagoon. The distance to the west coast is about 200 m. The elevation from the site is about 2 m ASL. and the distance to the center of the North Sea Energy Island OWF is 116 km.

Some buildings are located to the southeast of the met mast, but at a reasonable distance and heights such that no significant disturbance from these are expected to affect the measurements.

Prior to November 2000, the met mast was located in the town. The data for these periods have not been considered.

Figure 64. Location map of Thyborøn met mast for the period of available data (DMI # 0652, [44]), (source: KMS Ortofoto forår).

In general, the data quality is good. No filtering of erroneous data has been necessary.

The recovery rate of the data for the selected period is very good with 98.6%.

LISTA FYR

The observations made at Lista Fyr come from a meteorological mast operated by MET Norway (#SN42160) [45]. The data has been used to check the long-term consistency of the reference data and the long-term temperature.

Wind speed and direction measurements are recorded at 10 m AGL. Temperature data is measured at 2 m AGL. The period of measurements used is 01/01/1995 until 31/12/2022, which corresponds to 28 full years. The time resolution is hourly.

The met mast is located about 1.2 km Northwest of the town Vestbygd, next to the Lista lighthouse. The distance to the North Sea is about 110 m. The elevation from the site is about 13 m ASL. The met mast is placed about 180 km north of the North Sea Energy Island OWF.

Some buildings are located to the north and east of the met mast, but at a reasonable distance and heights such that no significant disturbance from these is expected to affect the measurements.

Figure 65. Location map of Lista Fyr met mast for the period of available data (MET Norway #SN42160 [45]) (source: Bing aerial map).

In general, the data quality is good. No filtering of erroneous data has been necessary.

The recovery rate of the data for the selected period is very good with 97.3%.

LINDESNES FYR

The observations made at Lindesnes Fyr come from a meteorological mast operated by MET Norway (#SN41770) [45]. The data has been used to check the long-term consistency of the reference data and the long-term temperature.

Wind speed and direction measurements are recorded at 10 m AGL. Temperature data is measured at 2 m AGL. The period of measurements used is 01/01/2006 until 31/12/2022, which corresponds to 17 full years. The time resolution is hourly.

The met mast is located on the southern tip of Lindesnes peninsula. The short distance of 50-75 m to the coast together the elevation ASL of 19 m makes the measurement well exposed to quite steep terrain and speed up effects, mainly from north-west to south-east sectors. The met mast is placed about 170 km north of the North Sea Energy Island OWF.

Figure 66. Location map of Lindesnes Fyr met mast for the period of available data (MET Norway # SN41770, [45] (source: Bing aerial map).

In general, the data quality is good. No filtering of erroneous data has been necessary.

The recovery rate of the data for the selected period is very good with 96.9 %.

viii. Other Datasets (not used)

Some data sets available for the study have not been deemed relevant to use for different reasons which are presented below.

The data measured from the oil rigs of Lomond, Ula and Yme have not been selected because redundant with the data collected on the Sleipner oil rig. The goal of these type of data being to check the long-term consistency and the air temperature, the Sleipner data are assumed sufficient.

The data measured from the Gorm C oil rig is redundant with the data measured from the Harald B oil rig. This oil rig has also the disadvantage of being further away from the Energy Island than Harald B and also measuring at a lower height (29 m ASL [44]) than at Harald B (69 m ASL).

Data from the DMI ground station of Blåvandshuk fyr has not been used because it is redundant with the DMI ground station data from Hvide Sande and Thyborøn. The location of the met mast at Blåvandshuk fyr has the disadvantage of being further away and placed on a small dune 19 m ASL.

Data from the boy NSBIII, available from the BSH data base [43]has not been deemed suitable for the study. Despite the advantage of providing offshore data of good quality, the low measurement height (10 m ASL) is not sufficient to be used with the wind model. As for the long-term consistency check of reference data, other data sources have been considered instead.

Appendix A.2. Data Analysis of Supporting Data

WIND SPEED DISTRIBUTION

The following table summarizes the resulting wind speeds.

Table 50. Summary of secondary data wind speed

MAST	ARITHMETIC MEAN WIND SPEEDS [M/S]	MAX MEAN WIND SPEED [M/S]	WEIBULL MEAN [M/S]	WEIBULL – A PARAMETER	WEIBULL – K PARAMETER
Thor – 150 m	9.95	27.46	10.08	11.37	2.39
FINO 3 – 91 m	10.08	36.34	10.19	11.50	2.43
Harald B – 69 m	10.25	34.50	10.23	11.55	2.25

WIND DIRECTION DISTRIBUTION

The frequency and energy distributions indicate that there is not only one defined main direction, but scattered distribution, being the third and fourth quadrant, from South-southwest to Northwest, the most dominant wind directions.

Thor FLS 1 year
150 m ASL
(05/2020 - 05/2021)

FINO3 4 years
91 m ASL
(01/2010 - 12/2013)

Harald B 4 years
69 m ASL
(10/2015 – 10/2022)*
not the full period

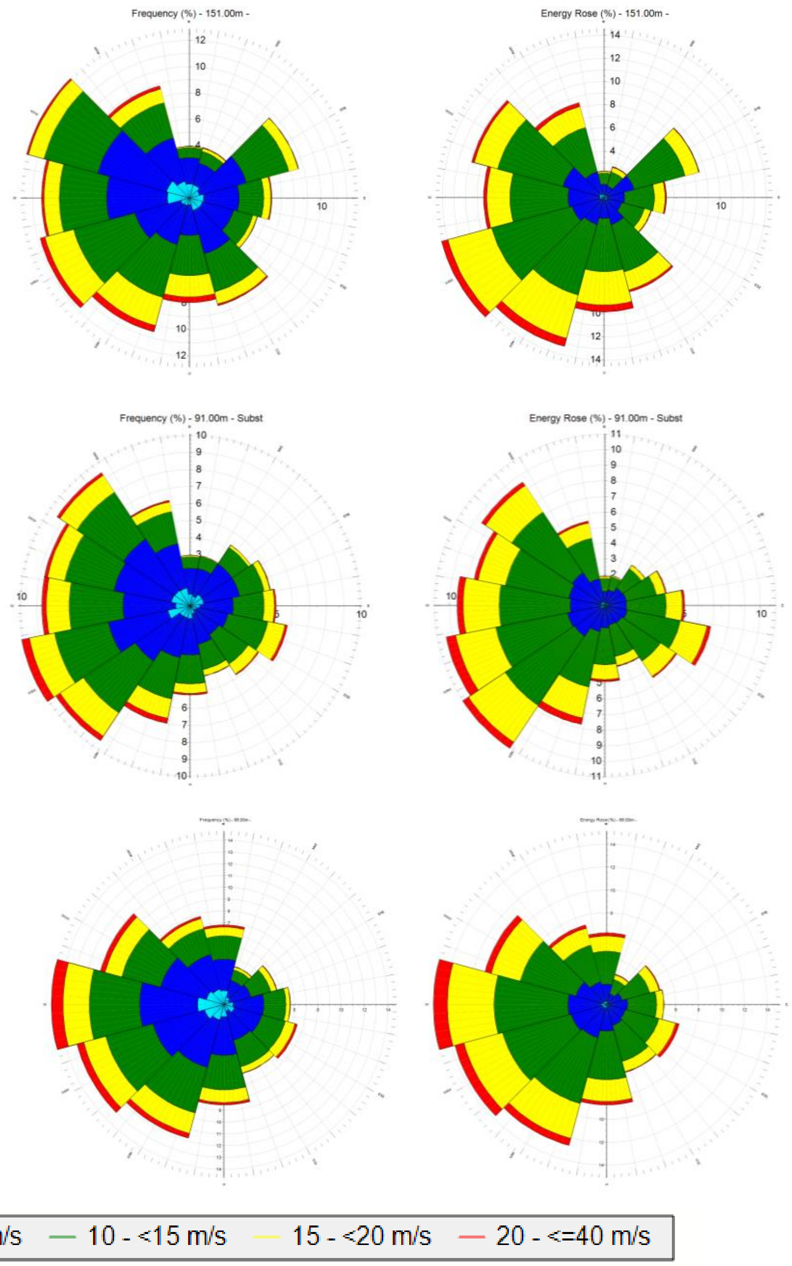

Figure 67. Wind direction frequency (on the left) and energy (on the right) distribution, Thor FLS, FINO3 and Harald B datasets

TURBULENCE INTENSITY

The turbulence intensity calculated from the mean wind speed and its standard deviation is presented in Figure 68. For FINO3, at 91 m, the mean turbulence intensity is 5.6% as expected on an offshore site. While M2 presents a measured value of 8.1% at 62 m and Høvsøre has an average of 6.3% at 116.5 m, both considering only the relevant sectors. As observed on Figure 69 the turbulence intensity has a uniform distribution across de sectors at FINO3, the same can be seen for the enabled sectors at M2 and Høvsøre.

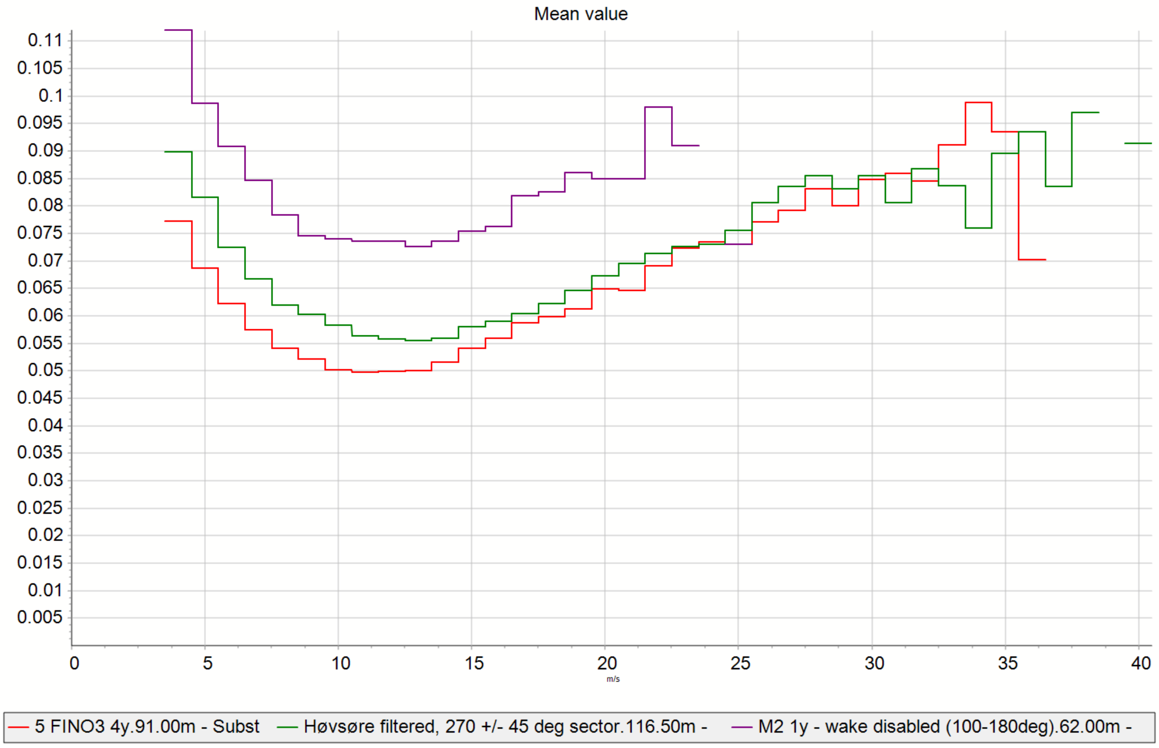

Figure 68. Turbulence intensity measured at FINO3 (4 years - 91 m), Høvsøre (15 years – 116.5 m) and M2 mast (1 year – 62 m) per wind speed bin.

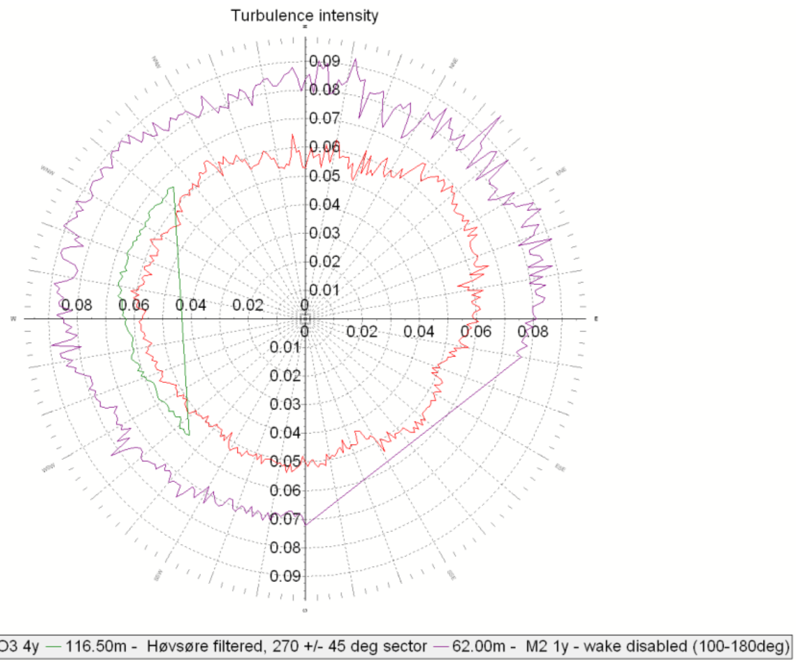

Figure 69. Turbulence intensity measured at FINO3 (4 years - 91 m), Høvsøre (15 years – 116.5 m) and M2 mast (1 year – 62 m) per wind direction (36 sectors)

DIURNAL VARIATIONS

The wind speed is lowest at midday and highest during the night. The daily variations of turbulence intensity are minimal as expected on an offshore site. At Harald B it is possible to see a drop in the windspeeds around 22h, and that is due to the daily gaps on the data between 21:10h and 00:00h.

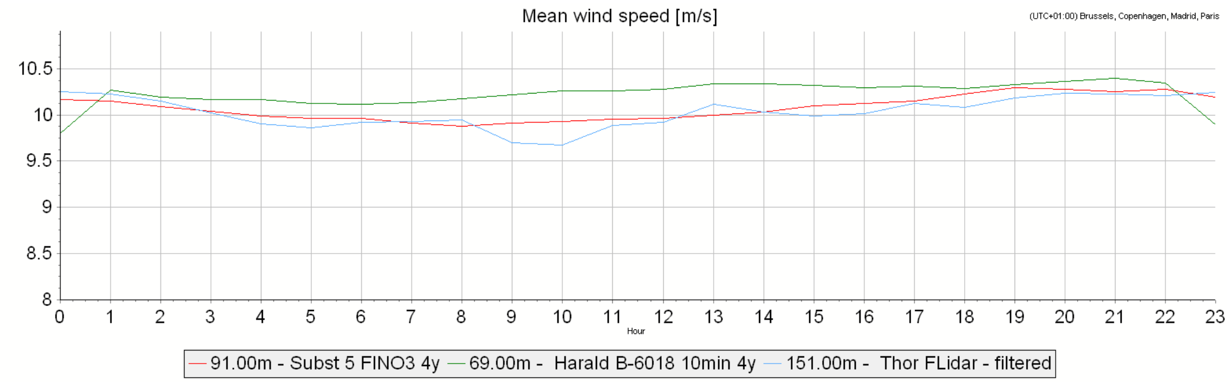

Figure 70. Daily variation of wind speed measured at FINO3 (4 years - 91 m), Harald B (4 years – 69 m) and Thor FLS (1 year – 150 m).

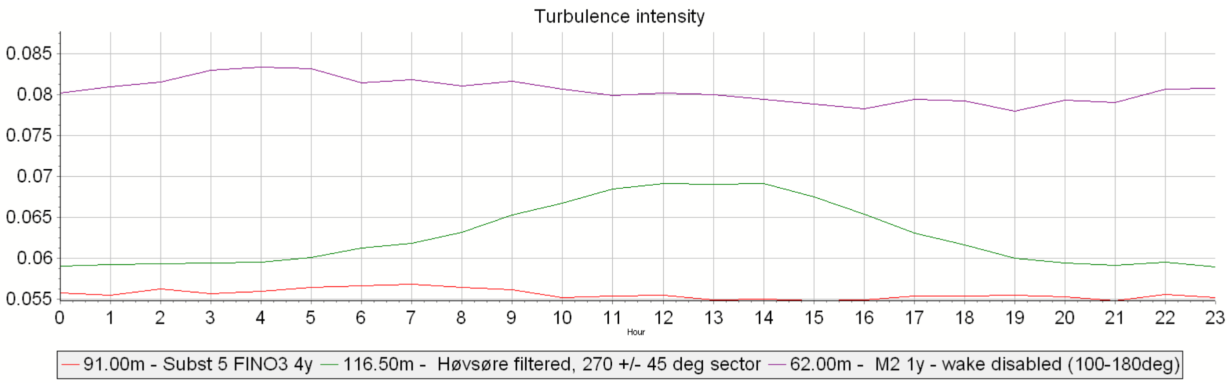

Figure 71. Daily variation of turbulence intensity measured *at FINO3 (4 years - 91 m), Høvsøre (15 years – 116.5 m) and M2 mast (1 year – 62 m)*

SEASONAL VARIATIONS

The monthly wind speed variations point to highest wind speeds during the late autumn and winter.

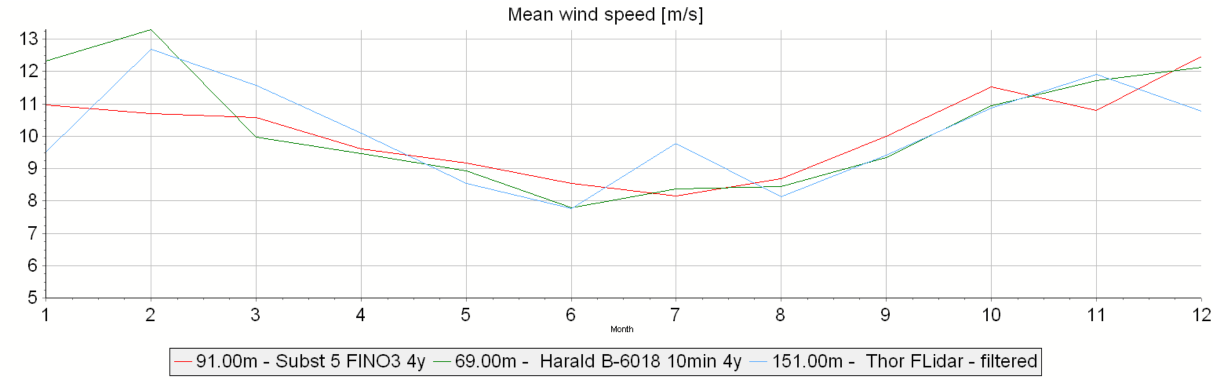

Figure 72. Monthly variation of wind speed measured at FINO3 (4 years - 91 m), Harald B (4 years – 69 m) and Thor FLS (1 year – 150 m).

TEMPERATURE

A summary of the mean temperature measured on the 9 secondary data sources is presented in Table 51.

The diurnal distribution of temperature shows a distinct difference between onshore and offshore stations. The amplitude is far smaller on the offshore sites as expected, which will resemble the North Sea Energy Island OWF more than the onshore stations Figure 73.

Table 51. Summary about Secondary Temperature data

Source	Height (ASL) [m]	Position	Period		Mean Temperature [°C]
Ekofisk	2.0	Offshore	Jan/1980 - Dec/2022	43 years	9.4
Valhall	2.0	Offshore	Jan/2015 - Dec/2022	8 years	9.9
Harald B	unknown	Offshore	Jan/2015 - Dec/2022	8 years	9.9
Lista Fyr	14.6	Onshore	Jan/1995 - Dec/2022	28 years	8.4
Lindesnes Fyr	20.6	Onshore	Jan/2006 - Dec/2022	17 years	8.9
Sleipner	2.0	Offshore	Jan/1997 - Dec/2022	26 years	9.5
Hvide Sande	3.9	Onshore	Jan/2002 - Dec/2022	21 years	9.7
Thyborøn	4.0	Onshore	Jan/2001 - Dec/2022	22 years	9.5
FINO3	95.0	Offshore	Jan/2010 - Dec/2013	4 years	9.1

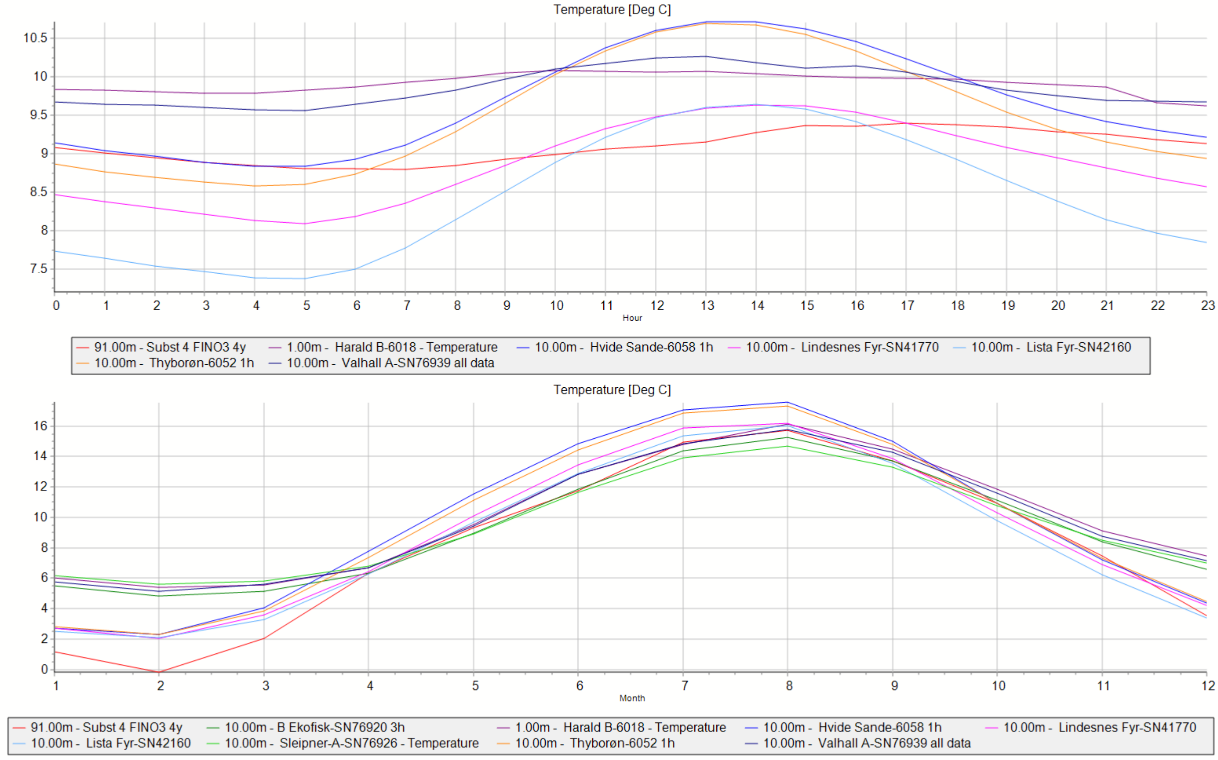

Figure 73. Diurnal and monthly variation of absolute temperature at the 9 secondary data sources. Sleipner and Ekofisk are not shown in the diurnal graph because they are 3h datasets.

Appendix A.3. Long-term Correction of Supporting Data

The measurement data from Thor, FINO3 and Harald B have been long-term corrected for wind model validation use. The reference period used is 2003-2022 (20 years). The argumentation for use of this period is presented in section 6.1.2.

REFERENCE DATA AND CORRELATION

For each dataset, three different reference datasets were considered: EMD-WRF, ERA5 and NORA3. These reference datasets are discussed in section 5. The closest node to each location was used.

EMD has several long-term correction methodologies at disposal. A full description of these can be found in the WindPRO reference document on Measure-Correlate-Predict (MCP) methods [26].

As each secondary data set consists of a number of complete years with reasonably high recovery rate, the risk of seasonal bias is limited. In the case of Harald B, however there is a risk of diurnal bias as the period 21.10 to 00.00 is largely missing from the dataset.

In each case correlation on wind speed, monthly correlation on energy content (index), self-prediction (concurrent period) and 24-hour slicing test (both converted to production output) as well as the ability to correctly reproduce observed directional distribution and wind speed frequency distribution was considered. The reference data and methodology with the best combined success was selected. This is summarized in Table 52.

Table 52. Best performing reference data and long-term correction methodology (LTC) for each secondary dataset.

REF: EMD-WRF	THOR	FINO3	HARALD B
Reference dataset	EMD-WRF	ERA5	EMD-WRF
Correlation, r [%] Wind Speed, hourly	94.9	95.3	94.4
Correlation, r [%] Wind Energy, monthly	99.5	99.0	97.9
LTC methodology	Matrix	Matrix	Linear regression
24-hour slicing test, % production	-1.41	0.26	0.29
Concurrent period prediction test, % production	0.48	0.01	-0.23

LONG-TERM WIND SPEED DISTRIBUTION

The long-term corrected wind speeds and wind distributions are presented in Table 53.

Frequency tables for each dataset can be found in appendix E.

Table 53. Long-term corrected wind speed and wind distribution, secondary data.

WS170	ELEVATION ASL [M]	PERIOD [Y]	ARITHMETIC MEAN WIND SPEEDS [M/S]	WEIBULL MEAN [M/S]	WEIBULL - A PARAMETER	WEIBULL - K PARAMETER
Thor	150	20	10.53	10.7	12.07	2.412
FINO3	91	20	10.13	10.23	11.55	2.376
Harald B	69	20	10.20	10.25	11.58	2.269

LONG-TERM WIND DIRECTION DISTRIBUTION

Thor 20 years
150 m ASL
(01/2003 - 12/2022)

FINO3 20 years
91 m ASL
(01/2003 - 12/2022)

Harald B 20 years
69 m ASL
(01/2003 - 12/2022)

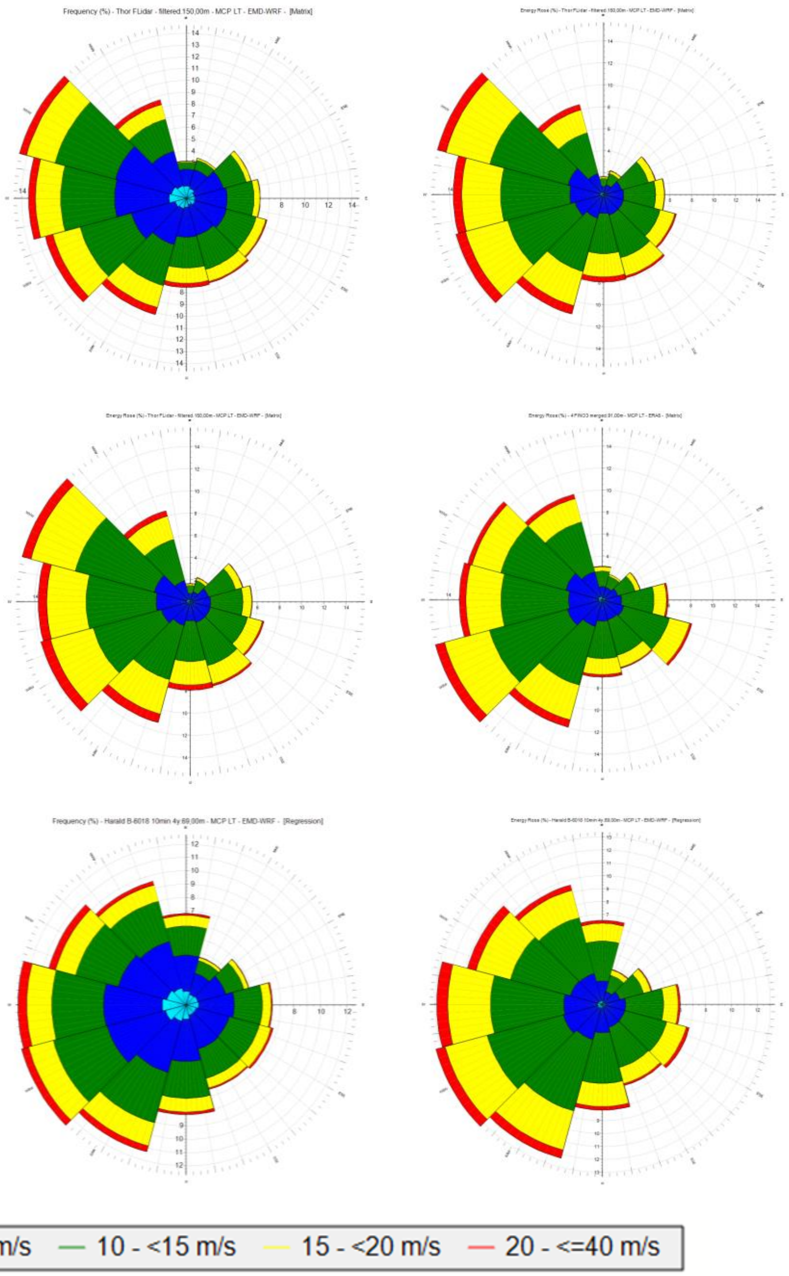

Figure 74. Long-term corrected frequency and energy roses, secondary data.

LONG-TERM DIURNAL VARIATIONS

Daily variation of the three long-term corrected datasets is presented in Figure 75. FINO3 and Thor are quite parallel with higher wind speed at night than at daytime, the same pattern observed in the measured data. Harald B has a different diurnal pattern, but it originates in the observations and is not an artifact of the long-term correction.

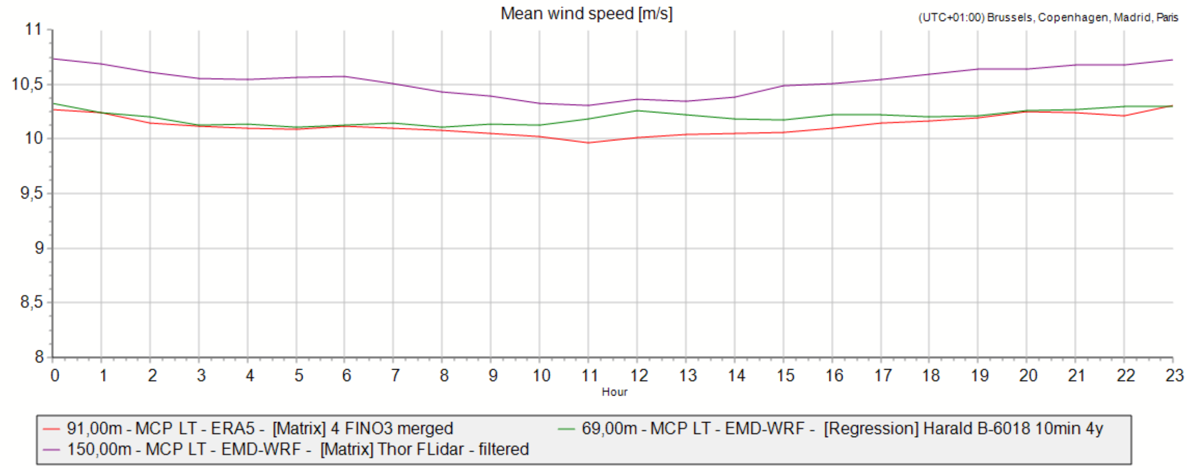

Figure 75. Long-term corrected diurnal variation, secondary data. Red: FINO3, green: Harald B, purple: Thor.

LONG-TERM SEASONAL VARIATIONS

The long-term seasonal variation mirrors that of the observation but is not more regular in shape with high wind speed at winter and lower wind speed in summer.

There is a distinctly different directional energy distribution summer and winter common for all three datasets.

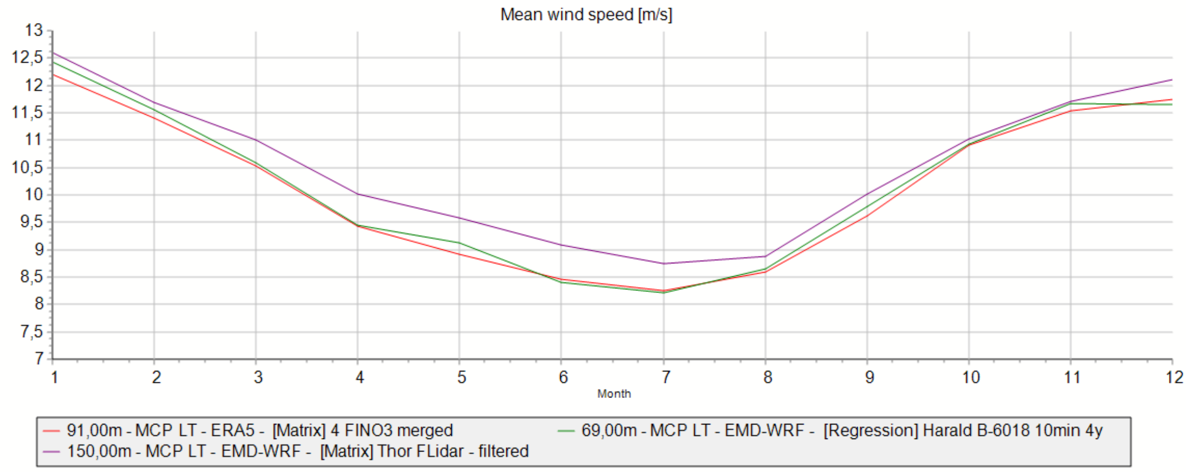

Figure 76. Long-term corrected seasonal variation, secondary data. Red: FINO3, green: Harald B, purple: Thor.

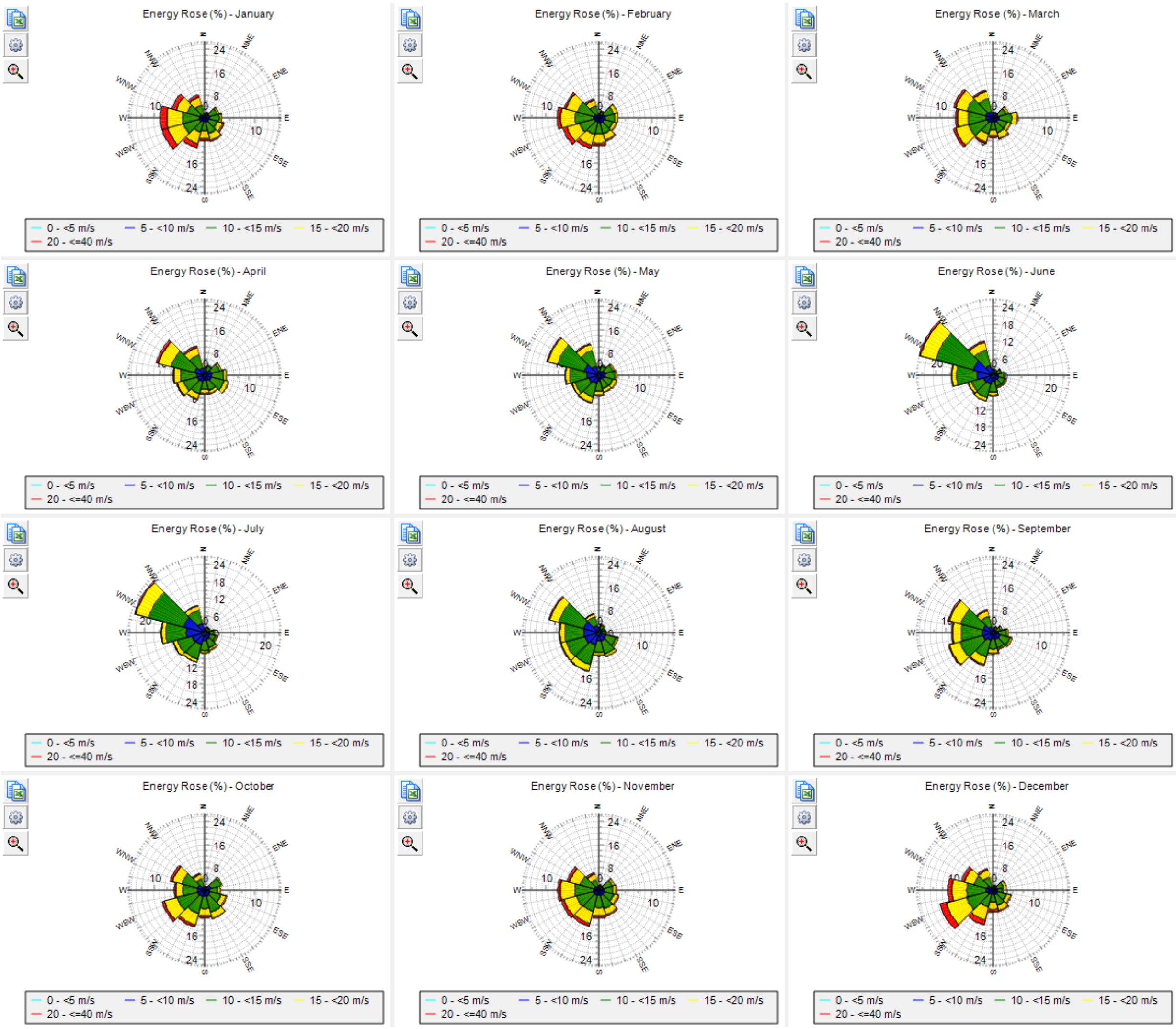

Figure 77. Long-term monthly energy roses, Thor.

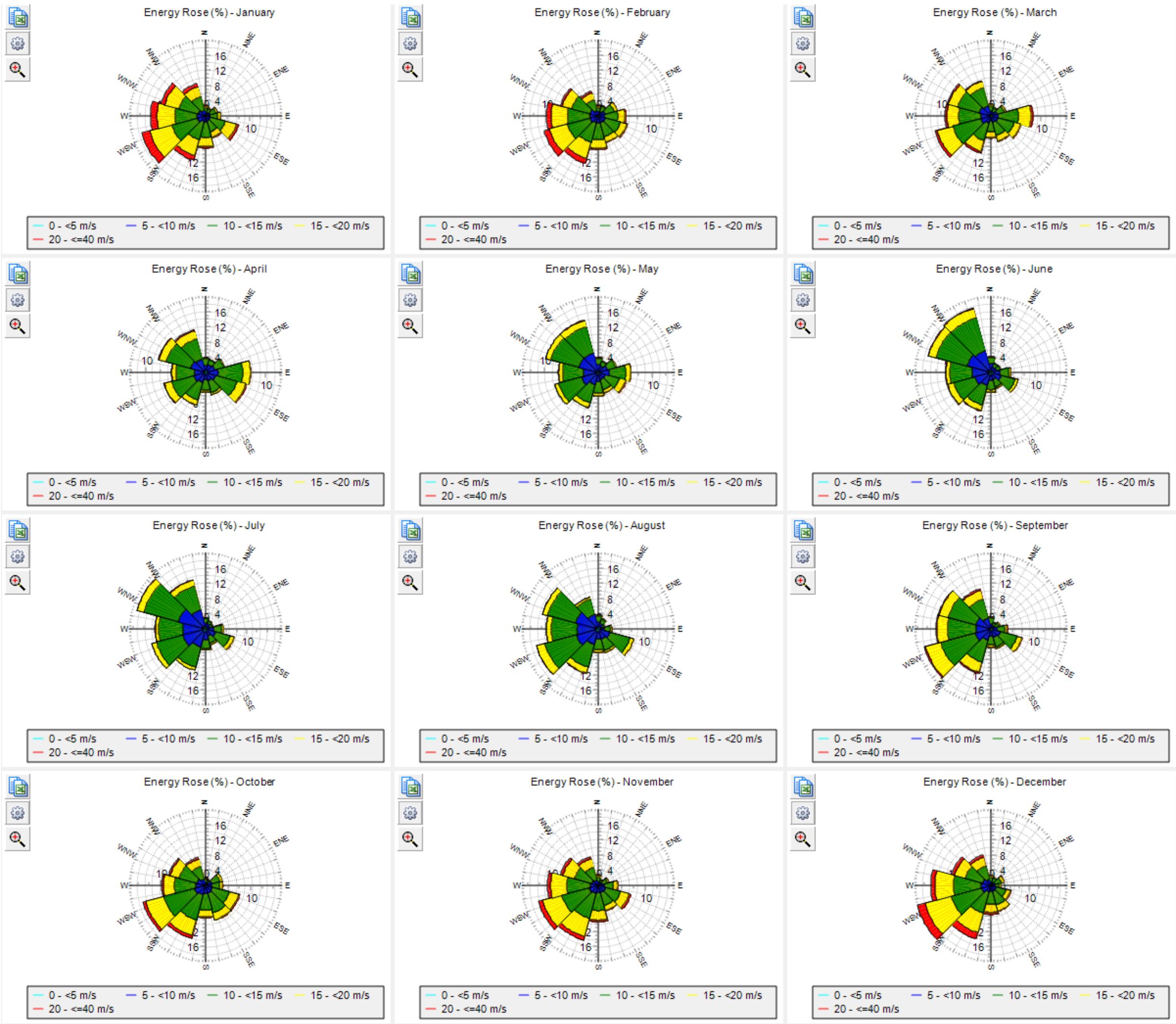

Figure 78. Long-term monthly energy roses, FINO3.

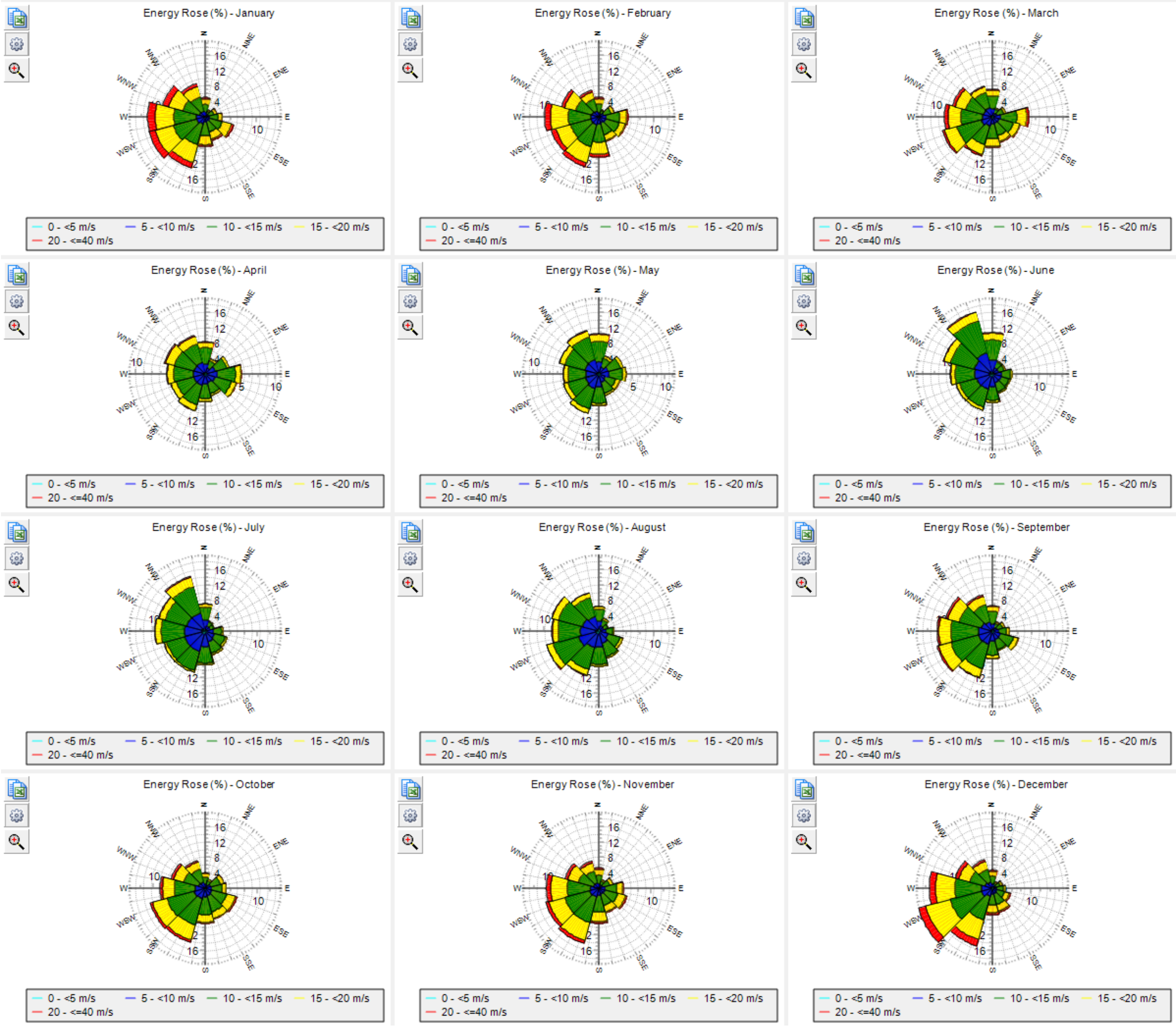

Figure 79. Long-term monthly energy roses, Harald B.

Appendix B. Verification and Classification Uncertainty

Verification uncertainty at 140 m height for WS170 [14].

WS170 height 140 m													
BIN lower [m/s]	BIN upper [m/s]	# of 10 min data sets	V_{rsd} [m/s]	V_{ref} [m/s]	V_{maxrsd} [m/s]	V_{minrsd} [m/s]	Std_{Vrsd} [m/s]	$Std_{Vrsd}/\sqrt{n}$ [m/s]	Mean deviation [%]	RSD Mounting uncertainty [%]	Separation Uncertainty [%]	V_{ref} Uncertainty [%]	**V_{RSD} Uncertainty (k=1) [%]**
3.75	4.25	119	4.01	3.98	5.14	3.45	0.25	0.023	0.69%	0.50%	0.01%	2.51%	**2.71%**
4.25	4.75	146	4.48	4.51	5.99	3.34	0.30	0.025	-0.65%	0.50%	0.01%	2.51%	**2.70%**
4.75	5.25	167	4.98	4.99	5.92	4.23	0.25	0.019	-0.32%	0.50%	0.01%	2.51%	**2.61%**
5.25	5.75	184	5.45	5.49	6.55	4.52	0.25	0.018	-0.81%	0.50%	0.01%	2.51%	**2.71%**
5.75	6.25	180	5.94	6.01	7.14	5.18	0.26	0.019	-1.24%	0.50%	0.01%	2.51%	**2.86%**
6.25	6.75	192	6.38	6.49	7.49	5.86	0.26	0.018	-1.67%	0.50%	0.01%	2.51%	**3.07%**
6.75	7.25	181	6.84	6.98	7.68	6.17	0.25	0.019	-1.95%	0.50%	0.01%	2.51%	**3.23%**
7.25	7.75	130	7.27	7.47	8.26	6.07	0.33	0.029	-2.66%	0.50%	0.01%	2.51%	**3.71%**
7.75	8.25	92	7.75	7.98	8.54	6.70	0.31	0.032	-2.93%	0.50%	0.01%	2.51%	**3.92%**
8.25	8.75	82	8.31	8.50	9.60	7.41	0.32	0.035	-2.24%	0.50%	0.01%	2.51%	**3.42%**
8.75	9.25	88	8.78	8.99	9.76	8.03	0.29	0.031	-2.34%	0.50%	0.01%	2.51%	**3.49%**
9.25	9.75	72	9.33	9.48	10.60	8.35	0.39	0.046	-1.63%	0.50%	0.01%	2.51%	**3.07%**
9.75	10.25	72	9.76	9.98	10.93	8.78	0.43	0.050	-2.22%	0.50%	0.01%	2.51%	**3.43%**
10.25	10.75	89	10.34	10.53	11.14	9.25	0.33	0.035	-1.75%	0.50%	0.01%	2.51%	**3.12%**
10.75	11.25	82	10.80	10.99	11.81	9.68	0.38	0.042	-1.69%	0.50%	0.01%	2.51%	**3.09%**
11.25	11.75	73	11.38	11.46	12.16	10.72	0.32	0.038	0.70%	0.50%	0.01%	2.51%	**2.70%**
11.75	12.25	45	11.71	12.02	12.41	10.18	0.42	0.063	-2.60%	0.50%	0.01%	2.51%	**3.69%**
12.25	12.75	55	12.26	12.50	13.42	11.19	0.46	0.063	-1.89%	0.50%	0.01%	2.51%	**3.22%**
12.75	13.25	38	12.92	12.99	13.74	11.71	0.36	0.058	-0.59%	0.50%	0.01%	2.51%	**2.66%**
13.25	13.75	33	13.29	13.48	14.22	11.80	0.51	0.089	-1.38%	0.50%	0.01%	2.51%	**2.98%**
13.75	14.25	18	13.59	14.01	14.47	12.97	0.49	0.116	-3.05%	0.50%	0.01%	2.51%	**4.07%**
14.25	14.75	23	14.50	14.52	15.89	13.73	0.53	0.111	-0.10%	0.50%	0.01%	2.51%	**2.67%**
14.75	15.25	22	14.66	15.01	15.78	13.79	0.45	0.095	-2.32%	0.50%	0.01%	2.51%	**3.52%**
15.25	15.75	12	15.14	15.58	15.97	13.81	0.55	0.160	-2.78%	0.50%	0.01%	2.51%	**3.93%**
15.75	16.25	17	15.75	15.94	16.36	14.66	0.50	0.121	-1.22%	0.50%	0.01%	2.51%	**2.94%**

Verification uncertainty at 120 m height for WS181 [15].

WS181 height 120 m													
BIN lower [m/s]	BIN upper [m/s]	# of 10 min data sets	V_{rsd} [m/s]	V_{mm} [m/s]	V_{maxrsd} [m/s]	V_{minrsd} [m/s]	Std_{Vrsd} [m/s]	$Std_{Vrsd}/\sqrt{n}$ [m/s]	Mean deviation [%]	RSD Mounting uncertainty [%]	Separation Uncertainty [%]	V_{RLL} Uncertainty [%]	**V_{RSD} Uncertainty (k=1) [%]**
3.75	4.25	115	4.07	4.00	5.65	3.04	0.36	0.033	1.68%	0.50%	0.19%	1.84%	**2.67%**
4.25	4.75	118	4.56	4.48	5.47	3.63	0.30	0.028	1.83%	0.50%	0.19%	1.76%	**2.66%**
4.75	5.25	113	5.11	4.99	6.38	4.20	0.34	0.032	2.36%	0.50%	0.19%	1.67%	**3.00%**
5.25	5.75	107	5.61	5.49	7.28	4.58	0.41	0.040	2.19%	0.50%	0.19%	1.64%	**2.88%**
5.75	6.25	89	6.12	6.01	7.59	5.59	0.32	0.034	1.86%	0.50%	0.19%	1.73%	**2.65%**
6.25	6.75	70	6.55	6.48	7.30	5.99	0.30	0.036	0.94%	0.50%	0.19%	1.65%	**2.05%**
6.75	7.25	81	7.08	7.00	7.98	6.21	0.31	0.035	1.08%	0.50%	0.19%	1.52%	**2.00%**
7.25	7.75	100	7.51	7.50	8.99	6.74	0.33	0.033	0.17%	0.50%	0.19%	1.55%	**1.71%**
7.75	8.25	100	8.12	8.00	9.47	7.35	0.32	0.032	1.57%	0.50%	0.19%	1.49%	**2.27%**
8.25	8.75	110	8.55	8.49	9.51	7.70	0.38	0.036	0.73%	0.50%	0.19%	1.47%	**1.78%**
8.75	9.25	102	9.03	9.02	10.01	7.93	0.38	0.038	0.14%	0.50%	0.19%	1.52%	**1.67%**
9.25	9.75	114	9.58	9.50	10.53	8.51	0.37	0.034	0.79%	0.50%	0.19%	1.44%	**1.76%**
9.75	10.25	65	10.00	9.97	10.77	9.20	0.34	0.042	0.29%	0.50%	0.19%	1.43%	**1.61%**
10.25	10.75	62	10.55	10.48	11.44	9.92	0.34	0.043	0.66%	0.50%	0.19%	1.47%	**1.75%**
10.75	11.25	91	11.09	10.96	12.19	8.88	0.44	0.046	1.12%	0.50%	0.19%	1.45%	**1.95%**
11.25	11.75	70	11.53	11.50	12.46	9.56	0.47	0.056	0.32%	0.50%	0.19%	1.47%	**1.67%**
11.75	12.25	52	12.01	11.99	13.74	11.12	0.45	0.063	0.16%	0.50%	0.19%	1.49%	**1.68%**
12.25	12.75	38	12.62	12.52	13.41	11.78	0.38	0.061	0.76%	0.50%	0.19%	1.54%	**1.86%**
12.75	13.25	44	13.07	12.97	14.23	12.38	0.41	0.062	0.80%	0.50%	0.19%	1.50%	**1.85%**
13.25	13.75	35	13.54	13.50	14.31	12.99	0.35	0.059	0.30%	0.50%	0.19%	1.69%	**1.85%**
13.75	14.25	30	14.07	14.02	14.77	13.17	0.40	0.073	0.32%	0.50%	0.19%	1.66%	**1.85%**
14.25	14.75	53											
14.75	15.25	58											
15.25	15.75	45											
15.75	16.25	22											

Type specific classification uncertainty from classification report for ZX300 by DNV-GL [17]

ZX300 Type Class Table											
EVs / Heights	Max influence (m x Range)								Preliminary accuracy	Type specific class	Standard uncertainty
	Temperature Gradient	Air Temperature	Turbulence Intensity	Wind Veer	Wind Shear	Air Density	Rain	Flow inclination angle			
[m]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]
135	-1.85	-1.81	0.46	0.60	-2.48	*	-0.59	0.71	3.78	2.67	1.54
130	-2.03	-1.34	0.62	0.57	-1.14	*	-0.60	1.17	3.11	2.20	1.27
125	-1.80	-1.37	0.70	0.59	-1.20	*	-0.96	1.07	3.07	2.17	1.25
120	-1.91	-1.13	0.78	0.58	-0.61	*	-0.92	0.96	2.83	2.00	1.16
115	-1.97	-0.90	0.87	0.57	-0.02	*	-0.87	0.86	2.70	1.91	1.10
110	-2.03	-0.66	0.95	0.57	0.57	*	-0.82	0.76	2.71	1.92	1.11
105	-2.09	-0.42	1.04	0.56	1.16	*	-0.77	0.65	2.88	2.04	1.18
100	-1.52	2.50	1.71	0.00	1.02	-0.45	-0.01	0.55	3.61	2.55	1.47
95	-1.18	1.96	1.47	0.12	1.17	-0.33	0.20	0.22	2.99	2.12	1.22
90	-0.82	1.42	1.43	0.23	1.31	-0.20	0.23	-0.11	2.57	1.81	1.05
85	-0.46	0.91	1.40	0.34	1.52	-0.07	0.25	-0.66	2.43	1.72	0.99
80	-0.10	0.57	1.50	0.47	1.68	0.05	0.28	-0.63	2.47	1.75	1.01
75	0.11	0.61	1.61	0.60	2.23	0.18	0.30	-0.59	2.96	2.10	1.21
70	0.14	1.11	1.33	0.72	2.79	0.31	0.28	-0.56	3.43	2.43	1.40
65	0.23	1.35	1.09	0.89	2.36	0.75	0.26	-0.52	3.21	2.27	1.31
60	0.23	1.77	0.86	1.04	2.05	1.13	0.24	-0.49	3.28	2.32	1.34
55	0.25	2.07	0.71	0.45	1.91	1.51	0.23	*	3.32	2.34	1.35
50	0.28	1.03	0.52	0.61	1.60	1.89	0.28	*	2.83	2.00	1.15
45	0.32	0.41	0.39	0.77	1.29	2.27	0.31	*	2.82	2.00	1.15
40	0.16	-0.22	0.27	0.93	0.99	2.66	0.35	*	3.03	2.14	1.24
35	0.10	-0.61	0.41	0.45	0.13	0.48	0.38	*	1.07	0.75	0.44
30	0.03	-0.76	0.53	0.34	-0.44	-0.41	0.41	*	1.23	0.87	0.50
25	0.02	-0.78	0.67	0.29	-1.01	-1.30	0.45	*	2.01	1.42	0.82
20	0.00	-0.71	0.82	0.23	-1.58	-2.18	0.48	*	2.95	2.09	1.21

* EV was not assessed in the height

Appendix C. Filtered and Repaired Dataset: Position 1 (Lot1, WS170), Position 2 (Lot 2, WS181)

Project:
Energy Island North Sea

Licensed user:
EMD International A/S
Niels Jernes Vej 10
DK-9220 Aalborg Ø
+45 6916 4850
Thomas Sørensen / ts@emd.dk
Calculated:
29/03/2023 09.58

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

270,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,62	7,80	6,53	9,16	10,23	11,56	12,28	10,67	12,01	12,21	12,01	11,96	12,93
0		0,49	1	0	0	1	0	0	0	0	0	0	0	0	0
1	0,50	1,49	390	54	47	37	37	21	32	27	32	30	11	19	43
2	1,50	2,49	885	107	63	129	82	76	47	66	72	59	55	57	72
3	2,50	3,49	1369	167	150	149	71	81	85	75	108	107	86	143	147
4	3,50	4,49	1845	185	175	125	85	130	99	94	102	202	199	244	205
5	4,50	5,49	2262	217	167	133	140	152	142	103	102	286	260	304	256
6	5,50	6,49	2730	226	188	112	100	206	147	231	183	234	330	456	317
7	6,50	7,49	3137	191	119	95	112	166	155	309	286	415	462	490	337
8	7,50	8,49	3121	195	71	79	77	116	179	387	320	478	410	437	372
9	8,50	9,49	2999	91	30	68	65	170	185	348	354	408	443	411	426
10	9,50	10,49	3336	117	24	56	82	243	139	268	390	474	458	596	489
11	10,50	11,49	3603	94	15	76	82	280	216	169	367	494	582	671	557
12	11,50	12,49	3889	79	29	110	72	411	277	186	331	521	635	650	588
13	12,50	13,49	3748	71	26	91	108	289	366	227	327	478	571	608	586
14	13,50	14,49	3382	51	17	115	113	266	337	237	312	438	446	535	515
15	14,50	15,49	2878	41	18	95	95	286	247	180	270	402	401	437	406
16	15,50	16,49	2643	32	8	85	63	268	224	150	250	349	401	406	407
17	16,50	17,49	2145	34	6	60	62	197	179	112	249	263	286	334	363
18	17,50	18,49	1740	31	10	32	80	142	183	91	200	238	243	226	264
19	18,50	19,49	1312	23	4	23	53	82	130	79	93	190	221	150	264
20	19,50	20,49	1063	12	2	12	21	33	72	60	93	197	146	131	284
21	20,50	21,49	840	12	5	0	8	13	43	36	81	184	111	103	244
22	21,50	22,49	588	6	3	0	8	13	49	15	53	127	82	78	154
23	22,50	23,49	424	1	3	1	10	5	34	6	54	54	33	55	168
24	23,50	24,49	357	2	1	1	7	11	22	10	49	70	29	58	97
25	24,50	25,49	238	0	2	1	3	13	12	7	30	35	17	61	57
26	25,50	26,49	128	0	3	5	1	2	1	1	15	21	15	25	39
27	26,50	27,49	74	2	7	3	0	0	0	0	3	9	17	14	19
28	27,50	28,49	42	0	3	5	0	0	0	0	2	7	9	8	8
29	28,50	29,49	36	1	2	3	0	0	0	0	0	2	3	14	11
30	29,50	30,49	31	0	1	2	0	0	0	0	0	4	2	17	5
31	30,50	31,49	34	0	0	0	0	0	0	0	0	1	6	18	9
32	31,50	32,49	25	0	0	0	0	0	0	0	0	0	5	16	4
33	32,50	33,49	22	0	0	0	0	0	0	0	0	0	3	15	4
34	33,50	34,49	9	0	0	0	0	0	0	0	0	0	3	6	0
35	34,50	35,49	6	0	0	0	0	0	0	0	0	0	2	3	1
36	35,50	36,49	1	0	0	0	0	0	0	0	0	0	1	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 09.58

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

240,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,52	7,93	6,51	9,10	10,17	11,47	12,25	10,64	11,91	12,09	11,87	11,80	12,79
0		0,49	3	0	2	1	0	0	0	0	0	0	0	0	0
1	0,50	1,49	386	51	40	42	36	30	27	25	28	28	13	17	49
2	1,50	2,49	893	96	65	138	83	64	53	72	73	60	64	59	66
3	2,50	3,49	1376	154	150	156	72	95	83	83	111	96	90	141	145
4	3,50	4,49	1909	185	184	134	88	128	93	85	109	195	210	269	229
5	4,50	5,49	2294	201	145	145	150	146	153	104	117	289	259	305	280
6	5,50	6,49	2764	226	185	120	108	189	151	252	191	241	348	438	315
7	6,50	7,49	3168	205	124	95	109	183	152	297	306	394	465	483	355
8	7,50	8,49	3143	188	75	77	71	132	192	378	321	499	408	431	371
9	8,50	9,49	3069	84	29	71	65	198	175	348	352	413	469	447	418
10	9,50	10,49	3409	133	19	56	89	251	142	264	395	462	467	621	510
11	10,50	11,49	3591	78	14	89	78	292	207	203	326	518	590	643	553
12	11,50	12,49	3930	74	29	105	79	405	242	212	347	525	658	664	590
13	12,50	13,49	3798	78	21	110	92	307	384	212	326	479	559	611	619
14	13,50	14,49	3364	50	14	105	119	256	356	242	336	442	443	510	491
15	14,50	15,49	2926	42	22	113	95	299	274	183	258	418	414	418	390
16	15,50	16,49	2633	28	5	102	72	263	224	143	271	312	391	388	434
17	16,50	17,49	2154	40	6	44	67	198	194	116	264	267	293	317	348
18	17,50	18,49	1693	27	8	30	72	134	183	96	186	217	255	228	257
19	18,50	19,49	1283	18	9	22	49	69	113	89	102	182	188	140	302
20	19,50	20,49	1045	16	2	16	19	27	69	54	80	215	165	116	266
21	20,50	21,49	754	19	2	2	9	12	46	25	67	165	107	92	208
22	21,50	22,49	539	4	3	0	10	8	53	20	58	92	53	74	164
23	22,50	23,49	436	1	2	0	11	13	16	12	57	69	37	56	162
24	23,50	24,49	333	1	2	3	6	12	26	7	47	56	24	62	87
25	24,50	25,49	179	3	1	2	1	11	6	3	16	29	18	37	52
26	25,50	26,49	98	3	5	1	0	1	2	1	11	7	19	20	28
27	26,50	27,49	58	0	7	3	0	0	0	0	3	6	9	13	17
28	27,50	28,49	41	1	3	7	0	0	0	0	1	3	4	16	6
29	28,50	29,49	33	0	2	3	0	0	0	0	0	4	5	8	11
30	29,50	30,49	37	0	0	1	0	0	0	0	0	2	2	24	8
31	30,50	31,49	29	0	0	0	0	0	0	0	0	1	4	17	7
32	31,50	32,49	22	0	0	0	0	0	0	0	0	0	2	15	5
33	32,50	33,49	15	0	0	0	0	0	0	0	0	0	3	8	4
34	33,50	34,49	6	0	0	0	0	0	0	0	0	0	2	2	2
35	34,50	35,49	4	0	0	0	0	0	0	0	0	0	3	1	0
36	35,50	36,49	1	0	0	0	0	0	0	0	0	0	1	0	0
37	36,50	37,49	1	0	0	0	0	0	0	0	0	0	1	0	0
38	37,50	38,49	1	0	0	0	0	0	0	0	0	0	0	1	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 09.58

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

200,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,36	7,83	6,47	9,14	9,99	11,37	12,18	10,56	11,73	11,86	11,67	11,66	12,60
0		0,49	5	1	3	1	0	0	0	0	0	0	0	0	0
1	0,50	1,49	393	43	39	41	43	25	33	31	26	30	12	18	52
2	1,50	2,49	900	105	68	145	73	64	59	63	75	51	68	59	70
3	2,50	3,49	1374	147	161	154	92	97	72	92	116	101	77	126	139
4	3,50	4,49	1949	191	169	110	100	149	81	81	108	217	229	293	221
5	4,50	5,49	2360	210	158	168	127	150	148	112	119	283	263	326	296
6	5,50	6,49	2819	248	167	126	123	188	146	229	208	243	390	435	316
7	6,50	7,49	3285	204	125	101	136	182	180	313	345	419	444	471	365
8	7,50	8,49	3069	161	81	72	76	116	186	370	301	473	418	409	406
9	8,50	9,49	3108	78	18	66	75	202	174	365	365	408	467	448	442
10	9,50	10,49	3573	142	20	56	104	281	138	271	395	508	495	652	511
11	10,50	11,49	3703	81	16	89	80	326	200	198	327	558	597	652	579
12	11,50	12,49	3935	65	24	119	82	414	260	236	338	523	651	650	573
13	12,50	13,49	3868	67	30	119	109	289	387	197	360	546	543	605	616
14	13,50	14,49	3462	57	16	107	110	270	382	254	347	493	419	526	481
15	14,50	15,49	2932	34	20	108	97	321	313	176	261	373	443	403	383
16	15,50	16,49	2615	31	6	108	72	275	226	136	294	297	379	360	431
17	16,50	17,49	2141	43	8	46	75	195	193	120	254	268	292	326	321
18	17,50	18,49	1540	33	9	32	61	99	169	100	141	218	211	203	264
19	18,50	19,49	1273	18	6	32	53	53	106	78	99	190	204	144	290
20	19,50	20,49	929	14	3	5	17	27	45	47	80	201	141	88	261
21	20,50	21,49	687	11	2	0	6	9	58	32	68	128	81	91	201
22	21,50	22,49	494	5	2	0	9	15	35	12	61	75	51	68	161
23	22,50	23,49	395	2	2	1	8	15	33	9	52	70	24	52	127
24	23,50	24,49	276	0	2	3	6	9	8	6	27	35	28	57	95
25	24,50	25,49	150	2	2	3	2	10	8	0	19	15	18	34	37
26	25,50	26,49	65	3	5	2	0	1	0	0	2	1	9	15	27
27	26,50	27,49	48	1	5	6	0	0	0	0	1	3	7	13	12
28	27,50	28,49	31	0	2	4	0	0	0	0	0	5	3	13	4
29	28,50	29,49	35	0	3	3	0	0	0	0	0	2	3	16	8
30	29,50	30,49	26	0	0	0	0	0	0	0	0	0	1	18	7
31	30,50	31,49	25	0	0	0	0	0	0	0	0	0	4	12	9
32	31,50	32,49	19	0	0	0	0	0	0	0	0	0	5	13	1
33	32,50	33,49	17	0	0	0	0	0	0	0	0	0	3	10	4
34	33,50	34,49	1	0	0	0	0	0	0	0	0	0	1	0	0
35	34,50	35,49	1	0	0	0	0	0	0	0	0	0	0	1	0
36	35,50	36,49	1	0	0	0	0	0	0	0	0	0	1	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 09.58

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

180,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,26	7,78	6,50	9,10	10,06	11,24	12,11	10,49	11,61	11,78	11,51	11,53	12,51
0		0,49	4	1	0	1	0	0	0	0	0	0	1	0	1
1	0,50	1,49	383	50	37	40	36	26	39	29	24	30	16	18	38
2	1,50	2,49	946	111	77	142	83	64	46	62	91	60	65	60	85
3	2,50	3,49	1365	150	156	162	72	118	77	94	112	82	87	123	132
4	3,50	4,49	1977	180	166	112	103	154	74	83	107	224	232	309	233
5	4,50	5,49	2396	223	150	185	127	147	132	108	119	263	291	330	321
6	5,50	6,49	2912	246	160	129	127	203	169	243	219	259	408	440	309
7	6,50	7,49	3288	225	127	102	142	166	181	321	343	405	447	460	369
8	7,50	8,49	3062	151	75	68	85	115	184	395	280	473	419	404	413
9	8,50	9,49	3206	96	25	62	84	210	182	368	370	401	460	497	451
10	9,50	10,49	3601	135	18	60	118	292	131	279	382	514	528	638	506
11	10,50	11,49	3841	82	18	91	95	346	222	204	352	594	623	655	559
12	11,50	12,49	3977	63	21	108	85	386	273	235	344	526	661	694	581
13	12,50	13,49	3950	75	25	123	118	291	409	254	375	540	515	610	615
14	13,50	14,49	3492	60	22	113	105	293	402	235	337	515	434	506	470
15	14,50	15,49	2907	36	14	121	88	341	275	171	288	376	445	375	377
16	15,50	16,49	2572	43	9	105	94	268	208	130	290	287	379	337	422
17	16,50	17,49	2052	32	9	54	85	165	214	129	216	250	268	316	314
18	17,50	18,49	1536	29	7	28	66	95	148	97	137	217	229	187	296
19	18,50	19,49	1214	21	4	31	41	45	93	76	101	199	181	136	286
20	19,50	20,49	855	6	3	4	18	16	54	44	84	178	122	82	244
21	20,50	21,49	671	11	1	0	6	14	49	19	66	114	86	93	212
22	21,50	22,49	460	7	2	0	7	9	41	14	61	72	29	63	155
23	22,50	23,49	371	1	4	1	8	14	24	8	38	63	35	51	124
24	23,50	24,49	222	2	1	2	5	12	13	3	20	22	28	47	67
25	24,50	25,49	116	1	4	5	2	7	3	0	9	5	9	28	43
26	25,50	26,49	55	5	4	1	0	2	0	0	4	2	4	15	18
27	26,50	27,49	50	0	8	7	0	0	0	0	1	4	5	14	11
28	27,50	28,49	40	0	1	2	0	0	0	0	0	6	2	18	11
29	28,50	29,49	22	0	2	1	0	0	0	0	0	0	2	14	3
30	29,50	30,49	22	0	0	1	0	0	0	0	0	0	5	12	4
31	30,50	31,49	30	0	0	0	0	0	0	0	0	0	1	19	10
32	31,50	32,49	18	0	0	0	0	0	0	0	0	0	4	10	4
33	32,50	33,49	6	0	0	0	0	0	0	0	0	0	3	3	0
34	33,50	34,49	2	0	0	0	0	0	0	0	0	0	1	1	0
35	34,50	35,49	1	0	0	0	0	0	0	0	0	0	1	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

120,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,86	7,63	6,52	8,90	9,94	10,99	11,56	10,08	11,14	11,20	11,01	11,17	12,17
0		0,49	2	0	0	2	0	0	0	0	0	0	0	0	0
1	0,50	1,49	376	51	42	42	23	26	40	21	41	25	11	31	23
2	1,50	2,49	1010	120	76	138	99	67	50	70	94	75	65	57	99
3	2,50	3,49	1385	159	138	142	94	119	73	112	102	72	87	137	150
4	3,50	4,49	2054	145	185	127	100	152	70	88	120	263	263	316	225
5	4,50	5,49	2634	246	163	214	131	159	139	129	167	273	323	339	351
6	5,50	6,49	3024	254	138	148	153	188	167	267	242	258	430	458	321
7	6,50	7,49	3311	229	106	131	113	157	234	352	288	432	454	420	395
8	7,50	8,49	3271	145	66	86	111	142	198	425	319	482	432	429	436
9	8,50	9,49	3444	94	15	60	128	239	195	383	368	441	516	550	455
10	9,50	10,49	3934	124	27	80	155	280	178	300	419	590	547	717	517
11	10,50	11,49	4247	67	15	103	127	378	290	298	391	596	691	700	591
12	11,50	12,49	4514	61	26	119	110	424	449	286	438	669	642	706	584
13	12,50	13,49	4202	76	34	149	130	339	454	266	435	570	518	653	578
14	13,50	14,49	3167	50	30	129	128	329	236	198	364	393	456	455	399
15	14,50	15,49	2693	37	9	99	94	344	185	179	292	286	407	348	413
16	15,50	16,49	2376	30	4	105	108	193	173	172	248	282	331	341	389
17	16,50	17,49	1793	46	9	58	83	131	180	105	159	210	228	269	315
18	17,50	18,49	1386	21	11	21	53	59	135	67	111	216	226	154	312
19	18,50	19,49	942	17	3	9	35	22	67	25	81	169	114	117	283
20	19,50	20,49	661	16	4	2	10	10	49	20	75	119	59	79	218
21	20,50	21,49	496	6	2	0	5	13	52	12	54	76	36	84	156
22	21,50	22,49	359	0	4	0	12	14	26	12	28	31	43	51	138
23	22,50	23,49	229	2	1	1	7	15	13	2	20	15	9	43	101
24	23,50	24,49	125	2	3	3	2	14	6	0	6	4	10	28	47
25	24,50	25,49	73	4	6	3	0	3	3	0	3	6	3	18	24
26	25,50	26,49	35	0	3	3	0	0	0	0	0	5	1	10	13
27	26,50	27,49	29	0	5	4	0	0	0	0	0	1	2	10	7
28	27,50	28,49	27	0	3	3	0	0	0	0	0	0	1	12	8
29	28,50	29,49	26	0	0	1	0	0	0	0	0	0	2	16	7
30	29,50	30,49	28	1	0	1	0	0	0	0	0	0	8	10	8
31	30,50	31,49	16	0	0	0	0	0	0	0	0	0	2	12	2
32	31,50	32,49	3	0	0	0	0	0	0	0	0	0	1	1	1
33	32,50	33,49	1	0	0	0	0	0	0	0	0	0	0	1	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Calculated:
29/03/2023 09.58

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

100,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,67	7,57	6,50	8,80	9,78	10,89	11,19	9,84	10,93	10,93	10,80	11,08	11,99
0		0,49	2	0	0	1	0	0	1	0	0	0	0	0	0
1	0,50	1,49	385	49	42	49	22	24	33	33	39	28	10	26	30
2	1,50	2,49	1005	135	77	124	103	63	58	68	84	69	69	56	99
3	2,50	3,49	1433	165	138	141	98	129	62	127	104	87	97	140	145
4	3,50	4,49	2191	151	191	143	121	149	81	107	134	291	271	314	238
5	4,50	5,49	2616	233	161	203	130	181	127	132	166	259	347	339	338
6	5,50	6,49	3061	255	146	171	126	186	182	267	234	263	441	452	338
7	6,50	7,49	3382	232	99	137	144	154	256	342	319	449	429	419	402
8	7,50	8,49	3398	137	57	81	99	167	221	436	317	505	462	449	467
9	8,50	9,49	3676	98	20	70	182	243	206	414	390	479	518	594	462
10	9,50	10,49	4087	111	26	87	159	268	235	308	447	629	584	708	525
11	10,50	11,49	4598	73	21	108	135	406	384	324	458	648	717	722	602
12	11,50	12,49	4662	53	26	143	119	469	499	291	462	695	607	684	614
13	12,50	13,49	3930	73	48	163	123	325	324	224	466	494	496	645	549
14	13,50	14,49	3028	56	24	137	131	350	179	199	350	338	467	401	396
15	14,50	15,49	2617	30	8	98	107	306	164	185	284	303	411	323	398
16	15,50	16,49	2265	39	5	94	91	183	163	167	220	244	300	363	396
17	16,50	17,49	1651	39	10	35	83	101	178	72	132	213	231	242	315
18	17,50	18,49	1297	32	6	16	47	75	106	52	95	230	176	146	316
19	18,50	19,49	831	15	6	8	27	18	51	20	73	140	102	113	258
20	19,50	20,49	568	12	2	0	6	11	53	16	59	84	50	81	194
21	20,50	21,49	464	7	2	0	7	14	41	17	48	60	39	74	155
22	21,50	22,49	303	2	5	0	8	19	20	7	24	19	11	57	131
23	22,50	23,49	184	2	1	1	10	16	7	1	15	6	12	36	77
24	23,50	24,49	108	1	4	4	0	9	6	0	6	4	6	23	45
25	24,50	25,49	56	4	4	2	1	2	2	0	0	10	4	10	17
26	25,50	26,49	32	0	4	2	0	0	0	0	0	0	0	13	13
27	26,50	27,49	29	0	4	8	0	0	0	0	0	0	0	12	5
28	27,50	28,49	29	0	2	3	0	0	0	0	0	0	3	15	6
29	28,50	29,49	33	0	0	0	0	0	0	0	0	0	7	18	8
30	29,50	30,49	17	0	0	0	0	0	0	0	0	0	4	11	2
31	30,50	31,49	7	0	0	0	0	0	0	0	0	0	0	5	2
32	31,50	32,49	1	0	0	0	0	0	0	0	0	0	0	1	0
33	32,50	33,49	1	0	0	0	0	0	0	0	0	0	0	1	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 09.58

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

90,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,55	7,53	6,59	8,74	9,61	10,80	10,98	9,75	10,76	10,77	10,64	10,98	11,92
0		0,49	1	0	0	0	0	0	0	1	0	0	0	0	0
1	0,50	1,49	393	63	35	46	23	26	33	33	45	24	12	28	25
2	1,50	2,49	1004	125	83	123	106	65	51	64	82	75	66	63	101
3	2,50	3,49	1481	158	136	142	109	116	75	125	111	104	103	148	154
4	3,50	4,49	2181	143	195	135	118	150	92	108	137	282	280	318	223
5	4,50	5,49	2756	239	170	213	147	176	137	139	190	287	352	352	354
6	5,50	6,49	3164	274	141	167	121	201	206	291	250	268	443	443	359
7	6,50	7,49	3418	227	107	144	145	148	243	346	335	450	463	407	403
8	7,50	8,49	3466	135	56	74	100	185	238	453	326	497	489	440	473
9	8,50	9,49	3789	102	18	79	186	259	213	422	386	495	535	614	480
10	9,50	10,49	4294	121	25	91	178	305	252	317	495	663	630	726	491
11	10,50	11,49	4772	61	24	119	130	474	466	303	463	685	696	752	599
12	11,50	12,49	4647	59	35	146	121	431	462	314	473	672	598	723	613
13	12,50	13,49	3726	72	50	169	120	317	254	211	466	446	489	601	531
14	13,50	14,49	3050	54	21	127	133	355	162	217	368	338	447	408	420
15	14,50	15,49	2535	31	17	101	105	300	151	192	254	275	399	333	377
16	15,50	16,49	2168	39	6	76	84	188	174	124	183	248	298	344	404
17	16,50	17,49	1641	37	8	18	75	91	159	77	143	219	237	253	324
18	17,50	18,49	1169	18	7	20	47	54	94	48	99	215	154	134	279
19	18,50	19,49	783	21	3	7	27	20	59	20	63	113	85	101	264
20	19,50	20,49	591	15	3	1	4	12	54	14	64	93	51	79	201
21	20,50	21,49	411	6	2	0	6	16	34	17	39	39	19	78	155
22	21,50	22,49	270	3	2	0	11	17	20	6	19	12	13	49	118
23	22,50	23,49	181	2	4	4	6	16	9	0	14	11	10	34	71
24	23,50	24,49	92	3	3	3	1	7	3	0	2	9	5	15	41
25	24,50	25,49	55	1	5	3	1	3	2	0	0	3	4	14	19
26	25,50	26,49	32	0	4	3	1	0	0	0	0	0	1	12	11
27	26,50	27,49	37	0	6	6	0	0	0	0	0	0	0	14	11
28	27,50	28,49	28	0	0	2	0	0	0	0	0	0	5	14	7
29	28,50	29,49	21	0	0	0	0	0	0	0	0	0	7	11	3
30	29,50	30,49	18	0	0	0	0	0	0	0	0	0	1	15	2
31	30,50	31,49	3	0	0	0	0	0	0	0	0	0	0	2	1
32	31,50	32,49	1	0	0	0	0	0	0	0	0	0	1	0	0
33	32,50	33,49	1	0	0	0	0	0	0	0	0	0	0	1	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 09.58

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

60,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,14	7,51	6,31	8,27	9,23	10,38	10,42	9,28	10,24	10,24	10,18	10,74	11,61
0		0,49	3	0	0	1	1	0	1	0	0	0	0	0	0
1	0,50	1,49	434	52	46	52	33	28	31	35	43	39	18	25	32
2	1,50	2,49	1085	129	83	149	106	69	39	81	82	73	90	73	111
3	2,50	3,49	1603	183	151	142	120	128	76	117	113	141	126	149	157
4	3,50	4,49	2331	135	197	155	124	162	102	113	136	315	308	325	259
5	4,50	5,49	2864	224	180	219	149	180	137	186	218	279	379	367	346
6	5,50	6,49	3407	286	148	165	144	209	248	322	310	321	461	440	353
7	6,50	7,49	3661	209	76	152	132	214	285	406	363	438	542	427	417
8	7,50	8,49	4024	135	51	106	184	200	280	525	401	571	542	493	536
9	8,50	9,49	4255	110	25	101	205	292	283	382	529	593	596	666	473
10	9,50	10,49	4799	114	35	135	180	407	436	298	530	734	649	739	542
11	10,50	11,49	5017	57	27	170	129	513	482	321	521	711	724	773	589
12	11,50	12,49	4172	65	41	179	122	390	245	238	483	521	551	701	636
13	12,50	13,49	3429	73	39	162	149	309	185	216	427	382	468	521	498
14	13,50	14,49	2781	49	12	107	93	326	156	209	283	304	468	395	379
15	14,50	15,49	2286	34	6	60	94	245	124	157	178	269	339	351	429
16	15,50	16,49	1884	50	6	24	82	134	157	90	169	238	251	333	350
17	16,50	17,49	1445	34	7	17	54	84	121	54	112	217	193	203	349
18	17,50	18,49	912	22	7	15	44	36	74	31	66	115	116	125	261
19	18,50	19,49	686	17	2	4	16	16	53	16	72	101	56	92	241
20	19,50	20,49	477	12	4	0	7	11	46	18	42	47	27	78	185
21	20,50	21,49	311	4	0	0	8	18	28	7	26	12	15	62	131
22	21,50	22,49	229	3	4	2	9	17	17	0	10	15	8	49	95
23	22,50	23,49	115	4	1	1	5	10	6	0	5	7	8	19	49
24	23,50	24,49	65	0	8	6	1	7	1	0	1	2	3	8	28
25	24,50	25,49	32	0	4	2	0	0	0	0	0	1	1	12	12
26	25,50	26,49	40	0	6	7	0	0	0	0	0	0	3	14	10
27	26,50	27,49	35	0	1	3	0	0	0	0	0	0	4	18	9
28	27,50	28,49	26	0	0	0	0	0	0	0	0	0	4	19	3
29	28,50	29,49	12	0	0	0	0	0	0	0	0	0	1	8	3
30	29,50	30,49	4	0	0	0	0	0	0	0	0	0	1	1	2
31	30,50	31,49	0	0	0	0	0	0	0	0	0	0	0	0	0
32	31,50	32,49	0	0	0	0	0	0	0	0	0	0	0	0	0
33	32,50	33,49	1	0	0	0	0	0	0	0	0	0	0	1	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

40,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			9,77	7,24	6,17	7,85	8,86	9,90	9,98	8,90	9,73	9,81	9,87	10,43	11,33
0		0,49	8	0	0	8	0	0	0	0	0	0	0	0	0
1	0,50	1,49	461	60	48	58	38	25	24	46	45	42	16	29	30
2	1,50	2,49	1126	143	82	155	98	76	43	80	83	77	86	92	111
3	2,50	3,49	1701	174	150	141	134	131	86	132	117	176	123	158	179
4	3,50	4,49	2550	142	199	175	134	199	102	115	170	337	352	358	267
5	4,50	5,49	3108	243	181	264	162	201	181	224	271	270	384	358	369
6	5,50	6,49	3543	281	132	155	154	232	281	326	331	348	532	431	340
7	6,50	7,49	4120	210	76	145	202	265	350	483	426	500	567	459	437
8	7,50	8,49	4426	119	60	132	203	230	305	507	535	620	579	575	561
9	8,50	9,49	4658	122	31	141	221	356	408	347	560	664	617	699	492
10	9,50	10,49	5030	87	29	172	170	447	473	297	564	746	717	754	574
11	10,50	11,49	4685	64	22	194	141	455	363	275	484	626	662	764	635
12	11,50	12,49	3942	64	35	147	142	363	188	207	476	482	551	658	629
13	12,50	13,49	3088	56	26	121	95	291	155	216	327	339	496	487	479
14	13,50	14,49	2517	58	10	86	90	274	127	211	200	269	408	403	381
15	14,50	15,49	2181	44	7	42	100	181	129	111	181	271	316	365	434
16	15,50	16,49	1726	42	10	10	65	137	167	70	141	234	218	289	343
17	16,50	17,49	1191	27	8	23	56	55	99	30	88	166	141	174	324
18	17,50	18,49	794	16	6	9	32	23	69	22	56	85	90	79	307
19	18,50	19,49	546	11	2	0	8	10	49	22	59	65	32	91	197
20	19,50	20,49	397	4	3	0	6	15	38	9	37	19	15	80	171
21	20,50	21,49	255	2	4	1	9	16	22	0	13	7	19	51	111
22	21,50	22,49	140	2	2	2	9	19	13	0	3	10	7	21	52
23	22,50	23,49	72	4	4	4	1	3	2	0	2	1	6	14	31
24	23,50	24,49	36	1	2	4	0	1	1	0	0	0	0	10	17
25	24,50	25,49	43	0	7	8	0	0	0	0	0	0	5	13	10
26	25,50	26,49	33	0	5	0	0	0	0	0	0	0	5	18	5
27	26,50	27,49	28	0	0	1	0	0	0	0	0	0	3	16	8
28	27,50	28,49	12	0	0	0	0	0	0	0	0	0	1	9	2
29	28,50	29,49	1	0	0	0	0	0	0	0	0	0	0	1	0
30	29,50	30,49	2	0	0	0	0	0	0	0	0	0	0	2	0
31	30,50	31,49	0	0	0	0	0	0	0	0	0	0	0	0	0
32	31,50	32,49	0	0	0	0	0	0	0	0	0	0	0	0	0
33	32,50	33,49	0	0	0	0	0	0	0	0	0	0	0	0	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 09.58

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

30,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			9,54	7,10	6,10	7,65	8,55	9,70	9,62	8,65	9,44	9,57	9,64	10,25	11,13
0		0,49	4	0	0	3	1	0	0	0	0	0	0	0	0
1	0,50	1,49	475	62	46	66	40	27	24	43	40	43	19	30	35
2	1,50	2,49	1177	140	88	153	110	69	49	91	88	87	91	88	123
3	2,50	3,49	1783	181	146	146	151	131	102	122	125	191	149	159	180
4	3,50	4,49	2685	150	215	178	145	224	104	115	206	327	370	374	277
5	4,50	5,49	3236	256	174	254	169	202	238	258	298	280	377	373	357
6	5,50	6,49	3795	279	128	159	192	259	329	366	336	382	566	436	363
7	6,50	7,49	4387	222	76	175	242	294	331	506	491	564	566	480	440
8	7,50	8,49	4610	116	54	141	221	238	370	507	567	652	593	580	571
9	8,50	9,49	4802	134	33	163	178	388	416	321	581	732	640	703	513
10	9,50	10,49	5165	89	28	166	198	480	457	283	570	755	739	819	581
11	10,50	11,49	4413	62	31	154	137	410	274	254	467	570	650	726	678
12	11,50	12,49	3775	74	36	142	120	341	156	207	448	439	552	653	607
13	12,50	13,49	2908	70	18	111	95	305	136	219	266	293	479	488	428
14	13,50	14,49	2448	42	10	70	104	236	125	176	203	307	395	366	414
15	14,50	15,49	2162	46	7	28	83	189	155	82	190	252	293	394	443
16	15,50	16,49	1545	33	8	12	64	105	148	66	105	219	186	232	367
17	16,50	17,49	1031	26	9	19	45	50	85	18	75	115	119	134	336
18	17,50	18,49	742	10	4	4	24	16	69	19	69	96	57	100	274
19	18,50	19,49	471	11	2	1	10	16	36	20	42	36	21	83	193
20	19,50	20,49	326	2	6	0	10	15	39	3	27	11	17	64	132
21	20,50	21,49	184	2	2	1	9	15	14	0	7	15	10	34	75
22	21,50	22,49	107	4	0	5	4	15	3	0	1	2	7	15	51
23	22,50	23,49	47	1	6	5	1	4	2	0	0	0	3	8	17
24	23,50	24,49	49	0	10	4	0	0	0	0	0	0	4	15	16
25	24,50	25,49	46	0	2	6	0	0	0	0	0	0	5	25	8
26	25,50	26,49	24	0	1	1	0	0	0	0	0	0	2	18	2
27	26,50	27,49	12	0	0	0	0	0	0	0	0	0	1	9	2
28	27,50	28,49	5	0	0	0	0	0	0	0	0	0	1	3	1
29	28,50	29,49	0	0	0	0	0	0	0	0	0	0	0	0	0
30	29,50	30,49	1	0	0	0	0	0	0	0	0	0	0	1	0
31	30,50	31,49	0	0	0	0	0	0	0	0	0	0	0	0	0
32	31,50	32,49	0	0	0	0	0	0	0	0	0	0	0	0	0
33	32,50	33,49	0	0	0	0	0	0	0	0	0	0	0	0	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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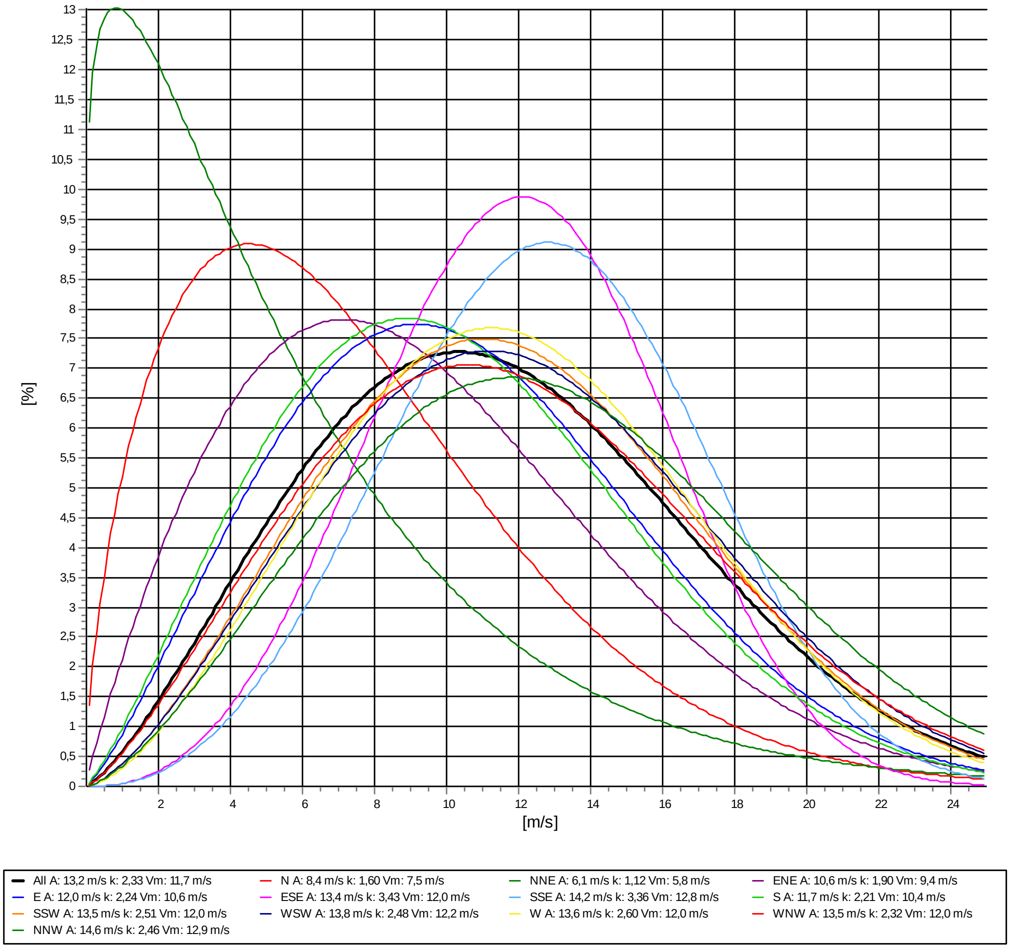
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **270,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,37	1,598	3,98	7,51
1-NNE	6,07	1,120	2,34	5,82
2-ENE	10,61	1,898	3,32	9,42
3-E	11,97	2,236	3,19	10,60
4-ESE	13,39	3,427	7,15	12,03
5-SSE	14,24	3,357	7,02	12,78
6-S	11,71	2,206	6,77	10,37
7-SSW	13,50	2,508	9,21	11,98
8-WSW	13,75	2,480	13,20	12,20
9-W	13,55	2,596	13,61	12,04
10-WNW	13,51	2,322	15,19	11,97
11-NNW	14,56	2,459	15,04	12,91
Mean	**13,15**	**2,333**	**100,00**	**11,66**



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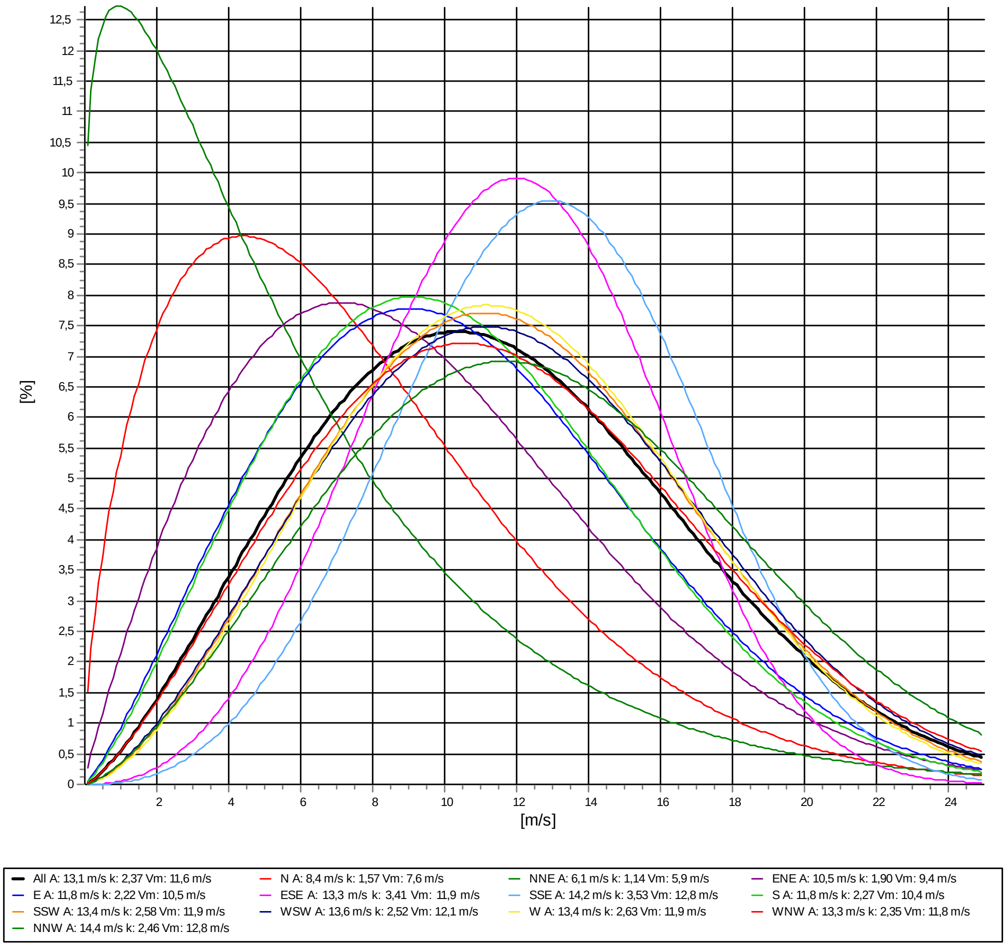
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **240,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,42	1,565	3,90	7,56
1-NNE	6,14	1,137	2,29	5,86
2-ENE	10,55	1,902	3,49	9,36
3-E	11,84	2,218	3,21	10,49
4-ESE	13,27	3,407	7,24	11,92
5-SSE	14,23	3,531	7,03	12,81
6-S	11,77	2,272	6,86	10,42
7-SSW	13,44	2,581	9,26	11,93
8-WSW	13,60	2,525	13,00	12,07
9-W	13,42	2,629	13,70	11,93
10-WNW	13,34	2,350	14,96	11,83
11-NNW	14,43	2,464	15,07	12,80
Mean	**13,06**	**2,366**	**100,00**	**11,58**



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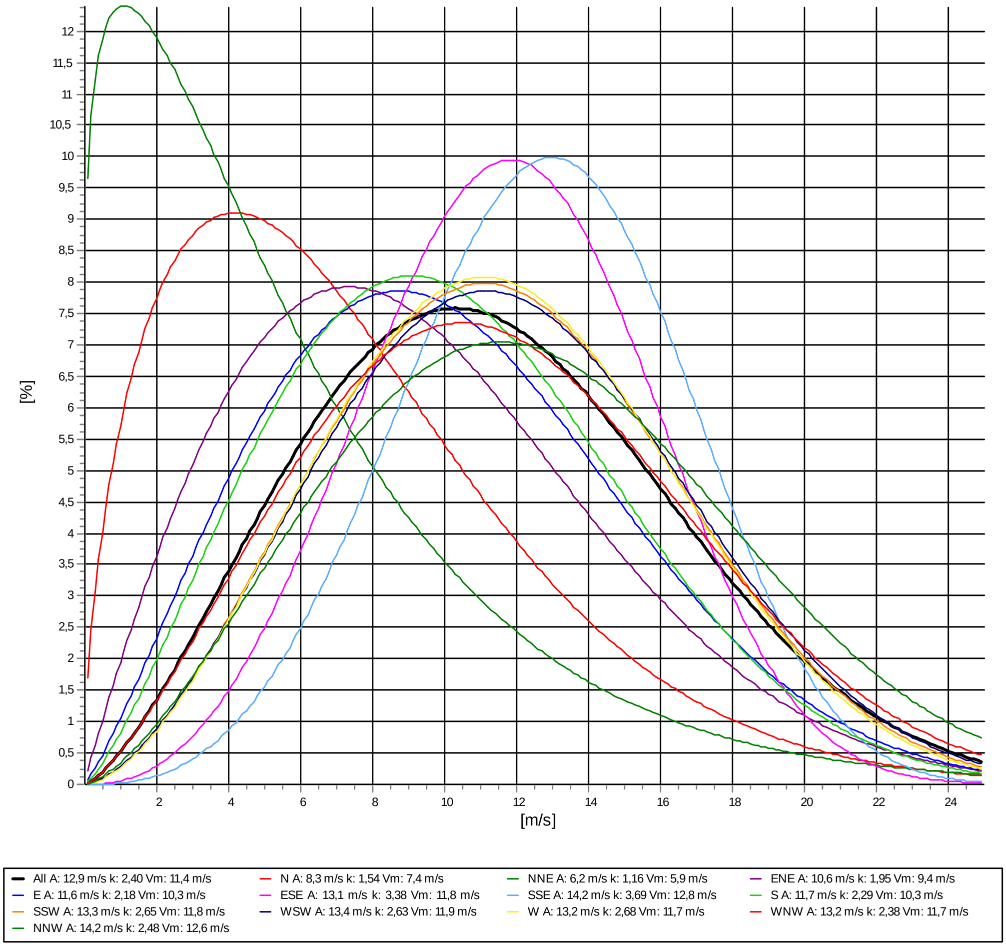
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **200,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,26	1,543	3,88	7,43
1-NNE	6,21	1,157	2,28	5,90
2-ENE	10,63	1,946	3,55	9,43
3-E	11,58	2,179	3,37	10,25
4-ESE	13,13	3,381	7,34	11,79
5-SSE	14,15	3,687	7,07	12,77
6-S	11,66	2,294	6,85	10,33
7-SSW	13,26	2,651	9,30	11,79
8-WSW	13,39	2,630	13,07	11,90
9-W	13,22	2,679	13,56	11,75
10-WNW	13,20	2,376	14,77	11,70
11-NNW	14,23	2,476	14,97	12,62
Mean	**12,90**	**2,403**	**100,00**	**11,44**



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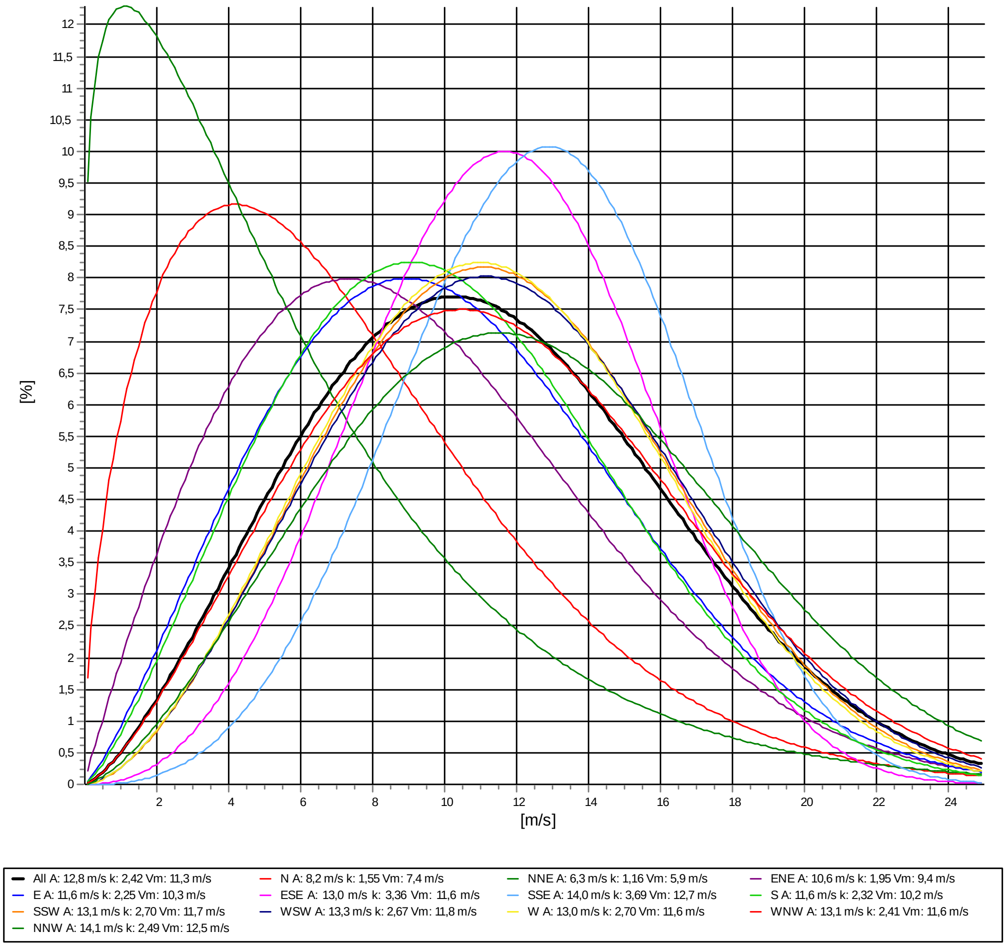
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **180,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,21	1,546	3,96	7,39
1-NNE	6,26	1,158	2,23	5,95
2-ENE	10,58	1,954	3,61	9,38
3-E	11,64	2,246	3,49	10,31
4-ESE	12,97	3,355	7,36	11,65
5-SSE	14,04	3,690	7,06	12,67
6-S	11,56	2,323	6,98	10,24
7-SSW	13,15	2,697	9,24	11,69
8-WSW	13,27	2,671	12,94	11,80
9-W	13,04	2,700	13,61	11,60
10-WNW	13,07	2,407	14,65	11,58
11-NNW	14,14	2,495	14,89	12,55
Mean	**12,79**	**2,425**	**100,00**	**11,34**



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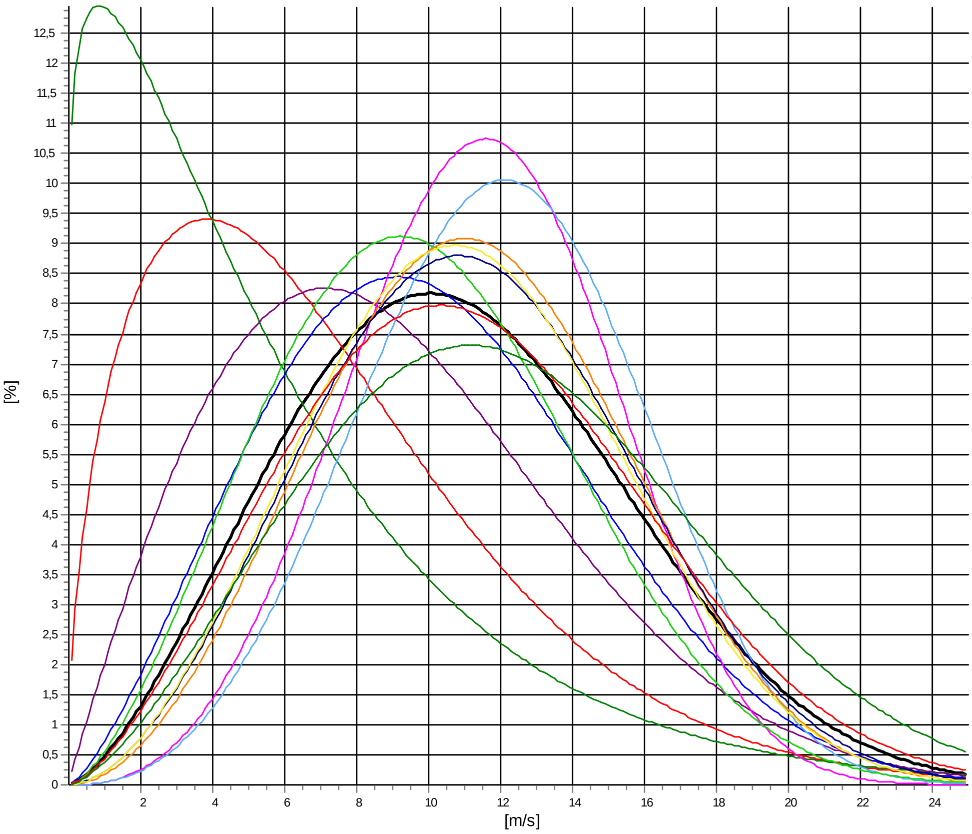
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **120,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,93	1,507	3,86	7,16
1-NNE	6,10	1,123	2,17	5,84
2-ENE	10,26	1,964	3,82	9,10
3-E	11,49	2,379	3,88	10,19
4-ESE	12,71	3,554	7,36	11,45
5-SSE	13,35	3,490	7,06	12,01
6-S	11,22	2,542	7,30	9,96
7-SSW	12,68	2,931	9,38	11,31
8-WSW	12,66	2,818	12,64	11,28
9-W	12,49	2,838	13,34	11,13
10-WNW	12,67	2,501	14,60	11,24
11-NNW	13,74	2,483	14,59	12,19
Mean	**12,34**	**2,498**	**100,00**	**10,95**



All A: 12,3 m/s k: 2,50 Vm: 11,0 m/s	N A: 7,9 m/s k: 1,51 Vm: 7,2 m/s	NNE A: 6,1 m/s k: 1,12 Vm: 5,8 m/s	ENE A: 10,3 m/s k: 1,96 Vm: 9,1 m/s
E A: 11,5 m/s k: 2,38 Vm: 10,2 m/s	ESE A: 12,7 m/s k: 3,55 Vm: 11,4 m/s	SSE A: 13,4 m/s k: 3,49 Vm: 12,0 m/s	S A: 11,2 m/s k: 2,54 Vm: 10,0 m/s
SSW A: 12,7 m/s k: 2,93 Vm: 11,3 m/s	WSW A: 12,7 m/s k: 2,82 Vm: 11,3 m/s	W A: 12,5 m/s k: 2,84 Vm: 11,1 m/s	WNW A: 12,7 m/s k: 2,50 Vm: 11,2 m/s
NNW A: 13,7 m/s k: 2,48 Vm: 12,2 m/s			

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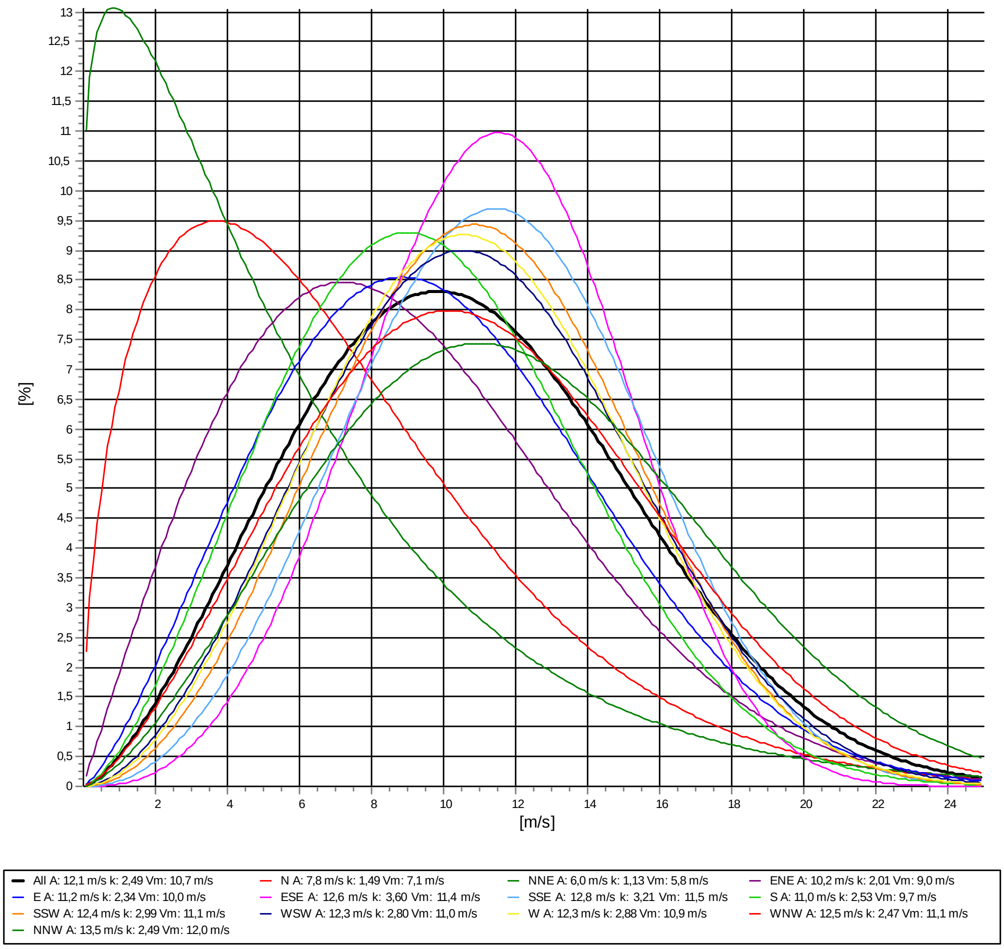
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **100,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,83	1,486	3,86	7,08
1-NNE	6,03	1,126	2,19	5,78
2-ENE	10,17	2,010	3,91	9,01
3-E	11,23	2,344	4,00	9,95
4-ESE	12,61	3,605	7,45	11,36
5-SSE	12,84	3,205	7,01	11,50
6-S	10,96	2,530	7,33	9,73
7-SSW	12,43	2,991	9,48	11,10
8-WSW	12,33	2,805	12,60	10,98
9-W	12,25	2,879	13,23	10,92
10-WNW	12,52	2,469	14,42	11,10
11-NNW	13,53	2,488	14,52	12,00
Mean	**12,11**	**2,489**	**100,00**	**10,74**



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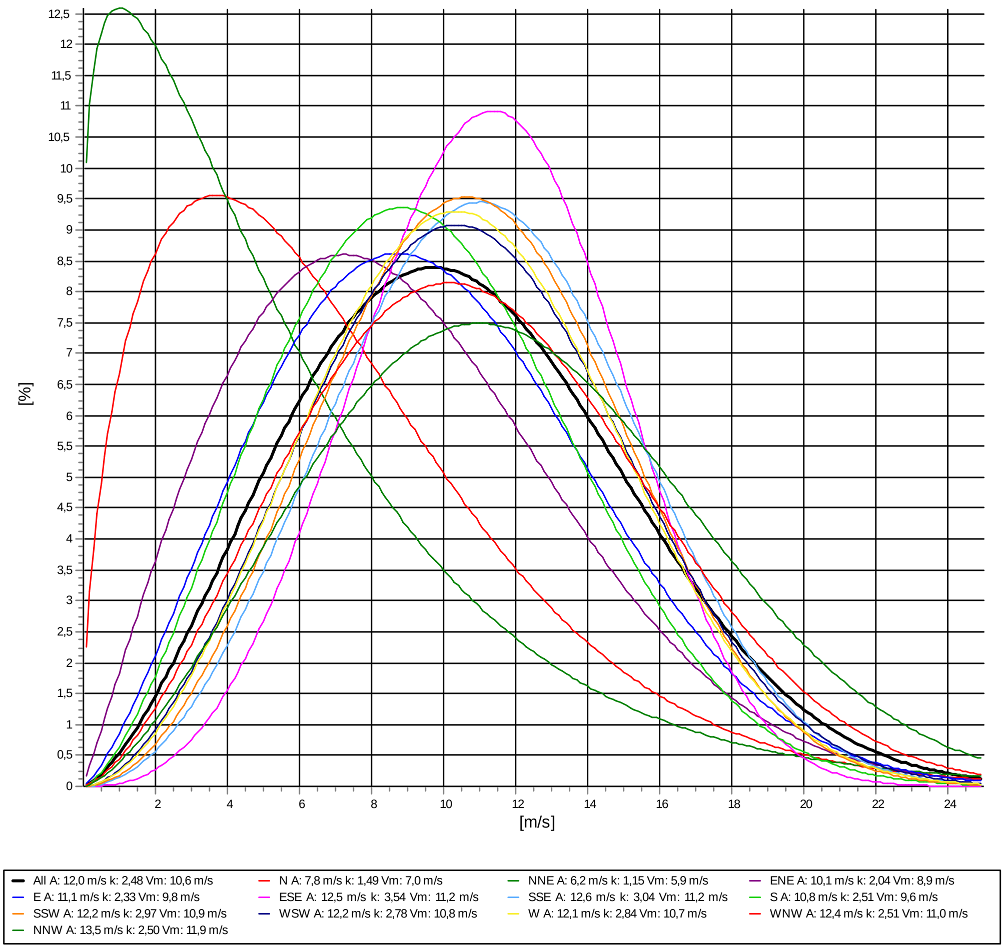
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **90,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,79	1,491	3,85	7,04
1-NNE	6,16	1,146	2,23	5,87
2-ENE	10,09	2,035	3,87	8,94
3-E	11,10	2,333	4,03	9,84
4-ESE	12,47	3,544	7,54	11,23
5-SSE	12,57	3,036	6,98	11,23
6-S	10,83	2,511	7,36	9,61
7-SSW	12,23	2,971	9,60	10,92
8-WSW	12,15	2,785	12,50	10,82
9-W	12,06	2,840	13,21	10,75
10-WNW	12,44	2,510	14,42	11,04
11-NNW	13,47	2,495	14,40	11,95
Mean	**11,97**	**2,481**	**100,00**	**10,62**



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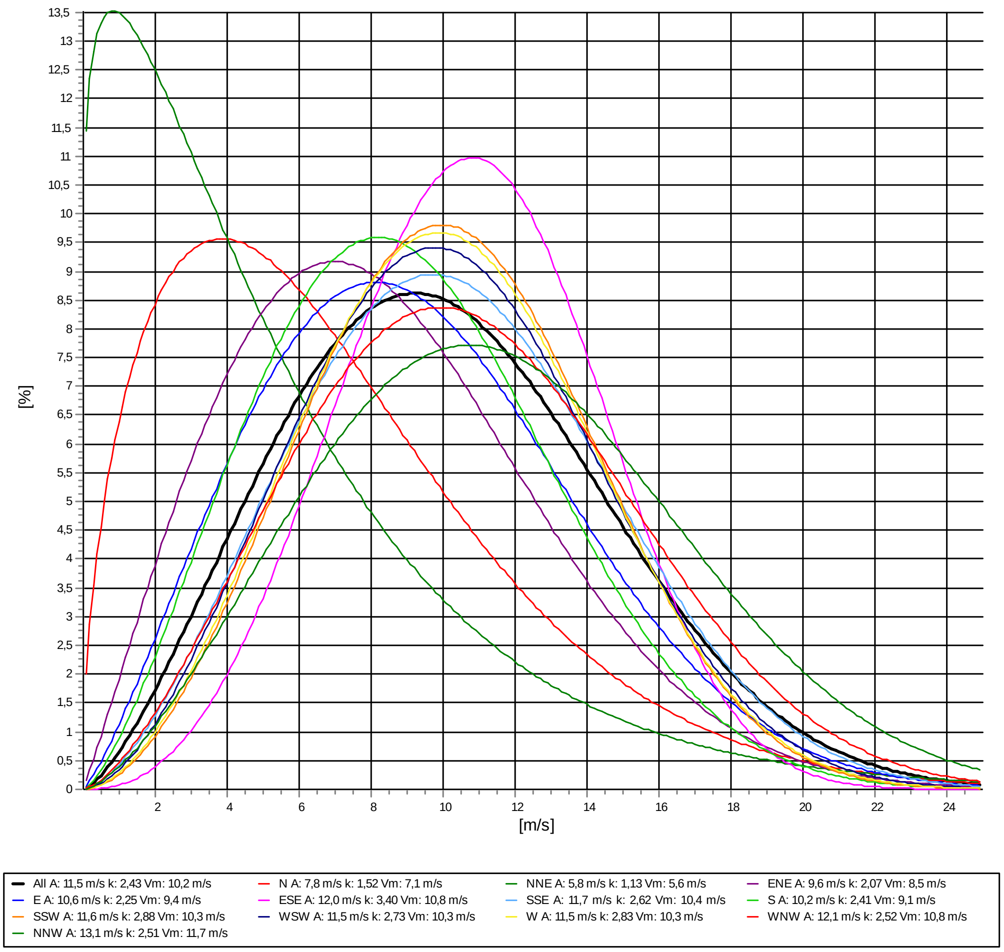
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **60,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,82	1,521	3,82	7,05
1-NNE	5,82	1,127	2,23	5,58
2-ENE	9,58	2,072	4,07	8,48
3-E	10,57	2,249	4,18	9,36
4-ESE	11,97	3,403	7,64	10,76
5-SSE	11,71	2,616	6,89	10,40
6-S	10,24	2,413	7,29	9,08
7-SSW	11,57	2,878	9,77	10,31
8-WSW	11,54	2,733	12,30	10,26
9-W	11,54	2,825	13,26	10,28
10-WNW	12,14	2,522	14,28	10,78
11-NNW	13,14	2,514	14,28	11,66
Mean	**11,47**	**2,432**	**100,00**	**10,17**



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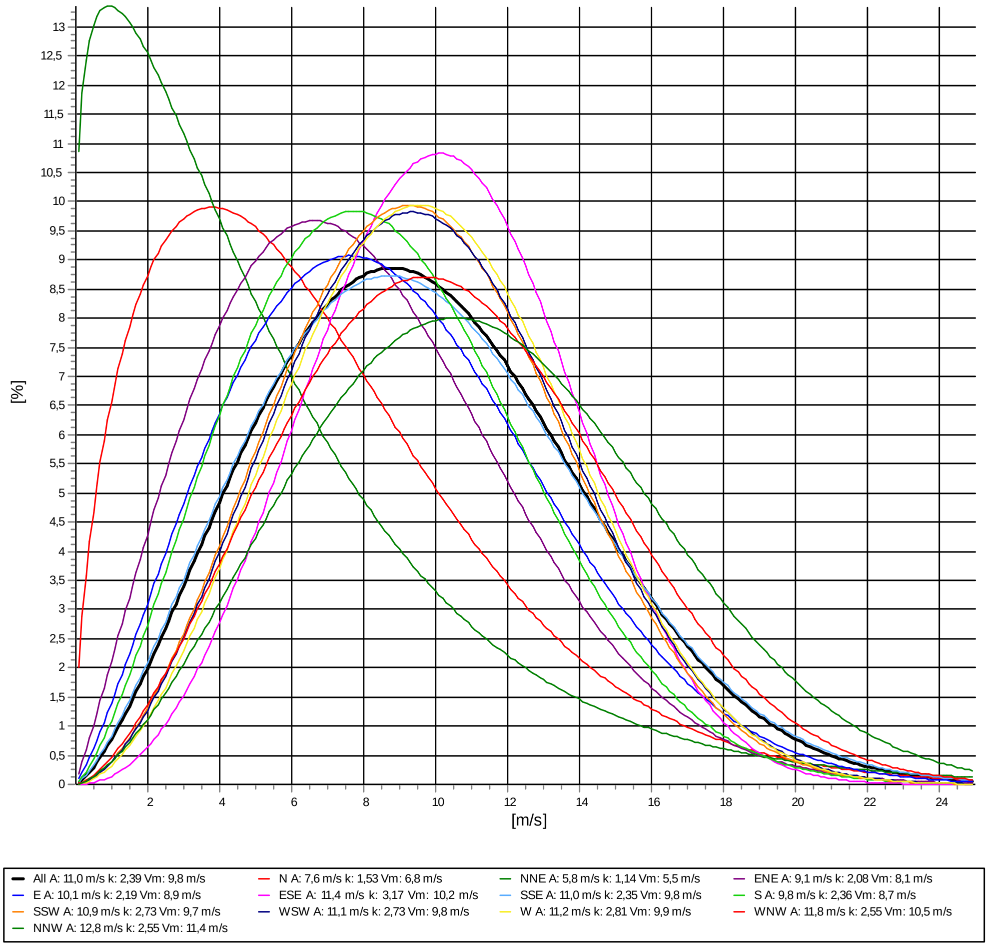
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **40,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,58	1,535	3,77	6,82
1-NNE	5,82	1,143	2,18	5,55
2-ENE	9,10	2,077	4,19	8,06
3-E	10,06	2,189	4,33	8,91
4-ESE	11,39	3,170	7,64	10,20
5-SSE	11,02	2,349	7,01	9,77
6-S	9,79	2,355	7,12	8,68
7-SSW	10,94	2,734	9,86	9,73
8-WSW	11,05	2,732	12,12	9,83
9-W	11,17	2,807	13,25	9,95
10-WNW	11,80	2,555	14,23	10,48
11-NNW	12,81	2,549	14,30	11,37
Mean	**11,02**	**2,395**	**100,00**	**9,77**



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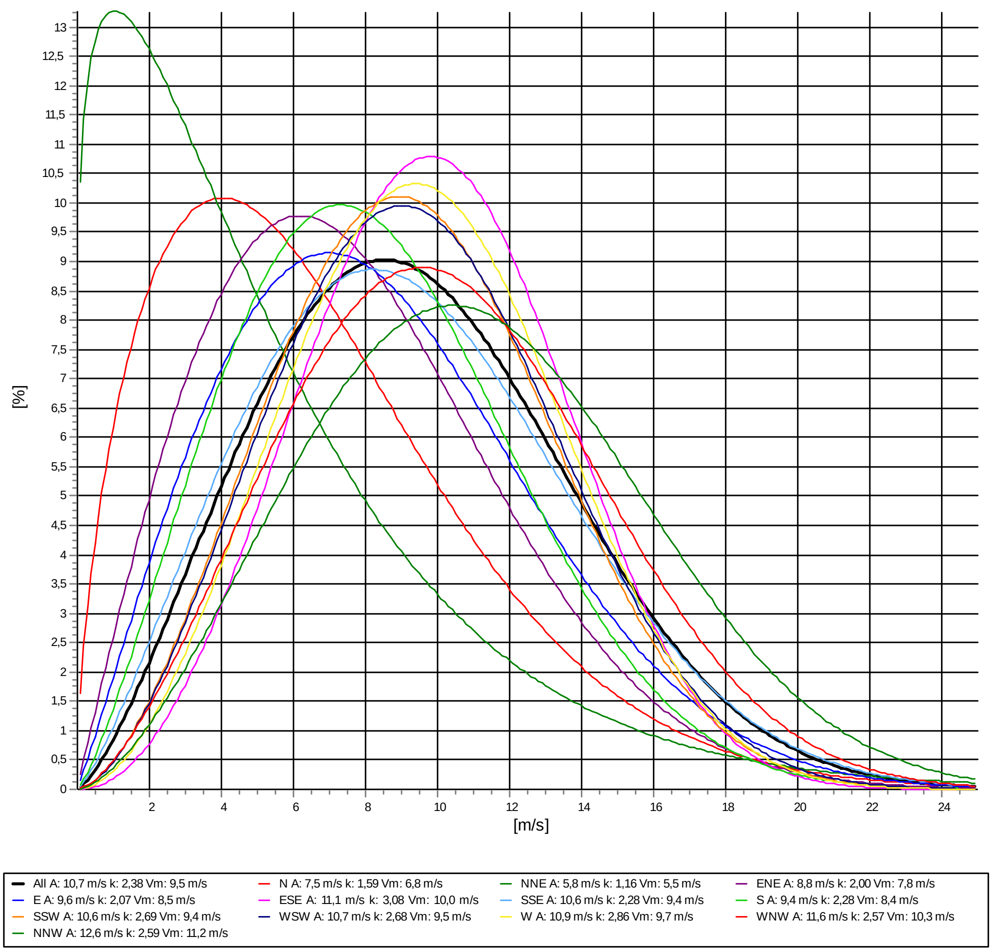
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **30,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,53	1,591	3,84	6,76
1-NNE	5,79	1,161	2,17	5,50
2-ENE	8,77	1,999	4,13	7,77
3-E	9,61	2,074	4,49	8,51
4-ESE	11,15	3,081	7,69	9,97
5-SSE	10,60	2,278	6,99	9,39
6-S	9,44	2,281	7,01	8,36
7-SSW	10,60	2,692	9,92	9,43
8-WSW	10,74	2,682	12,15	9,55
9-W	10,93	2,859	13,19	9,74
10-WNW	11,59	2,565	14,14	10,29
11-NNW	12,59	2,589	14,28	11,18
Mean	**10,74**	**2,375**	**100,00**	**9,52**



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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

270,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,48	7,84	6,54	8,97	9,61	11,50	12,09	10,58	12,07	12,40	11,74	11,88	12,58
0		0,49	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0,50	1,49	400	37	31	30	29	26	35	34	40	32	42	30	34
2	1,50	2,49	801	87	91	74	68	44	41	56	89	54	63	77	57
3	2,50	3,49	1323	130	124	173	93	69	120	93	77	101	102	130	111
4	3,50	4,49	2139	214	158	150	144	168	112	107	87	226	272	237	264
5	4,50	5,49	2517	197	204	140	114	210	174	169	103	197	331	353	325
6	5,50	6,49	2871	239	220	168	74	153	170	260	242	271	375	415	284
7	6,50	7,49	3077	206	238	124	96	150	119	296	295	332	457	436	328
8	7,50	8,49	3109	133	73	98	74	202	198	326	366	433	410	438	358
9	8,50	9,49	3076	77	65	97	97	145	135	281	351	436	414	469	509
10	9,50	10,49	3395	118	56	79	67	215	189	251	384	477	484	587	488
11	10,50	11,49	3583	64	20	101	66	261	246	194	344	525	593	628	541
12	11,50	12,49	3902	59	32	124	89	412	258	265	319	668	615	598	463
13	12,50	13,49	3712	48	15	105	111	334	355	242	341	529	526	582	524
14	13,50	14,49	3197	45	18	91	99	272	332	185	246	477	436	500	496
15	14,50	15,49	2964	53	11	116	80	290	312	167	219	448	422	409	437
16	15,50	16,49	2541	54	3	84	64	272	238	127	239	344	383	421	312
17	16,50	17,49	2034	43	2	50	32	187	212	119	244	271	301	312	261
18	17,50	18,49	1600	29	0	22	46	105	173	116	216	235	274	187	197
19	18,50	19,49	1341	16	1	23	38	65	106	77	148	224	212	144	287
20	19,50	20,49	1048	9	1	3	22	35	80	57	114	197	131	114	285
21	20,50	21,49	743	10	1	4	8	17	56	20	79	180	100	77	191
22	21,50	22,49	583	6	1	2	7	18	22	20	79	135	62	69	162
23	22,50	23,49	444	4	2	3	4	10	26	18	54	87	42	60	134
24	23,50	24,49	338	1	6	1	0	14	27	11	47	64	33	63	71
25	24,50	25,49	234	0	0	2	0	13	5	5	26	24	30	76	53
26	25,50	26,49	132	0	3	2	0	2	1	2	25	16	18	30	33
27	26,50	27,49	53	0	1	1	0	0	0	1	7	5	10	16	12
28	27,50	28,49	43	0	5	0	0	0	0	0	0	3	15	12	8
29	28,50	29,49	35	0	5	2	0	0	0	0	0	5	2	17	4
30	29,50	30,49	37	0	4	0	0	0	0	0	0	5	3	17	8
31	30,50	31,49	31	0	3	0	0	0	0	0	0	1	2	21	4
32	31,50	32,49	22	0	0	0	0	0	0	0	0	0	3	16	3
33	32,50	33,49	20	0	0	0	0	0	0	0	0	0	6	10	4
34	33,50	34,49	5	0	0	0	0	0	0	0	0	0	3	2	0
35	34,50	35,49	4	0	0	0	0	0	0	0	0	0	1	3	0
36	35,50	36,49	1	0	0	0	0	0	0	0	0	0	1	0	0
37	36,50	37,49	2	0	0	0	0	0	0	0	0	0	1	1	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Calculated:
29/03/2023 10.08

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

240,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,39	7,79	6,45	9,12	9,42	11,41	12,11	10,56	11,96	12,27	11,62	11,76	12,47
0		0,49	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0,50	1,49	400	37	41	25	33	25	30	33	36	38	32	34	36
2	1,50	2,49	820	90	105	72	70	47	43	55	98	51	56	73	60
3	2,50	3,49	1352	134	132	170	93	95	104	93	75	111	96	141	108
4	3,50	4,49	2095	207	154	150	149	152	103	96	94	227	266	253	244
5	4,50	5,49	2557	193	207	133	141	201	177	164	107	193	353	350	338
6	5,50	6,49	2905	255	217	170	77	165	168	250	249	259	395	415	285
7	6,50	7,49	3180	191	239	128	102	162	130	314	331	340	477	442	324
8	7,50	8,49	3086	119	79	92	71	193	191	308	369	440	410	445	369
9	8,50	9,49	3133	86	61	93	109	176	158	276	352	433	425	480	484
10	9,50	10,49	3425	113	55	77	83	197	177	252	367	499	499	595	511
11	10,50	11,49	3717	76	33	103	57	294	247	221	355	576	605	637	513
12	11,50	12,49	3901	62	21	130	105	383	234	273	326	644	625	608	490
13	12,50	13,49	3694	45	16	100	103	327	388	227	351	507	516	564	550
14	13,50	14,49	3277	48	18	94	100	287	386	193	237	507	431	486	490
15	14,50	15,49	2913	53	9	132	89	289	295	138	239	425	441	399	404
16	15,50	16,49	2518	59	3	80	48	276	230	126	250	360	374	411	301
17	16,50	17,49	2089	42	2	49	42	189	218	125	260	270	305	315	272
18	17,50	18,49	1566	18	1	32	45	97	175	114	220	236	241	185	202
19	18,50	19,49	1268	14	1	22	36	64	108	73	127	209	199	143	272
20	19,50	20,49	1046	10	2	6	18	41	69	51	120	200	134	113	282
21	20,50	21,49	712	11	0	4	9	13	52	27	80	177	83	72	184
22	21,50	22,49	533	4	3	4	7	17	30	15	86	106	53	64	144
23	22,50	23,49	424	2	4	3	0	11	21	21	53	86	39	65	119
24	23,50	24,49	310	0	1	1	0	8	21	10	41	44	29	76	79
25	24,50	25,49	207	0	3	2	0	11	5	4	31	22	28	55	46
26	25,50	26,49	84	0	4	1	0	1	1	0	8	6	20	21	22
27	26,50	27,49	50	0	3	2	0	0	0	0	2	3	14	14	12
28	27,50	28,49	41	0	6	1	0	0	0	0	0	7	6	14	7
29	28,50	29,49	34	0	2	0	0	0	0	0	0	5	1	20	6
30	29,50	30,49	36	0	4	0	0	0	0	0	0	4	1	20	7
31	30,50	31,49	27	0	2	0	0	0	0	0	0	0	4	16	5
32	31,50	32,49	14	0	0	0	0	0	0	0	0	0	2	10	2
33	32,50	33,49	18	0	0	0	0	0	0	0	0	0	7	11	0
34	33,50	34,49	3	0	0	0	0	0	0	0	0	0	1	2	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	3	0	0	0	0	0	0	0	0	0	1	2	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Calculated:
29/03/2023 10.08

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

200,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,24	7,69	6,42	9,09	9,28	11,41	11,98	10,50	11,79	12,05	11,41	11,57	12,35
0		0,49	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0,50	1,49	396	46	35	18	28	34	24	33	39	39	33	36	31
2	1,50	2,49	834	91	109	81	72	41	38	63	97	41	64	71	66
3	2,50	3,49	1363	137	130	169	89	106	101	96	80	114	91	154	96
4	3,50	4,49	2169	206	166	150	186	145	110	88	87	229	290	266	246
5	4,50	5,49	2552	205	222	140	133	196	174	149	131	195	326	344	337
6	5,50	6,49	3014	244	211	165	104	168	158	274	250	295	418	424	303
7	6,50	7,49	3264	203	253	131	107	175	134	304	343	355	501	438	320
8	7,50	8,49	3115	100	74	92	81	186	200	336	350	445	417	432	402
9	8,50	9,49	3208	95	59	93	118	181	162	261	375	434	439	506	485
10	9,50	10,49	3462	105	50	78	81	225	200	250	338	495	515	620	505
11	10,50	11,49	3763	69	32	110	72	303	229	268	344	579	616	633	508
12	11,50	12,49	4026	60	19	129	119	419	239	285	351	662	635	603	505
13	12,50	13,49	3617	42	18	98	104	303	378	205	313	536	499	596	525
14	13,50	14,49	3412	42	17	96	105	306	445	186	282	515	473	473	472
15	14,50	15,49	2942	57	11	142	80	314	293	139	269	444	405	392	396
16	15,50	16,49	2497	57	2	72	61	300	213	124	267	305	371	427	298
17	16,50	17,49	2042	38	3	42	46	178	225	150	225	286	310	291	248
18	17,50	18,49	1505	19	0	45	35	97	152	106	208	219	214	169	241
19	18,50	19,49	1243	11	2	16	25	59	102	74	139	213	184	129	289
20	19,50	20,49	914	10	1	3	20	30	55	45	92	192	98	94	274
21	20,50	21,49	674	12	1	5	14	21	37	20	100	152	73	73	166
22	21,50	22,49	465	2	3	2	3	15	27	24	65	97	38	67	122
23	22,50	23,49	414	4	1	4	0	11	24	16	56	73	48	73	104
24	23,50	24,49	270	1	3	2	0	15	7	6	33	23	38	66	76
25	24,50	25,49	117	0	2	2	0	8	3	1	10	8	20	29	34
26	25,50	26,49	58	0	4	1	0	2	0	1	0	5	13	13	19
27	26,50	27,49	37	1	4	0	0	0	0	0	0	5	3	13	11
28	27,50	28,49	43	0	7	0	0	0	0	0	0	8	4	18	6
29	28,50	29,49	28	0	5	0	0	0	0	0	0	1	0	14	8
30	29,50	30,49	25	0	1	0	0	0	0	0	0	0	3	17	4
31	30,50	31,49	20	0	1	0	0	0	0	0	0	0	3	13	3
32	31,50	32,49	17	0	0	0	0	0	0	0	0	0	3	11	3
33	32,50	33,49	9	0	0	0	0	0	0	0	0	0	3	6	0
34	33,50	34,49	4	0	0	0	0	0	0	0	0	0	1	3	0
35	34,50	35,49	1	0	0	0	0	0	0	0	0	0	1	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Calculated:
29/03/2023 10.08

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

180,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,14	7,68	6,40	9,12	9,31	11,39	11,82	10,50	11,64	11,90	11,27	11,49	12,24
0		0,49	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0,50	1,49	406	49	32	25	30	29	29	32	36	40	27	42	35
2	1,50	2,49	868	99	118	75	64	41	49	62	88	53	62	75	82
3	2,50	3,49	1342	134	122	166	96	86	102	85	90	110	96	151	104
4	3,50	4,49	2219	204	181	141	196	167	115	95	78	238	292	269	243
5	4,50	5,49	2556	196	207	147	125	182	174	146	146	201	339	343	350
6	5,50	6,49	3050	265	201	185	105	168	165	275	256	273	429	428	300
7	6,50	7,49	3308	202	255	140	106	165	138	309	352	373	502	443	323
8	7,50	8,49	3155	96	72	81	94	201	189	369	341	459	410	434	409
9	8,50	9,49	3266	101	61	94	123	183	192	260	393	433	447	507	472
10	9,50	10,49	3515	96	42	87	84	230	182	255	346	499	514	644	536
11	10,50	11,49	3902	73	35	111	91	314	238	286	344	643	645	627	495
12	11,50	12,49	4064	55	20	126	109	419	264	301	371	605	654	612	528
13	12,50	13,49	3630	41	17	111	110	319	380	212	304	565	463	594	514
14	13,50	14,49	3464	43	19	100	104	313	434	176	301	543	494	462	475
15	14,50	15,49	2937	54	9	145	80	359	269	140	287	406	390	406	392
16	15,50	16,49	2475	58	6	76	64	289	205	148	263	310	360	409	287
17	16,50	17,49	1973	47	2	48	51	144	222	148	227	266	297	283	238
18	17,50	18,49	1495	18	0	38	38	93	142	113	188	250	228	156	231
19	18,50	19,49	1183	9	1	16	33	62	87	70	121	186	157	125	316
20	19,50	20,49	861	17	1	4	14	18	52	41	89	196	97	79	253
21	20,50	21,49	577	8	0	4	12	20	37	21	91	107	49	86	142
22	21,50	22,49	526	4	2	6	4	12	38	20	63	112	52	73	140
23	22,50	23,49	354	4	1	1	0	17	15	12	56	48	34	70	96
24	23,50	24,49	208	0	3	2	0	10	5	5	15	14	32	60	62
25	24,50	25,49	100	0	4	1	0	9	4	1	1	6	13	28	33
26	25,50	26,49	35	0	1	0	0	0	0	0	0	2	7	9	16
27	26,50	27,49	49	0	7	1	0	0	0	0	0	6	3	18	14
28	27,50	28,49	30	0	6	0	0	0	0	0	0	6	1	12	5
29	28,50	29,49	24	0	3	0	0	0	0	0	0	1	1	9	10
30	29,50	30,49	36	0	4	1	0	0	0	0	0	0	4	23	4
31	30,50	31,49	23	0	0	0	0	0	0	0	0	0	2	19	2
32	31,50	32,49	11	0	0	0	0	0	0	0	0	0	5	4	2
33	32,50	33,49	7	0	0	0	0	0	0	0	0	0	2	5	0
34	33,50	34,49	1	0	0	0	0	0	0	0	0	0	0	1	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Calculated:
29/03/2023 10.08

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

150,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,96	7,53	6,31	9,15	9,29	11,29	11,61	10,27	11,55	11,59	11,06	11,31	12,11
0		0,49	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0,50	1,49	392	44	38	21	33	27	23	29	33	41	32	40	31
2	1,50	2,49	900	108	123	70	60	47	54	73	80	55	58	92	80
3	2,50	3,49	1349	131	140	161	84	90	100	79	84	123	95	148	114
4	3,50	4,49	2304	201	173	162	194	168	106	104	93	255	318	292	238
5	4,50	5,49	2586	206	210	156	144	171	162	165	144	200	338	343	347
6	5,50	6,49	3107	268	203	182	120	199	154	277	254	287	431	431	301
7	6,50	7,49	3404	212	256	140	101	159	162	362	334	376	513	448	341
8	7,50	8,49	3223	93	69	83	107	200	205	371	352	474	413	453	403
9	8,50	9,49	3333	100	56	101	125	187	183	291	375	442	458	556	459
10	9,50	10,49	3575	90	42	97	84	217	193	274	361	520	538	609	550
11	10,50	11,49	4105	77	39	113	93	353	244	320	358	666	666	660	516
12	11,50	12,49	4236	43	20	124	123	430	336	309	399	624	612	654	562
13	12,50	13,49	3827	41	17	120	115	360	449	210	339	612	514	585	465
14	13,50	14,49	3350	43	26	120	112	321	367	147	328	511	478	450	447
15	14,50	15,49	2815	51	8	137	65	385	194	158	293	366	394	391	373
16	15,50	16,49	2469	58	7	77	90	290	187	161	283	268	389	389	270
17	16,50	17,49	1881	37	0	47	36	133	191	146	243	278	256	253	261
18	17,50	18,49	1421	23	1	34	40	77	123	116	169	203	202	171	262
19	18,50	19,49	1037	6	1	15	27	43	91	41	108	196	122	106	281
20	19,50	20,49	770	15	1	2	18	17	43	19	94	168	72	77	244
21	20,50	21,49	565	6	1	7	9	17	39	34	65	109	48	77	153
22	21,50	22,49	451	5	3	4	2	14	28	12	64	74	53	80	112
23	22,50	23,49	272	1	0	0	0	16	13	8	26	20	36	74	78
24	23,50	24,49	141	0	5	2	0	9	6	2	7	4	14	39	53
25	24,50	25,49	59	0	2	1	0	5	0	1	0	7	3	15	25
26	25,50	26,49	47	0	2	3	0	0	0	0	0	3	3	20	16
27	26,50	27,49	37	0	2	1	0	0	0	0	0	7	1	13	13
28	27,50	28,49	25	0	4	2	0	0	0	0	0	1	0	9	9
29	28,50	29,49	33	0	6	0	0	0	0	0	0	0	1	22	4
30	29,50	30,49	26	0	3	0	0	0	0	0	0	0	4	15	4
31	30,50	31,49	20	0	0	0	0	0	0	0	0	0	3	15	2
32	31,50	32,49	8	0	0	0	0	0	0	0	0	0	4	4	0
33	32,50	33,49	3	0	0	0	0	0	0	0	0	0	2	1	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Calculated:
29/03/2023 10.08

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

120,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,74	7,56	6,30	9,04	9,35	11,12	11,25	9,97	11,36	11,21	10,79	11,15	11,91
0		0,49	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0,50	1,49	399	46	39	26	22	24	19	32	33	47	37	39	35
2	1,50	2,49	911	93	132	80	57	43	59	70	77	64	56	91	89
3	2,50	3,49	1434	129	158	151	89	93	102	90	81	148	110	160	123
4	3,50	4,49	2277	195	172	155	171	188	96	124	93	245	314	289	235
5	4,50	5,49	2702	226	213	174	157	204	154	177	161	204	344	333	355
6	5,50	6,49	3240	285	193	176	149	165	158	287	271	294	484	433	345
7	6,50	7,49	3423	182	243	157	95	182	198	345	306	415	506	458	336
8	7,50	8,49	3297	97	67	117	99	200	220	430	333	488	409	434	403
9	8,50	9,49	3489	107	57	95	146	178	215	318	388	430	497	566	492
10	9,50	10,49	3922	90	47	107	99	249	232	285	384	613	598	648	570
11	10,50	11,49	4186	66	30	123	108	382	274	364	386	657	667	657	472
12	11,50	12,49	4560	45	24	131	108	483	465	266	456	724	615	659	584
13	12,50	13,49	3786	34	24	138	134	369	422	182	362	599	467	582	473
14	13,50	14,49	3141	54	33	121	98	359	258	163	338	428	453	434	402
15	14,50	15,49	2778	63	4	107	107	332	157	171	306	337	434	401	359
16	15,50	16,49	2298	59	6	92	76	266	152	166	268	276	332	349	256
17	16,50	17,49	1752	31	1	46	41	130	167	143	209	202	258	238	286
18	17,50	18,49	1307	15	1	24	40	60	128	65	162	208	163	162	279
19	18,50	19,49	919	14	0	6	28	23	65	33	91	196	92	96	275
20	19,50	20,49	655	9	2	5	6	14	47	18	77	121	70	73	213
21	20,50	21,49	529	7	2	8	8	21	36	23	70	94	45	76	139
22	21,50	22,49	334	5	0	1	1	21	10	12	33	26	35	84	106
23	22,50	23,49	204	0	3	4	2	13	10	1	18	4	24	50	75
24	23,50	24,49	108	0	3	3	0	8	6	2	4	2	8	27	45
25	24,50	25,49	60	0	6	1	0	3	0	0	0	7	6	14	23
26	25,50	26,49	30	0	3	0	0	0	0	0	0	6	0	12	9
27	26,50	27,49	28	0	3	2	0	0	0	0	0	0	0	10	13
28	27,50	28,49	31	0	4	0	0	0	0	0	0	1	2	19	5
29	28,50	29,49	34	0	6	1	0	0	0	0	0	0	4	17	6
30	29,50	30,49	32	0	0	0	0	0	0	0	0	0	4	25	3
31	30,50	31,49	3	0	0	0	0	0	0	0	0	0	0	3	0
32	31,50	32,49	3	0	0	0	0	0	0	0	0	0	2	1	0
33	32,50	33,49	2	0	0	0	0	0	0	0	0	0	1	1	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Calculated:
29/03/2023 10.08

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

100,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,55	7,45	6,23	9,06	9,17	10,98	10,88	9,78	11,14	10,95	10,58	11,00	11,82
0		0,49	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0,50	1,49	387	50	38	15	24	20	18	28	36	46	36	43	33
2	1,50	2,49	946	100	145	89	53	46	50	78	75	68	53	105	84
3	2,50	3,49	1456	135	155	131	85	96	113	93	70	159	119	162	138
4	3,50	4,49	2376	207	199	157	181	184	102	133	109	254	331	292	227
5	4,50	5,49	2749	216	197	171	162	209	173	179	176	202	361	345	358
6	5,50	6,49	3314	274	211	185	163	178	173	283	266	320	504	424	333
7	6,50	7,49	3512	215	242	154	106	188	193	367	331	397	502	471	346
8	7,50	8,49	3468	96	68	115	129	196	263	448	320	500	426	465	442
9	8,50	9,49	3542	96	52	99	128	198	229	322	414	465	494	565	480
10	9,50	10,49	4082	104	52	118	119	275	256	295	401	630	631	659	542
11	10,50	11,49	4636	69	32	130	112	424	391	390	463	737	674	690	524
12	11,50	12,49	4538	32	22	148	113	503	497	220	478	717	615	636	557
13	12,50	13,49	3618	39	34	141	144	367	318	177	379	514	492	565	448
14	13,50	14,49	3067	41	30	122	109	361	187	178	326	439	462	427	385
15	14,50	15,49	2719	74	4	121	98	333	153	177	300	281	402	419	357
16	15,50	16,49	2131	56	5	72	64	227	150	166	228	271	300	323	269
17	16,50	17,49	1654	34	2	32	32	109	156	122	210	208	228	243	278
18	17,50	18,49	1089	13	0	26	29	46	102	37	125	193	126	111	281
19	18,50	19,49	830	10	0	4	20	23	48	24	84	160	92	91	274
20	19,50	20,49	640	7	3	10	8	15	49	19	76	125	43	85	200
21	20,50	21,49	462	8	1	4	8	21	29	22	55	50	54	75	135
22	21,50	22,49	297	5	2	4	3	18	8	8	29	13	27	77	103
23	22,50	23,49	156	0	3	2	0	15	7	1	7	1	9	42	69
24	23,50	24,49	77	0	3	4	0	9	5	2	0	5	5	22	22
25	24,50	25,49	59	0	4	1	0	0	0	0	0	6	6	18	24
26	25,50	26,49	19	0	2	2	0	0	0	0	0	2	0	3	10
27	26,50	27,49	39	0	3	0	0	0	0	0	0	1	0	20	15
28	27,50	28,49	40	0	5	1	0	0	0	0	0	0	5	18	11
29	28,50	29,49	27	0	4	0	0	0	0	0	0	0	3	19	1
30	29,50	30,49	16	0	0	0	0	0	0	0	0	0	3	12	1
31	30,50	31,49	4	0	0	0	0	0	0	0	0	0	0	4	0
32	31,50	32,49	2	0	0	0	0	0	0	0	0	0	1	1	0
33	32,50	33,49	1	0	0	0	0	0	0	0	0	0	1	0	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Calculated:
29/03/2023 10.08

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

90,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,42	7,33	6,31	8,91	9,01	10,83	10,68	9,70	10,94	10,82	10,43	10,95	11,70
0		0,49	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0,50	1,49	407	49	43	25	21	19	21	36	27	40	41	45	40
2	1,50	2,49	950	96	147	94	56	44	50	72	77	72	57	102	83
3	2,50	3,49	1500	135	151	134	86	96	113	100	72	162	136	169	146
4	3,50	4,49	2381	224	201	164	188	185	105	123	115	242	316	284	234
5	4,50	5,49	2884	225	202	163	174	219	174	198	184	228	408	335	374
6	5,50	6,49	3471	278	228	182	144	186	181	321	316	335	524	431	345
7	6,50	7,49	3641	196	228	169	121	227	219	388	321	421	501	490	360
8	7,50	8,49	3598	101	80	121	141	230	291	435	332	523	439	454	451
9	8,50	9,49	3715	92	59	115	122	192	271	321	448	488	512	607	488
10	9,50	10,49	4201	107	51	118	127	225	286	322	432	681	622	703	527
11	10,50	11,49	4748	55	37	137	96	465	462	394	478	750	696	646	532
12	11,50	12,49	4495	39	24	150	133	481	476	203	490	675	626	645	553
13	12,50	13,49	3473	42	34	139	120	349	252	186	369	504	464	553	461
14	13,50	14,49	3050	50	30	117	125	364	178	188	334	381	479	429	375
15	14,50	15,49	2659	62	6	124	82	325	138	187	270	297	380	414	374
16	15,50	16,49	2053	53	4	56	42	202	141	161	233	266	290	339	266
17	16,50	17,49	1574	21	1	36	37	98	155	107	187	201	218	236	277
18	17,50	18,49	1050	14	0	21	25	51	93	37	115	189	116	100	289
19	18,50	19,49	814	9	0	11	20	23	46	24	70	163	74	89	285
20	19,50	20,49	596	9	0	9	6	13	49	21	76	111	52	84	166
21	20,50	21,49	431	7	2	3	10	20	20	22	44	36	49	83	135
22	21,50	22,49	262	4	2	3	2	16	10	6	24	9	15	65	106
23	22,50	23,49	143	0	3	1	0	11	12	0	4	2	14	41	55
24	23,50	24,49	85	0	5	3	0	7	3	1	1	10	5	16	34
25	24,50	25,49	47	0	5	0	0	2	1	0	0	4	2	15	18
26	25,50	26,49	25	0	3	1	0	0	0	0	0	1	1	10	9
27	26,50	27,49	36	0	5	0	0	0	0	0	0	0	3	19	9
28	27,50	28,49	32	0	5	0	0	0	0	0	0	0	3	18	6
29	28,50	29,49	31	0	4	0	0	0	0	0	0	0	4	20	3
30	29,50	30,49	11	0	0	0	0	0	0	0	0	0	0	10	1
31	30,50	31,49	1	0	0	0	0	0	0	0	0	0	1	0	0
32	31,50	32,49	2	0	0	0	0	0	0	0	0	0	0	2	0
33	32,50	33,49	1	0	0	0	0	0	0	0	0	0	1	0	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Calculated:
29/03/2023 10.08

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

60,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,04	7,31	6,28	8,48	8,72	10,43	10,02	9,32	10,41	10,32	9,99	10,76	11,40
0		0,49	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0,50	1,49	429	45	43	18	30	20	15	35	36	42	46	44	55
2	1,50	2,49	998	95	148	101	48	45	62	75	75	73	79	104	93
3	2,50	3,49	1612	154	178	152	72	98	132	90	79	183	167	151	156
4	3,50	4,49	2478	221	199	169	199	203	107	125	119	246	352	280	258
5	4,50	5,49	3062	223	203	149	189	222	208	213	248	267	433	351	356
6	5,50	6,49	3645	302	238	232	142	219	195	314	308	357	550	435	353
7	6,50	7,49	3985	183	235	161	136	247	300	523	357	466	528	476	373
8	7,50	8,49	4055	106	59	146	182	273	336	418	433	573	523	514	492
9	8,50	9,49	4113	100	61	118	150	212	308	361	516	632	538	637	480
10	9,50	10,49	4736	96	63	158	111	303	496	395	516	744	647	664	543
11	10,50	11,49	4851	53	35	182	118	569	460	220	545	750	683	683	553
12	11,50	12,49	4048	38	35	168	125	416	262	200	425	554	609	637	579
13	12,50	13,49	3158	46	46	135	135	324	193	177	319	413	468	506	396
14	13,50	14,49	2907	62	21	101	86	327	140	226	324	344	441	424	411
15	14,50	15,49	2305	62	5	59	66	283	96	172	232	278	334	389	329
16	15,50	16,49	1832	45	3	36	29	143	130	133	233	226	264	329	261
17	16,50	17,49	1287	26	2	27	36	90	133	46	116	201	163	165	282
18	17,50	18,49	927	14	0	14	20	39	60	27	71	182	99	110	291
19	18,50	19,49	698	12	1	5	17	13	45	14	79	116	50	94	252
20	19,50	20,49	496	7	2	8	7	16	38	26	52	43	44	93	160
21	20,50	21,49	322	8	1	3	10	18	19	12	28	15	22	75	111
22	21,50	22,49	184	1	3	1	0	13	6	3	10	5	11	57	74
23	22,50	23,49	112	0	2	3	0	14	8	1	0	8	7	21	48
24	23,50	24,49	40	0	4	0	0	3	1	0	0	2	3	10	17
25	24,50	25,49	36	0	6	1	0	0	0	0	0	1	0	15	13
26	25,50	26,49	39	0	8	0	0	0	0	0	0	0	5	16	10
27	26,50	27,49	34	0	4	0	0	0	0	0	0	0	4	22	4
28	27,50	28,49	32	0	4	0	0	0	0	0	0	0	2	20	6
29	28,50	29,49	7	0	0	0	0	0	0	0	0	0	1	6	0
30	29,50	30,49	4	0	0	0	0	0	0	0	0	0	1	2	1
31	30,50	31,49	0	0	0	0	0	0	0	0	0	0	0	0	0
32	31,50	32,49	0	0	0	0	0	0	0	0	0	0	0	0	0
33	32,50	33,49	0	0	0	0	0	0	0	0	0	0	0	0	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Calculated:
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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

40,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			9,67	7,23	6,11	8,05	8,39	10,03	9,52	8,94	9,89	9,88	9,68	10,47	11,11
0		0,49	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0,50	1,49	479	45	50	30	28	16	18	35	44	47	46	63	57
2	1,50	2,49	1028	95	151	95	50	46	69	73	83	88	82	107	89
3	2,50	3,49	1761	163	190	170	87	127	131	92	84	204	174	156	183
4	3,50	4,49	2622	233	201	159	215	189	110	129	135	277	397	309	268
5	4,50	5,49	3316	216	229	199	202	257	223	245	305	290	451	341	358
6	5,50	6,49	3924	285	268	221	132	243	271	400	342	376	573	466	347
7	6,50	7,49	4271	186	204	179	179	298	341	531	386	538	555	503	371
8	7,50	8,49	4448	92	60	171	209	314	371	448	530	634	559	560	500
9	8,50	9,49	4522	100	73	152	149	247	431	354	572	722	535	656	531
10	9,50	10,49	4914	89	46	173	117	407	493	313	601	773	691	652	559
11	10,50	11,49	4606	58	45	188	143	536	314	197	483	628	696	743	575
12	11,50	12,49	3658	38	35	161	117	372	188	202	367	505	560	583	530
13	12,50	13,49	3034	41	42	79	108	316	134	211	314	366	492	489	442
14	13,50	14,49	2550	72	15	75	81	277	105	182	244	313	399	428	359
15	14,50	15,49	2251	69	4	39	45	252	109	155	248	286	319	412	313
16	15,50	16,49	1563	44	1	31	42	128	138	74	162	217	199	233	294
17	16,50	17,49	1121	17	0	24	25	56	102	39	92	189	125	161	291
18	17,50	18,49	814	10	0	9	19	21	55	21	65	124	77	110	303
19	18,50	19,49	613	13	1	4	11	14	44	27	71	73	43	93	219
20	19,50	20,49	380	8	2	8	8	19	23	13	35	19	25	98	122
21	20,50	21,49	205	2	5	1	1	18	15	4	7	6	16	52	78
22	21,50	22,49	119	0	1	2	2	17	6	0	4	7	8	21	51
23	22,50	23,49	67	2	3	2	0	7	3	0	0	1	2	16	31
24	23,50	24,49	35	0	6	0	0	0	0	0	0	1	1	16	11
25	24,50	25,49	47	0	5	1	0	0	0	0	0	0	6	24	11
26	25,50	26,49	38	0	8	0	0	0	0	0	0	0	2	23	5
27	26,50	27,49	22	0	3	0	0	0	0	0	0	0	4	14	1
28	27,50	28,49	8	0	1	0	0	0	0	0	0	0	1	5	1
29	28,50	29,49	4	0	0	0	0	0	0	0	0	0	0	4	0
30	29,50	30,49	0	0	0	0	0	0	0	0	0	0	0	0	0
31	30,50	31,49	0	0	0	0	0	0	0	0	0	0	0	0	0
32	31,50	32,49	0	0	0	0	0	0	0	0	0	0	0	0	0
33	32,50	33,49	0	0	0	0	0	0	0	0	0	0	0	0	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Frequency distribution (TAB file data)

30,00m - Subst

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			9,45	6,99	6,07	7,79	8,13	9,79	9,21	8,72	9,59	9,63	9,49	10,26	10,96
0		0,49	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0,50	1,49	503	51	45	36	28	19	33	30	45	53	47	65	51
2	1,50	2,49	1044	103	146	95	53	43	83	73	86	86	77	104	95
3	2,50	3,49	1890	175	195	184	97	146	117	101	89	221	213	174	178
4	3,50	4,49	2739	229	209	159	234	204	127	132	171	289	384	314	287
5	4,50	5,49	3518	225	221	224	200	270	267	261	327	313	500	356	354
6	5,50	6,49	4102	294	280	205	149	256	322	468	358	395	556	476	343
7	6,50	7,49	4456	180	181	199	236	312	363	506	448	582	567	497	385
8	7,50	8,49	4646	92	75	190	187	297	405	463	565	690	581	568	533
9	8,50	9,49	4689	108	55	171	130	276	475	342	647	746	534	642	563
10	9,50	10,49	4974	77	65	161	152	457	449	261	525	780	740	725	582
11	10,50	11,49	4386	50	39	187	144	499	248	206	426	576	680	740	591
12	11,50	12,49	3464	34	49	106	101	359	146	203	362	458	550	578	518
13	12,50	13,49	2947	55	32	85	93	288	127	187	320	353	491	473	443
14	13,50	14,49	2543	57	7	67	67	287	104	197	242	331	395	437	352
15	14,50	15,49	2044	60	6	29	50	206	128	124	219	258	267	385	312
16	15,50	16,49	1464	41	0	27	25	116	156	64	125	200	196	202	312
17	16,50	17,49	1028	15	0	26	27	40	76	20	91	186	103	116	328
18	17,50	18,49	734	7	0	4	16	13	53	22	71	103	55	114	276
19	18,50	19,49	525	7	0	8	17	17	47	24	50	35	34	105	181
20	19,50	20,49	300	7	5	5	6	16	15	12	19	12	20	63	120
21	20,50	21,49	155	2	1	0	1	22	10	2	4	9	7	40	57
22	21,50	22,49	80	0	3	1	0	13	4	0	0	3	7	13	36
23	22,50	23,49	49	1	4	2	0	2	1	0	0	0	2	13	24
24	23,50	24,49	46	0	9	1	0	0	0	0	0	1	4	20	11
25	24,50	25,49	44	0	6	0	0	0	0	0	0	0	4	26	8
26	25,50	26,49	26	0	3	0	0	0	0	0	0	0	2	20	1
27	26,50	27,49	13	0	2	1	0	0	0	0	0	0	0	8	2
28	27,50	28,49	5	0	0	0	0	0	0	0	0	0	2	3	0
29	28,50	29,49	1	0	0	0	0	0	0	0	0	0	0	1	0
30	29,50	30,49	0	0	0	0	0	0	0	0	0	0	0	0	0
31	30,50	31,49	0	0	0	0	0	0	0	0	0	0	0	0	0
32	31,50	32,49	0	0	0	0	0	0	0	0	0	0	0	0	0
33	32,50	33,49	0	0	0	0	0	0	0	0	0	0	0	0	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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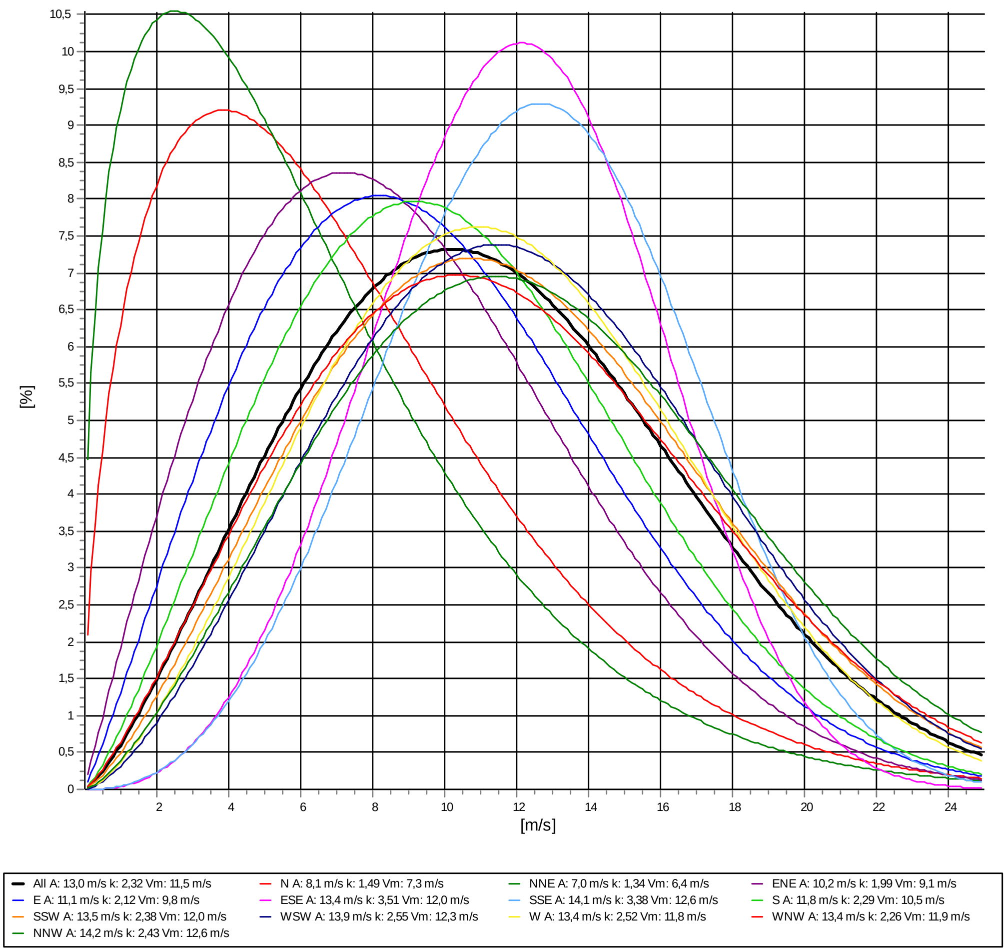
29/03/2023 10.08

Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **270,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,09	1,494	3,66	7,31
1-NNE	6,96	1,344	2,71	6,39
2-ENE	10,24	1,995	3,64	9,08
3-E	11,08	2,116	2,96	9,81
4-ESE	13,37	3,513	7,18	12,03
5-SSE	14,05	3,382	7,29	12,62
6-S	11,82	2,285	6,81	10,47
7-SSW	13,50	2,379	9,31	11,96
8-WSW	13,90	2,551	13,63	12,34
9-W	13,35	2,525	13,97	11,85
10-WNW	13,40	2,260	14,71	11,87
11-NNW	14,21	2,430	14,11	12,60
Mean	**13,02**	**2,321**	**100,00**	**11,53**



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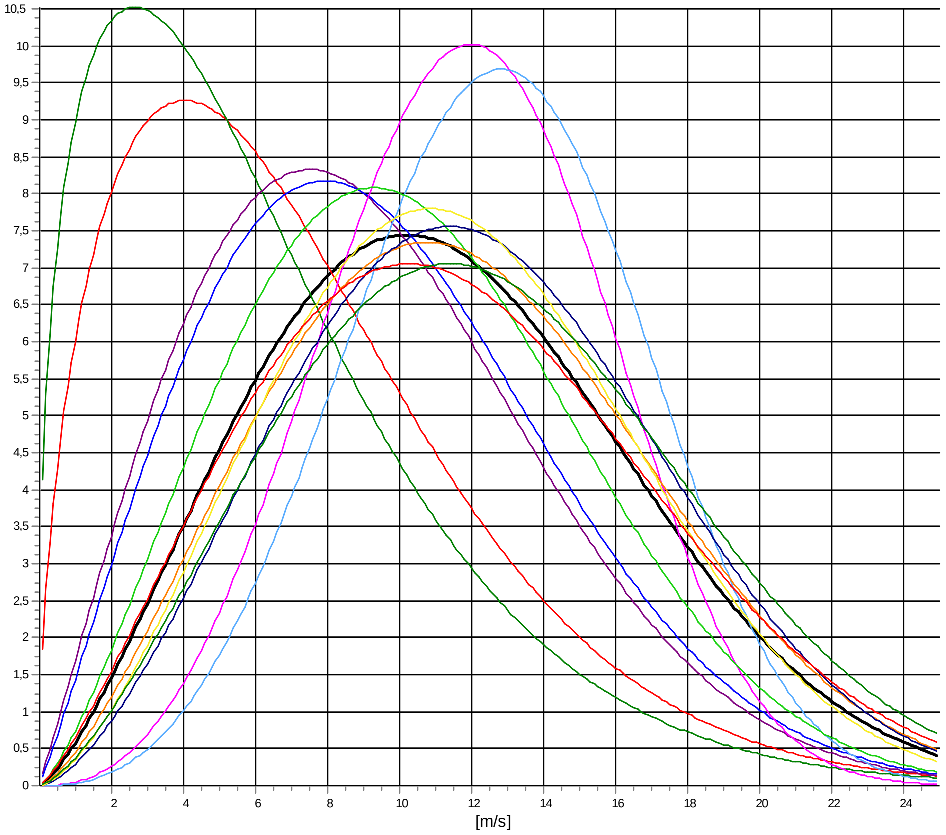
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **240,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,09	1,529	3,63	7,29
1-NNE	6,98	1,366	2,78	6,39
2-ENE	10,45	2,042	3,65	9,26
3-E	10,82	2,092	3,09	9,58
4-ESE	13,23	3,439	7,23	11,90
5-SSE	14,08	3,545	7,31	12,68
6-S	11,83	2,329	6,72	10,48
7-SSW	13,42	2,424	9,46	11,89
8-WSW	13,76	2,591	13,58	12,22
9-W	13,19	2,558	13,94	11,71
10-WNW	13,27	2,263	14,68	11,75
11-NNW	14,10	2,453	13,94	12,51
Mean	**12,92**	**2,348**	**100,00**	**11,45**



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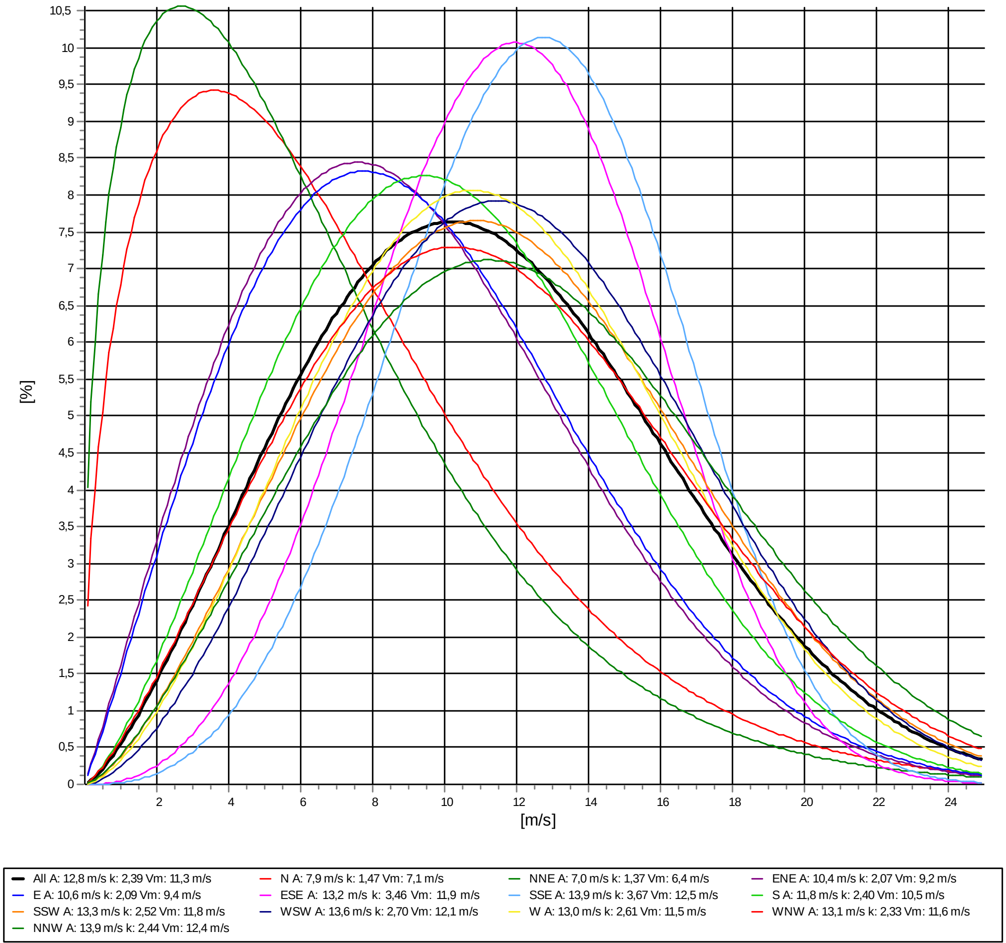
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **200,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,87	1,467	3,60	7,12
1-NNE	6,95	1,375	2,81	6,35
2-ENE	10,40	2,072	3,66	9,22
3-E	10,61	2,089	3,27	9,40
4-ESE	13,23	3,455	7,45	11,89
5-SSE	13,89	3,674	7,24	12,53
6-S	11,82	2,396	6,80	10,48
7-SSW	13,28	2,519	9,40	11,78
8-WSW	13,58	2,702	13,52	12,08
9-W	12,97	2,611	13,88	11,52
10-WNW	13,09	2,326	14,58	11,60
11-NNW	13,94	2,444	13,79	12,36
Mean	**12,77**	**2,391**	**100,00**	**11,32**



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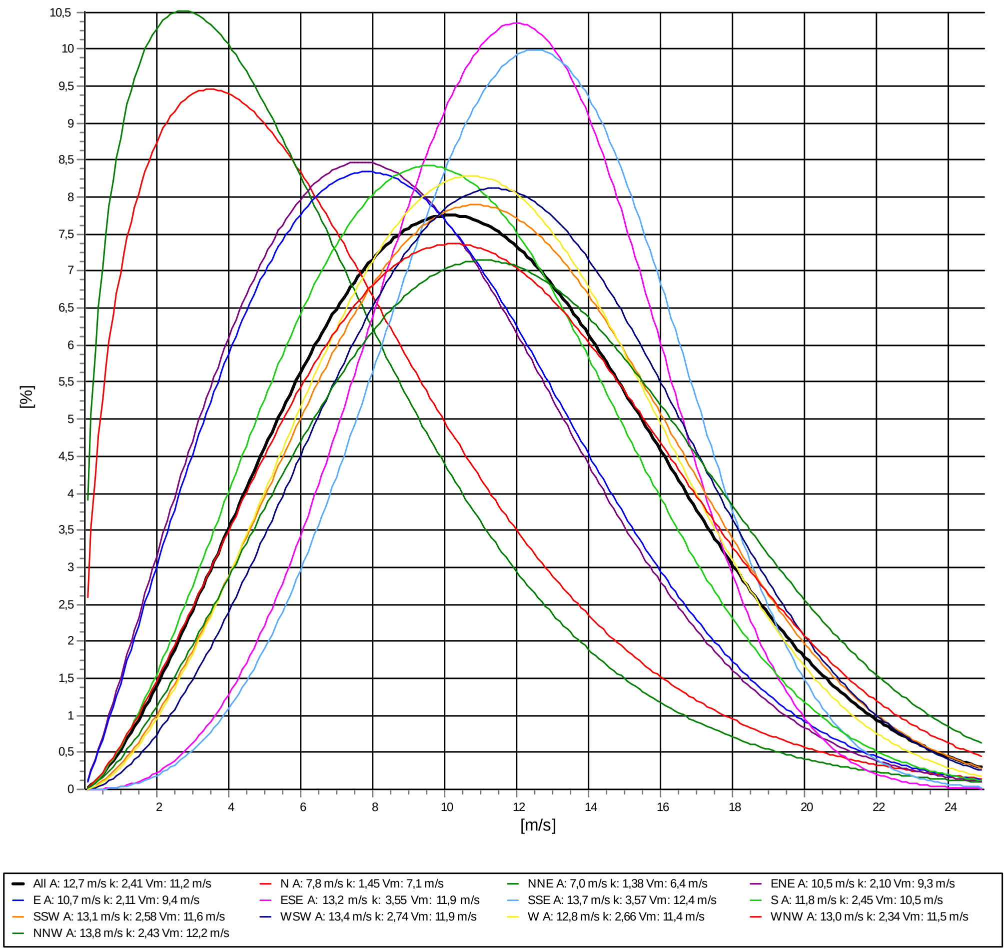
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **180,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,82	1,452	3,63	7,09
1-NNE	6,99	1,381	2,77	6,38
2-ENE	10,47	2,103	3,74	9,27
3-E	10,66	2,110	3,36	9,44
4-ESE	13,17	3,547	7,45	11,86
5-SSE	13,72	3,568	7,22	12,36
6-S	11,81	2,455	6,94	10,48
7-SSW	13,12	2,580	9,38	11,65
8-WSW	13,42	2,744	13,46	11,94
9-W	12,82	2,660	13,76	11,39
10-WNW	13,00	2,336	14,53	11,52
11-NNW	13,81	2,427	13,76	12,24
Mean	**12,66**	**2,413**	**100,00**	**11,23**



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Calculated:
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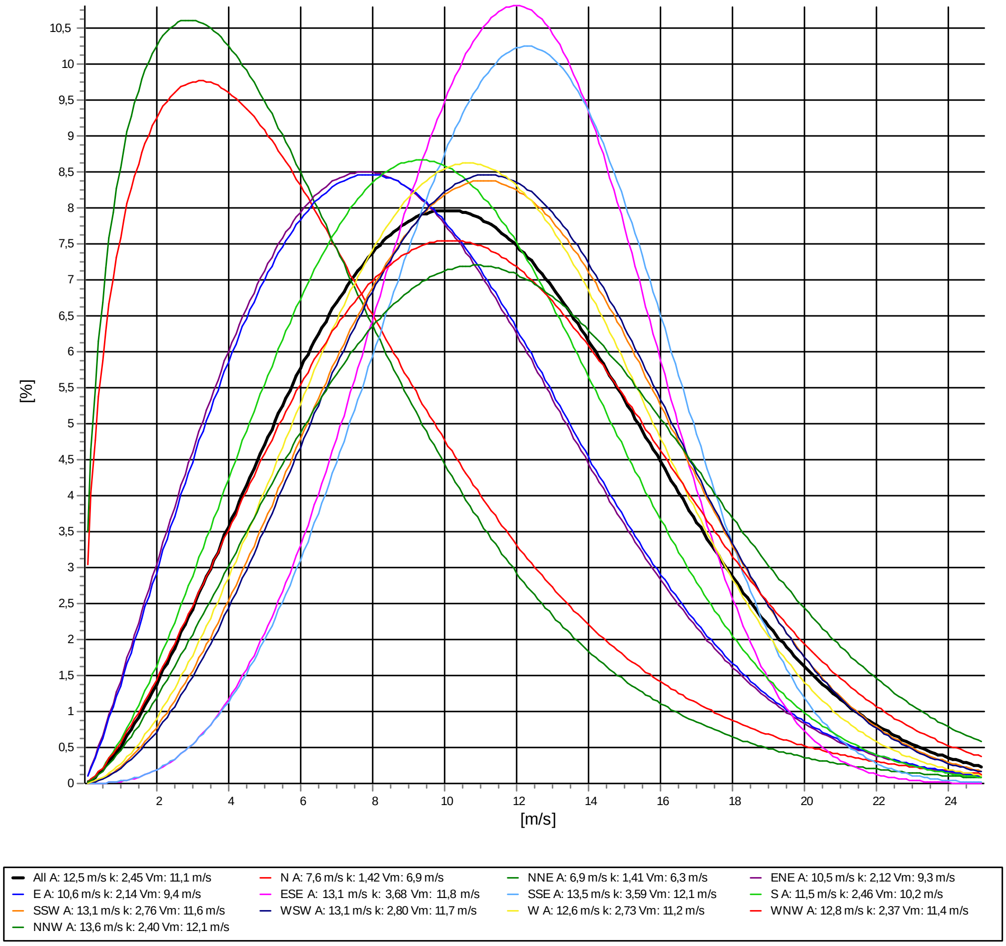
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **150,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,55	1,422	3,59	6,87
1-NNE	6,94	1,414	2,82	6,32
2-ENE	10,52	2,125	3,83	9,31
3-E	10,62	2,140	3,44	9,40
4-ESE	13,06	3,683	7,60	11,78
5-SSE	13,46	3,591	7,06	12,13
6-S	11,52	2,463	7,16	10,22
7-SSW	13,07	2,758	9,44	11,63
8-WSW	13,11	2,802	13,31	11,67
9-W	12,59	2,729	13,66	11,20
10-WNW	12,83	2,367	14,55	11,37
11-NNW	13,60	2,402	13,55	12,06
Mean	**12,47**	**2,447**	**100,00**	**11,06**



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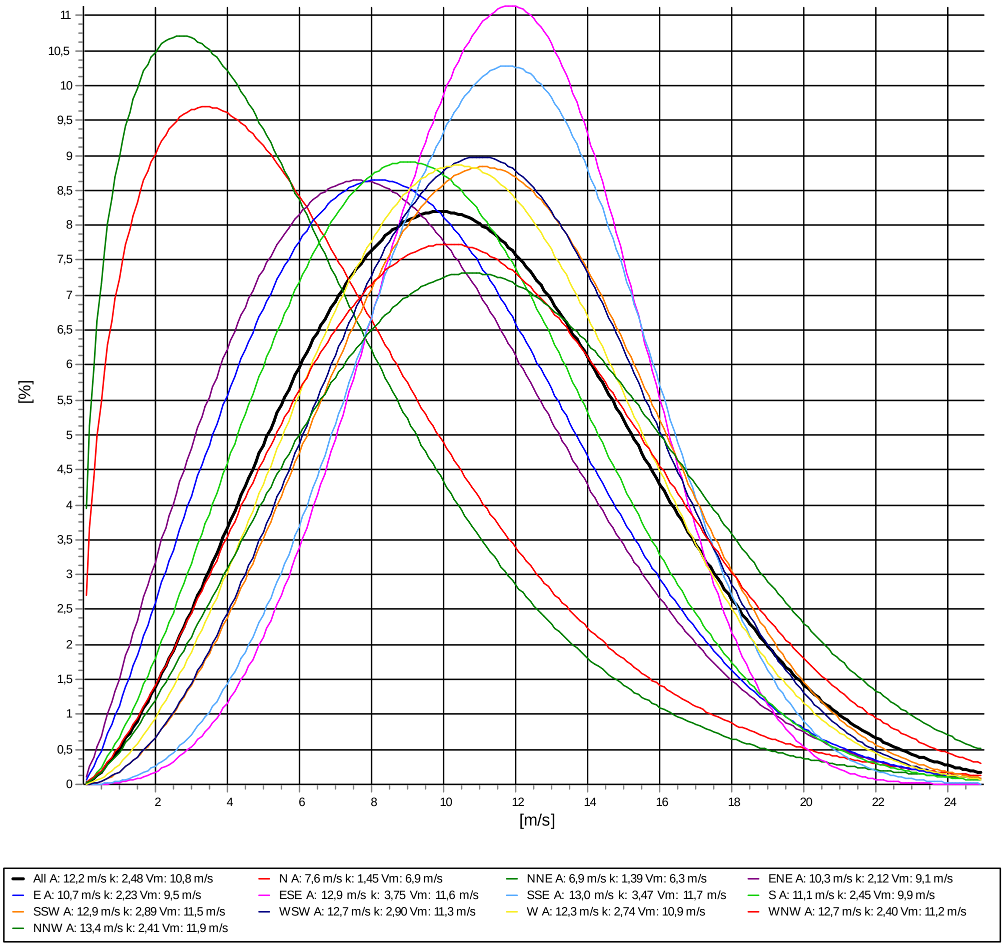
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **120,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,63	1,450	3,57	6,92
1-NNE	6,86	1,386	2,85	6,26
2-ENE	10,32	2,117	3,95	9,14
3-E	10,70	2,230	3,55	9,48
4-ESE	12,87	3,745	7,73	11,62
5-SSE	13,00	3,469	7,04	11,69
6-S	11,15	2,448	7,26	9,89
7-SSW	12,88	2,890	9,46	11,49
8-WSW	12,72	2,902	13,18	11,35
9-W	12,28	2,738	13,57	10,92
10-WNW	12,66	2,403	14,34	11,22
11-NNW	13,42	2,413	13,51	11,90
Mean	**12,22**	**2,476**	**100,00**	**10,84**



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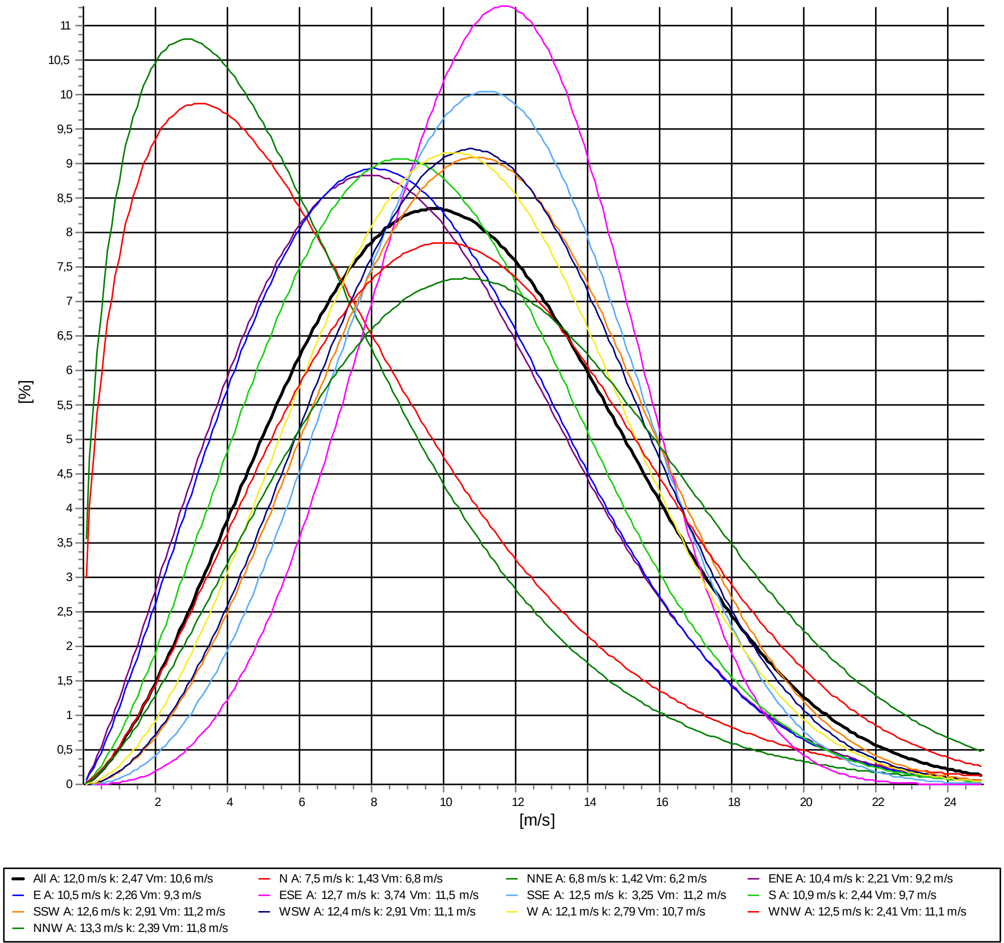
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **100,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,46	1,428	3,62	6,78
1-NNE	6,81	1,416	2,92	6,20
2-ENE	10,41	2,213	3,96	9,22
3-E	10,47	2,264	3,64	9,28
4-ESE	12,68	3,744	7,82	11,45
5-SSE	12,53	3,249	7,06	11,23
6-S	10,92	2,442	7,25	9,68
7-SSW	12,59	2,913	9,54	11,23
8-WSW	12,43	2,912	13,02	11,09
9-W	12,05	2,790	13,48	10,73
10-WNW	12,48	2,409	14,31	11,07
11-NNW	13,28	2,393	13,37	11,78
Mean	**12,00**	**2,474**	**100,00**	**10,64**



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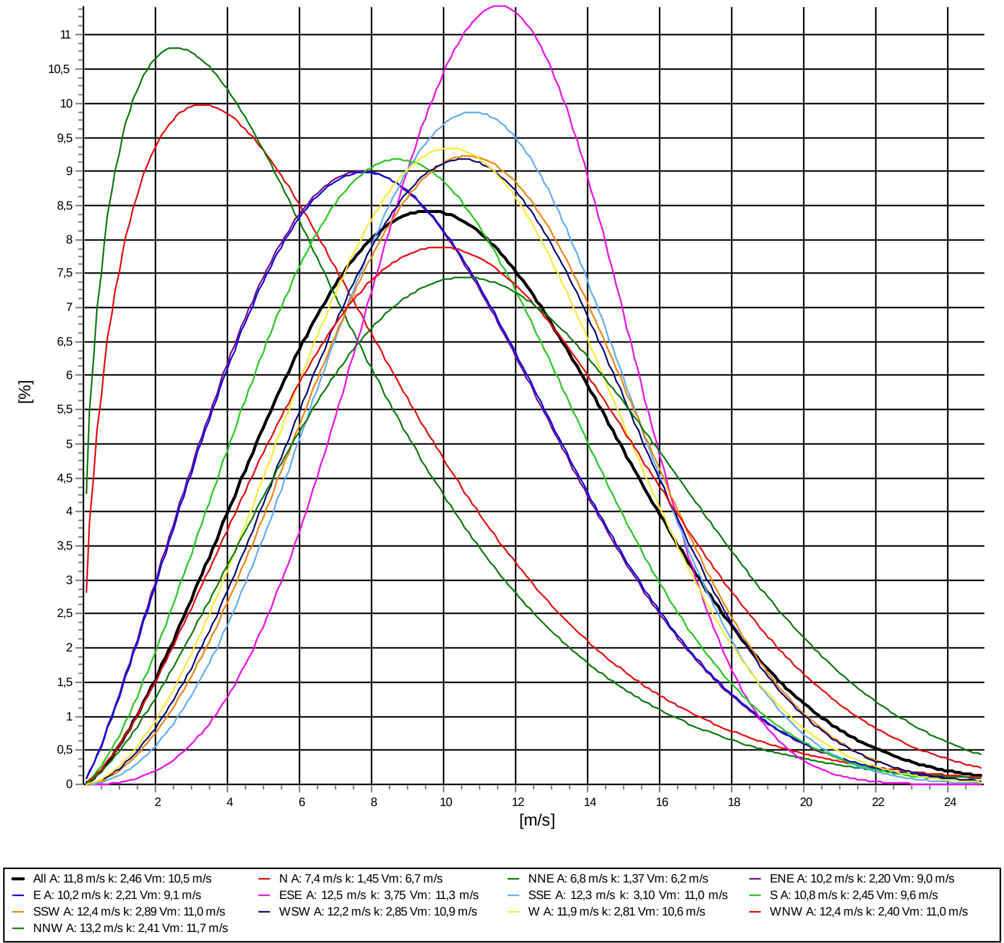
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **90,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,41	1,449	3,57	6,72
1-NNE	6,79	1,367	2,98	6,21
2-ENE	10,19	2,205	4,00	9,03
3-E	10,24	2,213	3,59	9,07
4-ESE	12,54	3,745	7,73	11,32
5-SSE	12,26	3,102	7,16	10,96
6-S	10,83	2,449	7,36	9,60
7-SSW	12,36	2,894	9,58	11,02
8-WSW	12,24	2,845	12,97	10,90
9-W	11,90	2,810	13,46	10,60
10-WNW	12,39	2,398	14,23	10,98
11-NNW	13,19	2,413	13,37	11,69
Mean	**11,84**	**2,460**	**100,00**	**10,50**



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Calculated:
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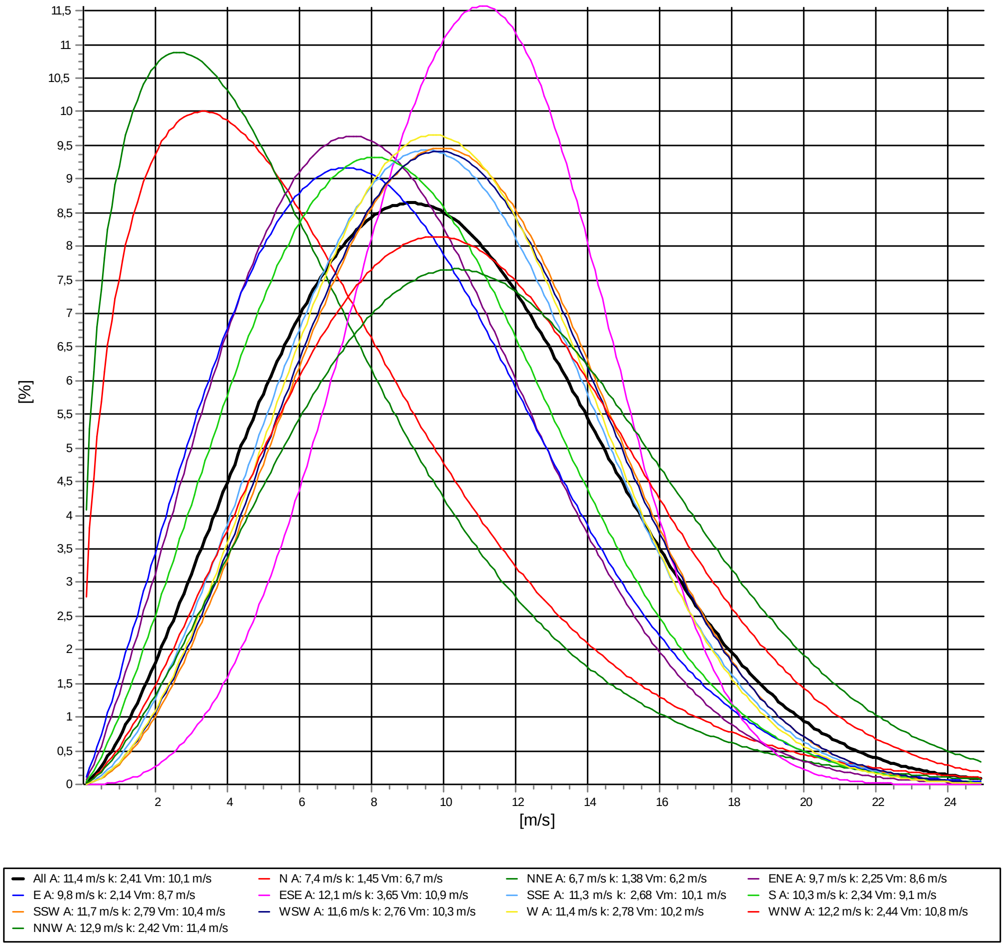
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **60,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,39	1,453	3,62	6,70
1-NNE	6,75	1,383	3,07	6,16
2-ENE	9,68	2,255	4,09	8,57
3-E	9,81	2,144	3,64	8,69
4-ESE	12,09	3,647	7,84	10,90
5-SSE	11,34	2,682	7,15	10,08
6-S	10,28	2,336	7,26	9,11
7-SSW	11,68	2,792	9,77	10,40
8-WSW	11,62	2,757	12,82	10,34
9-W	11,41	2,778	13,49	10,15
10-WNW	12,17	2,442	13,98	10,79
11-NNW	12,87	2,424	13,27	11,41
Mean	**11,36**	**2,412**	**100,00**	**10,07**



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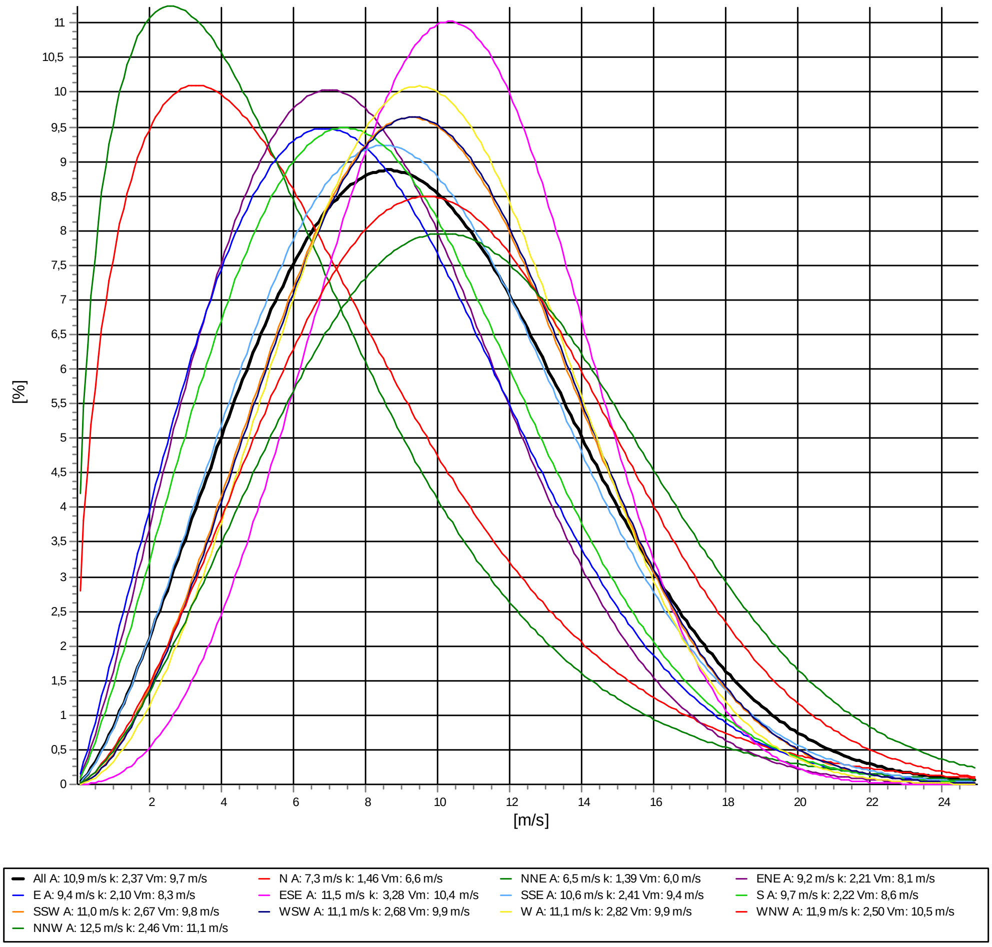
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)

Height: **40,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,33	1,456	3,58	6,64
1-NNE	6,54	1,387	3,15	5,97
2-ENE	9,17	2,214	4,15	8,12
3-E	9,36	2,103	3,76	8,29
4-ESE	11,55	3,283	7,97	10,35
5-SSE	10,64	2,412	7,05	9,43
6-S	9,73	2,223	7,14	8,62
7-SSW	11,05	2,668	9,87	9,82
8-WSW	11,09	2,684	12,75	9,86
9-W	11,06	2,822	13,43	9,85
10-WNW	11,89	2,500	14,00	10,55
11-NNW	12,54	2,464	13,16	11,12
Mean	**10,91**	**2,368**	**100,00**	**9,67**



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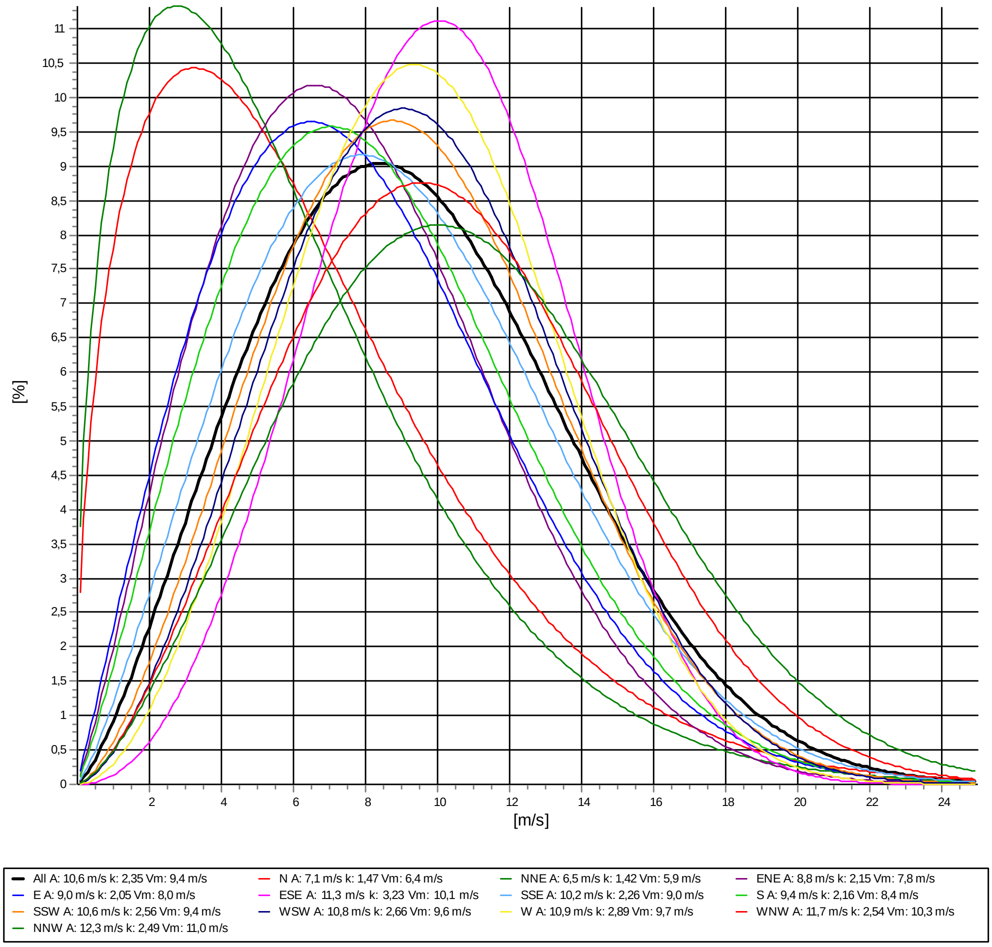
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 complete 1y; Complete period **Period:** Full period: 15/11/2021 - 15/11/2022 (12,0 months)
Height: **30,00m - Subst**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	7,11	1,468	3,57	6,43
1-NNE	6,50	1,421	3,13	5,91
2-ENE	8,85	2,150	4,15	7,84
3-E	9,03	2,045	3,84	8,00
4-ESE	11,27	3,227	7,93	10,10
5-SSE	10,21	2,263	7,17	9,04
6-S	9,43	2,156	7,06	8,35
7-SSW	10,63	2,555	9,90	9,44
8-WSW	10,81	2,665	12,74	9,61
9-W	10,86	2,890	13,39	9,68
10-WNW	11,66	2,536	13,89	10,35
11-NNW	12,35	2,485	13,25	10,95
Mean	**10,64**	**2,347**	**100,00**	**9,43**



Appendix D. Long-term Corrected Dataset: Position 1 (Lot 1, WS170), Position 2 (Lot 2, WS181), Position 3,

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

270,00m - MCP LT - 270m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,31	8,73	7,83	9,72	10,62	11,01	11,21	11,24	11,96	12,25	11,65	11,55	12,16
0		0,49	327	23	32	42	36	15	21	25	34	22	27	28	22
1	0,50	1,49	1483	157	137	218	163	115	86	78	114	98	94	100	123
2	1,50	2,49	3559	343	333	437	315	297	207	248	344	266	252	256	261
3	2,50	3,49	4779	368	379	381	279	359	336	334	415	454	477	526	471
4	3,50	4,49	7018	572	493	410	416	773	556	413	416	690	866	769	644
5	4,50	5,49	8329	685	528	472	632	686	519	628	595	828	883	1094	779
6	5,50	6,49	10383	738	573	464	684	688	617	835	1014	1233	1413	1413	711
7	6,50	7,49	11641	708	597	608	583	659	733	1229	1201	1421	1461	1433	1008
8	7,50	8,49	11324	557	354	605	615	611	775	1090	1349	1346	1477	1434	1111
9	8,50	9,49	11385	370	185	457	681	853	689	1034	1259	1335	1450	1681	1391
10	9,50	10,49	12361	344	187	584	646	857	655	890	1409	1605	1625	2059	1500
11	10,50	11,49	12299	339	245	802	597	805	753	726	1202	1391	1613	2117	1709
12	11,50	12,49	12008	301	211	673	726	1045	950	936	1028	1294	1461	1757	1626
13	12,50	13,49	10944	374	286	532	728	716	882	796	1039	1397	1264	1506	1424
14	13,50	14,49	9956	232	197	506	808	844	587	775	859	1219	1089	1439	1401
15	14,50	15,49	9001	246	181	333	297	803	540	594	914	1107	1131	1331	1524
16	15,50	16,49	8148	252	106	267	354	685	613	539	1102	943	970	1054	1263
17	16,50	17,49	6644	165	72	206	407	541	458	473	787	916	727	984	908
18	17,50	18,49	5790	145	58	199	476	411	486	425	540	807	833	656	754
19	18,50	19,49	4656	106	44	157	348	330	299	452	514	667	673	527	539
20	19,50	20,49	3337	60	21	109	127	215	184	272	488	570	384	403	504
21	20,50	21,49	2586	48	15	69	86	155	163	261	361	448	291	359	330
22	21,50	22,49	2107	31	12	41	46	97	147	179	264	377	280	331	302
23	22,50	23,49	1502	20	2	19	47	78	81	100	217	234	215	181	308
24	23,50	24,49	1264	19	6	13	9	43	37	87	244	316	163	185	142
25	24,50	25,49	870	12	6	8	13	29	37	63	130	193	154	138	87
26	25,50	26,49	610	1	3	1	5	12	19	37	103	148	144	82	55
27	26,50	27,49	320	0	2	0	2	4	5	26	67	77	67	38	32
28	27,50	28,49	231	0	1	1	3	1	1	20	28	71	41	34	30
29	28,50	29,49	167	1	1	0	0	0	2	13	22	63	32	22	11
30	29,50	30,49	101	2	0	0	0	0	0	5	9	37	24	18	6
31	30,50	31,49	75	0	0	0	0	0	0	7	3	19	21	16	9
32	31,50	32,49	33	0	0	0	0	0	0	1	4	9	7	8	4
33	32,50	33,49	30	0	0	0	0	0	0	1	0	4	11	11	3
34	33,50	34,49	22	0	0	0	0	0	0	0	2	6	8	5	1
35	34,50	35,49	9	0	0	0	0	0	0	0	0	3	4	2	0
36	35,50	36,49	9	0	0	0	0	0	0	0	1	2	6	0	0
37	36,50	37,49	8	0	0	0	0	0	0	0	0	4	3	0	1
38	37,50	38,49	1	0	0	0	0	0	0	0	0	0	1	0	0
39	38,50	39,49	2	0	0	0	0	0	0	0	0	1	1	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		1	0	0	0	0	0	0	0	0	1	0	0	0

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

240,00m - MCP LT - 240m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,21	8,62	7,87	9,68	10,62	10,83	11,27	11,15	11,91	12,10	11,45	11,42	12,05
0		0,49	327	31	31	21	47	25	17	21	24	29	36	18	27
1	0,50	1,49	1406	150	150	210	141	107	76	105	74	99	107	74	113
2	1,50	2,49	3716	336	298	474	271	359	214	304	325	264	292	287	292
3	2,50	3,49	4825	368	398	371	302	448	260	331	394	440	495	558	460
4	3,50	4,49	6903	575	475	371	415	696	569	366	459	668	858	770	681
5	4,50	5,49	8511	710	511	530	704	643	510	609	556	926	948	1076	788
6	5,50	6,49	10829	764	592	530	762	757	647	828	1081	1204	1432	1399	833
7	6,50	7,49	11603	722	564	580	519	659	821	1269	1253	1402	1435	1366	1013
8	7,50	8,49	11338	489	359	578	527	597	792	1087	1341	1406	1553	1504	1105
9	8,50	9,49	11554	417	204	486	812	885	621	1018	1237	1343	1436	1745	1350
10	9,50	10,49	12288	322	188	574	682	846	689	842	1339	1552	1622	2112	1520
11	10,50	11,49	12523	278	234	894	633	911	695	813	1127	1490	1651	2104	1693
12	11,50	12,49	11889	348	263	650	720	899	901	912	1080	1267	1375	1753	1721
13	12,50	13,49	11181	322	274	511	702	869	998	833	1071	1409	1292	1477	1423
14	13,50	14,49	10129	257	202	470	731	885	605	854	922	1230	1050	1500	1423
15	14,50	15,49	8957	219	184	337	493	756	565	567	972	1066	1181	1268	1349
16	15,50	16,49	8109	286	102	238	370	629	615	520	1014	1012	967	1028	1328
17	16,50	17,49	6804	142	55	189	415	531	516	517	817	823	728	1068	1003
18	17,50	18,49	5532	126	64	247	509	390	421	415	564	774	819	530	673
19	18,50	19,49	4617	86	46	170	278	300	296	400	607	682	577	574	601
20	19,50	20,49	3329	70	23	91	104	211	233	256	467	623	419	354	478
21	20,50	21,49	2534	43	13	69	78	131	220	255	252	409	362	397	305
22	21,50	22,49	1867	24	13	37	68	81	107	157	258	339	184	256	343
23	22,50	23,49	1356	17	3	17	32	68	76	101	244	277	128	174	219
24	23,50	24,49	1048	21	4	13	14	34	35	74	159	240	184	153	117
25	24,50	25,49	802	9	6	6	17	22	34	60	149	148	165	103	83
26	25,50	26,49	490	1	2	0	7	8	14	34	100	119	94	49	62
27	26,50	27,49	268	0	3	1	4	3	4	27	36	81	54	34	21
28	27,50	28,49	215	0	1	0	1	1	1	18	31	67	39	27	29
29	28,50	29,49	136	1	1	1	0	0	2	8	12	50	22	22	17
30	29,50	30,49	87	2	0	0	0	0	0	6	7	26	25	17	4
31	30,50	31,49	52	0	0	0	0	0	0	3	5	14	9	12	9
32	31,50	32,49	36	0	0	0	0	0	0	0	2	9	11	9	5
33	32,50	33,49	20	0	0	0	0	0	0	1	2	4	7	4	2
34	33,50	34,49	17	0	0	0	0	0	0	0	0	5	6	5	1
35	34,50	35,49	7	0	0	0	0	0	0	0	0	2	5	0	0
36	35,50	36,49	9	0	0	0	0	0	0	0	1	3	5	0	0
37	36,50	37,49	3	0	0	0	0	0	0	0	0	2	0	0	1
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	2	0	0	0	0	0	0	0	0	1	1	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		1	0	0	0	0	0	0	0	0	1	0	0	0

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

200,00m - MCP LT - 200m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,05	8,64	7,92	9,67	10,49	10,70	11,22	11,05	11,67	11,85	11,23	11,27	11,86
0		0,49	328	22	37	30	53	21	14	28	27	34	32	16	14
1	0,50	1,49	1429	128	149	219	139	86	89	121	71	103	110	85	129
2	1,50	2,49	3672	298	315	500	327	337	187	278	343	261	271	272	283
3	2,50	3,49	4823	354	380	301	326	445	244	336	417	444	494	605	477
4	3,50	4,49	7269	594	475	417	448	709	554	384	532	720	854	839	743
5	4,50	5,49	8455	636	471	592	662	668	536	553	560	863	1052	1092	770
6	5,50	6,49	11304	945	587	485	809	753	663	918	1182	1242	1460	1381	879
7	6,50	7,49	11624	631	518	608	640	613	793	1182	1283	1432	1453	1467	1004
8	7,50	8,49	11516	508	373	587	487	684	857	1211	1314	1470	1510	1358	1157
9	8,50	9,49	11840	332	174	467	931	959	626	1012	1180	1366	1577	1906	1310
10	9,50	10,49	12062	376	207	555	592	804	579	787	1333	1576	1524	2088	1641
11	10,50	11,49	12777	312	235	831	794	972	739	1017	1123	1447	1651	1928	1728
12	11,50	12,49	12402	327	229	768	799	885	896	941	1171	1422	1413	1776	1775
13	12,50	13,49	11380	303	307	584	695	893	931	838	1186	1489	1170	1574	1410
14	13,50	14,49	9831	196	215	444	649	854	653	717	978	1146	1174	1467	1338
15	14,50	15,49	9649	277	181	363	480	888	780	720	1152	1188	1075	1180	1365
16	15,50	16,49	7806	249	105	283	431	578	533	359	985	970	950	1087	1276
17	16,50	17,49	6833	151	63	184	361	492	586	486	670	880	884	1090	986
18	17,50	18,49	5244	119	76	237	459	352	350	529	604	730	639	535	614
19	18,50	19,49	4270	77	32	158	297	282	246	377	581	640	519	473	588
20	19,50	20,49	3019	81	24	84	173	182	244	257	288	421	384	421	460
21	20,50	21,49	2303	65	12	67	82	99	173	232	328	382	261	355	247
22	21,50	22,49	1740	16	13	34	52	69	97	138	256	357	214	184	310
23	22,50	23,49	1354	16	2	12	23	50	78	93	200	295	178	187	220
24	23,50	24,49	885	12	8	12	15	25	26	73	148	188	176	98	104
25	24,50	25,49	532	4	5	4	20	16	24	49	108	105	75	63	59
26	25,50	26,49	322	1	4	1	2	4	9	25	55	75	59	47	40
27	26,50	27,49	244	0	2	0	4	2	0	27	34	87	34	26	28
28	27,50	28,49	163	0	0	1	1	1	2	14	18	52	30	28	16
29	28,50	29,49	84	3	0	0	0	0	1	6	7	25	20	16	6
30	29,50	30,49	64	0	0	0	0	0	0	5	5	12	17	18	7
31	30,50	31,49	32	0	0	0	0	0	0	1	2	9	9	5	6
32	31,50	32,49	25	0	0	0	0	0	0	1	1	3	12	6	2
33	32,50	33,49	21	0	0	0	0	0	0	0	1	7	6	6	1
34	33,50	34,49	7	0	0	0	0	0	0	0	0	3	3	1	0
35	34,50	35,49	5	0	0	0	0	0	0	0	1	2	1	0	1
36	35,50	36,49	2	0	0	0	0	0	0	0	0	1	1	0	0
37	36,50	37,49	3	0	0	0	0	0	0	0	0	1	2	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	1	0	0	0	0	0	0	0	0	1	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

180,00m - MCP LT - 180m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,94	8,55	7,89	9,60	10,48	10,56	11,20	10,91	11,60	11,66	11,06	11,14	11,80
0		0,49	326	21	38	40	34	21	24	30	10	43	25	18	22
1	0,50	1,49	1509	109	201	162	139	123	98	115	90	124	134	103	111
2	1,50	2,49	3622	303	287	479	338	329	221	262	299	225	286	284	309
3	2,50	3,49	4928	405	373	338	294	419	239	343	435	488	526	675	393
4	3,50	4,49	7329	596	540	475	485	684	483	375	465	713	973	821	719
5	4,50	5,49	8763	664	500	609	580	740	604	670	650	896	1094	1014	742
6	5,50	6,49	11582	931	628	561	909	709	646	894	1184	1289	1479	1413	939
7	6,50	7,49	11410	596	484	610	614	582	776	1162	1244	1474	1445	1354	1069
8	7,50	8,49	11561	498	379	499	509	702	862	1303	1226	1408	1487	1485	1203
9	8,50	9,49	11945	376	177	567	958	984	635	1012	1216	1298	1491	1910	1321
10	9,50	10,49	12435	288	232	465	741	889	635	860	1330	1691	1562	2110	1632
11	10,50	11,49	12704	330	226	801	672	954	775	916	1207	1506	1726	1935	1656
12	11,50	12,49	12769	353	226	793	884	932	958	951	1174	1391	1483	1822	1802
13	12,50	13,49	11427	303	318	533	683	803	921	888	1216	1487	1233	1567	1475
14	13,50	14,49	10186	229	235	512	665	931	725	740	1090	1262	1127	1401	1269
15	14,50	15,49	9386	327	175	365	521	810	741	639	1139	1057	1066	1109	1437
16	15,50	16,49	7934	189	97	252	502	645	566	432	907	1001	968	1201	1174
17	16,50	17,49	6218	187	90	231	337	424	521	476	683	754	729	913	873
18	17,50	18,49	5355	81	62	197	514	247	330	525	646	705	687	653	708
19	18,50	19,49	3928	88	47	150	241	263	298	317	422	582	511	468	541
20	19,50	20,49	3071	78	28	99	121	169	232	249	399	464	430	340	462
21	20,50	21,49	2011	34	15	47	83	99	165	204	255	323	164	276	346
22	21,50	22,49	1614	14	8	27	53	61	98	129	231	366	176	192	259
23	22,50	23,49	1243	18	4	17	19	40	76	94	187	262	205	192	129
24	23,50	24,49	693	10	3	6	23	19	38	84	128	154	108	53	67
25	24,50	25,49	486	0	4	6	12	10	22	33	99	92	67	64	77
26	25,50	26,49	343	4	4	0	4	8	10	28	43	74	66	45	57
27	26,50	27,49	207	0	1	1	2	2	4	11	38	65	33	27	23
28	27,50	28,49	127	0	3	0	1	2	1	11	17	38	35	8	11
29	28,50	29,49	77	0	0	0	0	0	1	5	7	24	22	12	6
30	29,50	30,49	55	0	1	0	0	0	1	2	1	15	13	14	8
31	30,50	31,49	31	0	0	0	0	0	0	1	1	3	12	9	5
32	31,50	32,49	19	0	0	0	0	0	0	0	2	2	5	7	3
33	32,50	33,49	11	0	0	0	0	0	0	0	1	2	5	3	0
34	33,50	34,49	7	0	0	0	0	0	0	0	1	1	4	1	0
35	34,50	35,49	5	0	0	0	0	0	0	0	1	0	1	2	1
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	2	0	0	0	0	0	0	0	0	1	1	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	1	0	0	0	0	0	0	0	0	0	1	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 10.16

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

150,00m - MCP LT - 150m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,83	8,47	8,12	9,63	10,44	10,62	11,12	10,68	11,44	11,50	10,91	11,01	11,64
0		0,49	312	30	34	60	6	7	27	23	30	50	28	8	9
1	0,50	1,49	1583	144	142	169	152	111	88	141	124	168	106	97	141
2	1,50	2,49	3435	270	311	430	266	297	194	285	304	244	285	249	300
3	2,50	3,49	4917	435	356	321	375	433	199	325	431	448	512	668	414
4	3,50	4,49	7584	544	453	514	481	700	508	504	497	713	1010	911	749
5	4,50	5,49	8831	716	469	567	648	638	561	569	664	918	1173	1097	811
6	5,50	6,49	11310	884	652	584	843	652	751	904	1069	1255	1405	1343	968
7	6,50	7,49	11593	621	472	548	713	662	856	1216	1312	1299	1322	1437	1135
8	7,50	8,49	11559	465	382	621	640	684	773	1234	1334	1414	1519	1419	1074
9	8,50	9,49	12133	347	210	473	874	954	569	1096	1215	1408	1531	2068	1388
10	9,50	10,49	12915	413	233	644	754	961	587	897	1250	1681	1693	1983	1819
11	10,50	11,49	12642	270	239	686	726	793	890	984	1206	1530	1640	1980	1698
12	11,50	12,49	13405	360	326	850	830	974	983	1057	1217	1558	1515	1895	1840
13	12,50	13,49	12012	333	302	481	773	905	917	952	1347	1523	1323	1626	1530
14	13,50	14,49	9848	235	209	395	621	812	743	798	1113	1183	1226	1291	1222
15	14,50	15,49	9448	240	157	434	606	926	664	569	1035	1334	1091	1117	1275
16	15,50	16,49	8405	207	137	381	616	576	624	564	953	1047	853	1190	1257
17	16,50	17,49	6007	143	91	218	358	470	474	529	651	677	742	831	823
18	17,50	18,49	4852	98	64	224	374	315	357	380	536	649	667	556	632
19	18,50	19,49	3952	100	38	136	334	176	264	288	497	636	471	402	610
20	19,50	20,49	2534	71	34	87	90	129	202	215	275	393	272	313	453
21	20,50	21,49	2016	29	18	45	61	94	165	175	340	353	162	276	298
22	21,50	22,49	1463	20	14	22	28	82	89	103	219	296	202	227	161
23	22,50	23,49	914	19	3	10	18	46	51	58	141	141	137	125	165
24	23,50	24,49	591	7	5	3	19	17	30	47	117	94	92	79	81
25	24,50	25,49	350	0	1	0	9	10	16	26	61	62	62	52	51
26	25,50	26,49	231	0	1	0	3	5	8	20	39	54	34	35	32
27	26,50	27,49	173	2	1	0	1	0	3	7	27	46	31	28	27
28	27,50	28,49	123	0	0	0	0	0	1	7	11	34	31	23	16
29	28,50	29,49	59	0	0	0	0	0	1	3	5	17	16	8	9
30	29,50	30,49	54	0	0	0	0	0	0	0	2	12	21	12	7
31	30,50	31,49	24	0	2	0	0	0	0	0	2	9	5	5	1
32	31,50	32,49	19	0	0	0	0	0	1	0	1	4	3	7	3
33	32,50	33,49	13	0	0	0	0	0	0	0	0	3	5	4	1
34	33,50	34,49	7	0	0	0	0	0	0	0	1	0	2	1	3
35	34,50	35,49	1	0	0	0	0	0	0	0	0	0	1	0	0
36	35,50	36,49	1	0	0	0	0	0	0	0	0	1	0	0	0
37	36,50	37,49	1	0	0	0	0	0	0	0	0	0	1	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	2	0	0	0	0	0	0	0	0	1	1	0	0
40	39,50	40,49	1	0	0	0	0	0	0	0	0	0	1	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

120,00m - MCP LT - 120m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,67	8,41	8,36	9,53	10,47	10,45	10,92	10,45	11,30	11,22	10,67	10,83	11,46
0		0,49	324	23	24	48	23	8	11	28	33	55	28	31	12
1	0,50	1,49	1577	161	127	194	153	115	82	124	145	149	122	89	116
2	1,50	2,49	3377	254	222	360	282	307	220	304	268	288	281	271	320
3	2,50	3,49	5080	418	345	323	388	590	249	295	382	517	519	644	410
4	3,50	4,49	7504	509	420	543	419	605	434	485	567	796	1052	967	707
5	4,50	5,49	9324	633	410	745	699	742	664	635	648	945	1125	1179	899
6	5,50	6,49	10998	832	650	758	620	678	725	910	994	1173	1414	1322	922
7	6,50	7,49	11601	647	477	570	757	668	838	1109	1311	1381	1358	1384	1101
8	7,50	8,49	11589	380	370	510	635	686	730	1297	1242	1320	1551	1612	1256
9	8,50	9,49	12742	416	300	589	889	971	551	1097	1351	1465	1582	2101	1430
10	9,50	10,49	13460	454	273	446	780	945	753	1029	1214	1850	1729	2200	1787
11	10,50	11,49	13352	298	257	672	832	988	980	1089	1307	1525	1694	2052	1658
12	11,50	12,49	13902	309	387	747	833	986	1117	1150	1337	1785	1496	1983	1772
13	12,50	13,49	11945	317	277	597	835	988	954	934	1263	1514	1261	1553	1452
14	13,50	14,49	10092	233	190	468	627	979	751	728	1028	1206	1164	1282	1436
15	14,50	15,49	9583	218	155	506	753	736	740	610	1261	1305	966	1120	1213
16	15,50	16,49	8148	151	178	424	558	624	450	618	1020	1022	853	1100	1150
17	16,50	17,49	5921	126	89	233	461	392	493	384	644	786	662	841	810
18	17,50	18,49	4476	112	61	143	259	284	337	317	515	626	720	512	590
19	18,50	19,49	2958	88	36	121	257	163	152	187	375	450	246	361	522
20	19,50	20,49	2196	44	21	73	125	163	126	181	290	294	235	269	375
21	20,50	21,49	1876	36	17	38	42	70	162	136	250	276	265	292	292
22	21,50	22,49	1157	11	5	20	31	59	92	76	170	192	157	172	172
23	22,50	23,49	758	11	5	14	16	48	40	62	112	125	107	113	105
24	23,50	24,49	489	9	4	4	16	24	26	27	91	94	65	54	75
25	24,50	25,49	341	4	2	2	12	12	12	20	47	84	53	40	53
26	25,50	26,49	204	2	1	0	4	0	8	13	29	52	33	37	25
27	26,50	27,49	126	2	1	2	2	2	3	9	15	37	15	27	11
28	27,50	28,49	80	0	1	0	0	0	4	3	7	21	19	14	11
29	28,50	29,49	52	1	1	0	0	0	1	1	3	12	15	11	7
30	29,50	30,49	35	0	0	0	0	0	0	1	2	7	8	11	6
31	30,50	31,49	26	0	0	0	0	0	0	0	0	4	6	14	2
32	31,50	32,49	10	0	0	0	0	0	1	0	0	3	3	1	2
33	32,50	33,49	7	0	0	0	0	0	0	0	1	2	3	1	0
34	33,50	34,49	4	0	0	0	0	0	0	0	0	1	1	0	2
35	34,50	35,49	4	0	0	0	0	0	0	0	0	4	0	0	0
36	35,50	36,49	1	0	0	0	0	0	0	0	0	0	1	0	0
37	36,50	37,49	1	0	0	0	0	0	0	0	0	0	1	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 10.16

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

100,00m - MCP LT - 100m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,47	8,34	8,24	9,39	10,32	10,28	10,61	10,16	11,07	10,96	10,45	10,71	11,34
0		0,49	300	35	34	34	17	11	9	25	33	43	28	20	11
1	0,50	1,49	1690	175	155	196	193	122	96	132	155	155	113	96	102
2	1,50	2,49	3378	229	265	338	293	309	221	308	270	265	291	290	299
3	2,50	3,49	5328	426	366	305	426	544	282	379	455	578	517	657	393
4	3,50	4,49	7737	515	430	539	444	661	545	468	519	847	1055	950	764
5	4,50	5,49	9186	606	407	774	619	683	598	659	681	915	1214	1118	912
6	5,50	6,49	11242	888	615	784	703	702	787	916	1023	1168	1397	1367	892
7	6,50	7,49	11991	653	552	694	691	667	838	1159	1327	1427	1482	1414	1087
8	7,50	8,49	12418	400	334	602	813	783	851	1374	1265	1392	1565	1647	1392
9	8,50	9,49	12999	356	286	465	901	949	624	1267	1369	1534	1672	2162	1414
10	9,50	10,49	13990	470	269	573	836	927	874	1144	1281	1911	1747	2229	1729
11	10,50	11,49	14459	265	271	747	881	1145	1218	1109	1509	1832	1699	2127	1656
12	11,50	12,49	13702	307	429	821	830	992	1034	1066	1294	1668	1464	1988	1809
13	12,50	13,49	11477	283	265	627	695	1010	874	944	1301	1374	1291	1441	1372
14	13,50	14,49	9844	247	200	398	721	849	695	646	1126	1389	1109	1199	1265
15	14,50	15,49	9495	212	189	543	734	769	583	637	1150	1187	961	1174	1356
16	15,50	16,49	7516	199	155	377	473	496	560	542	765	828	746	1234	1141
17	16,50	17,49	5610	95	83	189	436	383	471	341	687	764	707	742	712
18	17,50	18,49	3719	126	62	118	288	222	247	230	399	554	493	423	557
19	18,50	19,49	2798	71	30	105	207	154	158	193	350	368	321	369	472
20	19,50	20,49	2205	50	17	56	113	139	155	147	325	339	276	242	346
21	20,50	21,49	1558	24	17	29	71	58	117	124	209	247	149	240	273
22	21,50	22,49	963	9	5	11	32	58	69	74	142	125	130	144	164
23	22,50	23,49	648	9	5	9	16	38	31	40	105	98	95	92	110
24	23,50	24,49	394	8	1	3	17	18	18	21	69	90	53	51	45
25	24,50	25,49	250	3	2	2	6	5	8	18	36	69	39	33	29
26	25,50	26,49	169	2	2	1	3	1	7	9	20	40	19	37	28
27	26,50	27,49	103	1	2	0	4	1	4	6	10	24	19	22	10
28	27,50	28,49	55	0	0	1	1	0	0	0	3	12	16	12	10
29	28,50	29,49	40	1	1	0	0	0	2	0	0	8	10	13	5
30	29,50	30,49	24	0	0	0	0	0	0	0	2	3	7	9	3
31	30,50	31,49	14	0	0	0	1	0	0	0	1	4	2	2	4
32	31,50	32,49	6	0	0	0	0	0	0	0	0	2	3	1	0
33	32,50	33,49	8	0	0	0	0	0	0	0	1	2	2	1	2
34	33,50	34,49	2	0	0	0	0	0	0	0	1	1	0	0	0
35	34,50	35,49	1	0	0	0	0	0	0	0	0	0	1	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	1	0	0	0	0	0	0	0	0	0	1	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

90,00m - MCP LT - 90m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,35	8,32	8,19	9,31	10,18	10,17	10,44	10,07	10,84	10,84	10,32	10,57	11,28
0		0,49	309	26	32	34	8	22	24	20	53	35	14	18	23
1	0,50	1,49	1673	134	136	205	185	148	77	144	146	147	132	111	108
2	1,50	2,49	3443	271	271	351	280	279	208	299	271	288	312	288	325
3	2,50	3,49	5483	443	406	340	420	545	294	350	451	614	551	632	437
4	3,50	4,49	7741	463	438	549	520	618	550	484	593	824	1040	990	672
5	4,50	5,49	9756	629	492	767	667	728	720	718	764	959	1257	1186	869
6	5,50	6,49	11234	819	643	729	634	673	827	1006	1064	1226	1316	1377	920
7	6,50	7,49	12215	664	546	625	712	649	777	1129	1306	1478	1631	1498	1200
8	7,50	8,49	12541	452	334	612	840	812	893	1450	1313	1293	1550	1654	1338
9	8,50	9,49	13409	417	325	503	1147	1053	673	1071	1346	1676	1684	2155	1359
10	9,50	10,49	14455	423	243	771	864	1001	975	1120	1428	1813	1727	2363	1727
11	10,50	11,49	14833	256	338	719	927	1154	1219	1276	1593	1786	1744	2128	1693
12	11,50	12,49	13131	276	402	776	761	987	911	948	1316	1707	1435	1866	1746
13	12,50	13,49	11276	316	297	600	633	1002	836	920	1249	1355	1291	1381	1396
14	13,50	14,49	10080	206	255	476	767	897	615	688	1107	1457	1094	1216	1302
15	14,50	15,49	9118	202	194	618	576	663	585	752	1060	1064	935	1187	1282
16	15,50	16,49	6903	165	114	218	475	486	451	374	838	752	747	1114	1169
17	16,50	17,49	5521	126	84	165	381	348	494	375	598	807	634	764	745
18	17,50	18,49	3681	110	51	141	365	237	231	229	410	500	487	427	493
19	18,50	19,49	2670	53	27	90	216	121	162	192	308	342	304	386	469
20	19,50	20,49	2123	74	16	64	71	119	165	177	296	342	236	260	303
21	20,50	21,49	1377	25	19	31	44	72	114	76	159	214	172	196	255
22	21,50	22,49	947	9	9	11	46	60	66	65	154	126	109	113	179
23	22,50	23,49	497	11	4	5	17	14	31	34	68	94	76	49	94
24	23,50	24,49	341	6	1	4	22	14	14	17	54	85	45	34	45
25	24,50	25,49	224	3	4	0	2	9	9	20	26	55	29	32	35
26	25,50	26,49	126	1	1	0	4	0	7	5	12	34	22	25	15
27	26,50	27,49	69	0	0	0	1	0	4	0	7	16	13	19	9
28	27,50	28,49	71	0	1	0	0	1	3	0	3	16	16	18	13
29	28,50	29,49	31	1	0	0	0	0	0	0	2	6	11	5	6
30	29,50	30,49	19	1	0	0	0	0	0	0	0	5	2	9	2
31	30,50	31,49	10	0	0	0	0	0	0	0	0	0	6	4	0
32	31,50	32,49	5	0	0	0	0	0	0	0	1	2	0	0	2
33	32,50	33,49	5	0	0	0	0	0	0	0	1	2	0	1	1
34	33,50	34,49	2	0	0	0	0	0	0	0	0	0	2	0	0
35	34,50	35,49	1	0	0	0	0	0	0	0	0	0	1	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 10.16

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

60,00m - MCP LT - 60m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,00	8,10	7,84	9,04	9,86	9,83	9,95	9,65	10,44	10,38	9,99	10,31	11,03
0		0,49	300	4	16	41	19	23	9	36	47	40	14	18	33
1	0,50	1,49	1780	143	150	194	192	126	60	203	159	147	110	174	122
2	1,50	2,49	3498	295	250	393	290	299	184	298	219	290	358	292	330
3	2,50	3,49	5513	433	384	342	397	442	337	332	426	735	601	599	485
4	3,50	4,49	8226	566	475	602	520	668	614	548	585	888	1116	953	691
5	4,50	5,49	10356	684	518	794	661	897	782	869	934	959	1180	1211	867
6	5,50	6,49	11935	842	606	804	670	853	880	1176	1154	1242	1352	1465	891
7	6,50	7,49	12329	595	465	611	829	669	708	1211	1333	1482	1681	1513	1232
8	7,50	8,49	14251	501	403	772	971	858	927	1510	1479	1571	1766	2076	1417
9	8,50	9,49	14824	385	341	653	1166	1158	1097	1142	1578	1748	1889	2329	1338
10	9,50	10,49	15798	422	321	882	960	1239	1220	1286	1642	2021	1878	2254	1673
11	10,50	11,49	14510	298	328	877	733	1208	1077	1154	1436	1633	1687	2157	1922
12	11,50	12,49	12860	341	359	755	874	933	847	963	1427	1628	1254	1798	1681
13	12,50	13,49	11293	291	267	617	848	919	685	699	1413	1477	1343	1343	1391
14	13,50	14,49	9317	212	194	522	551	722	589	799	997	1105	1173	1298	1155
15	14,50	15,49	8152	188	128	353	644	582	502	521	903	1107	716	1211	1297
16	15,50	16,49	6188	169	81	234	371	373	416	454	613	711	689	1001	1076
17	16,50	17,49	4374	86	49	150	308	312	311	320	393	565	546	671	663
18	17,50	18,49	3076	83	40	127	275	184	160	197	365	391	388	412	454
19	18,50	19,49	2344	78	17	68	166	140	156	148	330	350	270	222	399
20	19,50	20,49	1626	38	9	46	51	93	103	125	220	182	162	257	340
21	20,50	21,49	995	12	12	13	42	77	88	79	130	125	117	132	168
22	21,50	22,49	744	9	3	8	21	47	42	50	110	149	92	81	132
23	22,50	23,49	393	9	2	5	14	21	26	23	56	70	64	48	55
24	23,50	24,49	256	1	3	3	11	9	12	11	32	57	36	34	47
25	24,50	25,49	153	3	3	1	3	3	4	8	23	33	31	23	18
26	25,50	26,49	100	0	0	2	1	0	1	3	8	13	22	33	17
27	26,50	27,49	58	0	1	4	0	1	0	1	4	9	13	15	10
28	27,50	28,49	32	0	0	0	0	0	0	0	1	8	10	8	5
29	28,50	29,49	19	0	0	0	0	0	0	0	1	6	5	5	2
30	29,50	30,49	10	0	0	0	0	0	0	0	0	4	1	2	3
31	30,50	31,49	6	0	0	0	0	0	0	0	1	1	2	1	1
32	31,50	32,49	3	0	0	0	0	0	0	0	1	2	0	0	0
33	32,50	33,49	1	0	0	0	0	0	0	0	0	0	1	0	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

40,00m - MCP LT - 40m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			9,60	7,97	7,60	8,51	9,48	9,31	9,51	9,18	9,90	9,94	9,62	10,03	10,75
0		0,49	329	13	15	40	20	17	3	40	59	55	15	28	24
1	0,50	1,49	1845	145	165	216	165	139	62	212	155	173	143	155	115
2	1,50	2,49	3718	308	255	394	311	314	216	313	271	342	356	300	338
3	2,50	3,49	6098	451	424	355	439	567	374	355	448	811	686	663	525
4	3,50	4,49	9097	572	488	771	608	825	653	673	706	925	1158	986	732
5	4,50	5,49	11159	740	549	955	682	854	895	955	1126	957	1283	1231	932
6	5,50	6,49	12585	804	575	756	840	966	937	1247	1231	1340	1551	1465	873
7	6,50	7,49	14232	591	535	890	1003	834	908	1459	1591	1629	1742	1731	1319
8	7,50	8,49	15244	501	421	845	1021	971	1176	1502	1684	1710	1780	2196	1437
9	8,50	9,49	15872	410	380	896	1138	1226	1109	1216	1658	1976	2048	2383	1432
10	9,50	10,49	15460	370	293	898	915	1259	1199	1195	1590	1824	1808	2309	1800
11	10,50	11,49	14207	312	365	846	677	1182	926	1070	1517	1751	1605	2003	1953
12	11,50	12,49	12097	368	288	477	918	865	592	874	1484	1551	1436	1650	1594
13	12,50	13,49	10186	307	246	550	623	696	558	718	1085	1322	1284	1424	1373
14	13,50	14,49	8972	187	146	456	645	637	562	682	872	1150	1005	1359	1271
15	14,50	15,49	7465	223	117	265	527	577	533	434	783	942	671	1149	1244
16	15,50	16,49	5510	124	79	229	413	383	399	394	457	659	625	873	875
17	16,50	17,49	3518	106	46	136	284	208	228	192	420	437	453	420	588
18	17,50	18,49	2631	96	31	88	219	138	172	189	277	339	267	366	449
19	18,50	19,49	1962	40	16	56	107	109	141	130	261	187	249	270	396
20	19,50	20,49	1238	24	10	19	37	66	90	86	174	147	132	195	258
21	20,50	21,49	743	14	8	8	32	55	61	49	110	143	98	69	96
22	21,50	22,49	455	8	3	5	19	19	32	23	71	85	58	51	81
23	22,50	23,49	283	1	2	2	13	11	12	14	39	57	37	42	53
24	23,50	24,49	180	3	4	2	4	2	10	7	22	32	31	34	29
25	24,50	25,49	102	1	2	2	1	1	1	3	6	18	20	30	17
26	25,50	26,49	57	0	0	3	0	1	0	2	4	8	14	15	10
27	26,50	27,49	40	0	0	0	0	0	0	0	1	10	11	10	8
28	27,50	28,49	13	1	0	0	0	0	0	0	1	4	2	5	0
29	28,50	29,49	11	0	0	0	0	0	0	0	1	3	2	0	5
30	29,50	30,49	8	0	0	0	0	0	0	0	1	2	2	2	1
31	30,50	31,49	3	0	0	0	0	0	0	0	0	2	1	0	0
32	31,50	32,49	0	0	0	0	0	0	0	0	0	0	0	0	0
33	32,50	33,49	0	0	0	0	0	0	0	0	0	0	0	0	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 10.16

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

30,00m - MCP LT - 30m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			9,41	7,77	7,30	8,45	9,24	9,00	9,22	9,04	9,69	9,74	9,50	9,89	10,50
0		0,49	244	19	24	44	31	18	6	21	15	19	18	13	16
1	0,50	1,49	1859	187	114	172	242	141	66	186	117	184	188	127	135
2	1,50	2,49	3688	290	316	324	252	344	233	275	290	412	282	300	370
3	2,50	3,49	6528	440	464	413	465	673	492	426	386	733	818	733	485
4	3,50	4,49	9432	535	569	778	648	783	613	707	986	974	1015	1045	779
5	4,50	5,49	11657	804	591	842	826	994	904	1004	1032	1063	1437	1227	933
6	5,50	6,49	13314	907	529	785	974	952	1007	1343	1375	1461	1557	1462	962
7	6,50	7,49	15154	671	614	976	1073	937	1068	1590	1691	1684	1751	1691	1408
8	7,50	8,49	15643	424	380	917	1053	1111	1091	1538	1663	1709	2049	2280	1428
9	8,50	9,49	16312	442	417	874	1171	1254	1100	1248	1722	2056	1935	2405	1688
10	9,50	10,49	15198	316	347	843	959	1112	1092	1185	1468	1886	1824	2413	1753
11	10,50	11,49	13994	309	339	617	898	942	955	1054	1525	1691	1524	2080	2060
12	11,50	12,49	11616	333	305	530	638	801	711	725	1376	1587	1464	1640	1506
13	12,50	13,49	10055	245	204	533	714	786	482	851	964	1267	1274	1464	1271
14	13,50	14,49	8774	266	128	412	544	594	499	618	882	1178	836	1349	1468
15	14,50	15,49	7017	197	82	254	523	517	483	392	722	863	734	1125	1125
16	15,50	16,49	4614	106	45	198	398	295	269	348	468	522	614	674	677
17	16,50	17,49	3483	83	39	132	273	194	264	232	402	421	408	465	570
18	17,50	18,49	2588	98	23	99	214	130	170	191	259	315	281	306	502
19	18,50	19,49	1546	37	13	44	89	81	117	109	210	162	232	239	213
20	19,50	20,49	1081	9	12	26	53	57	76	61	164	136	159	138	190
21	20,50	21,49	623	13	5	11	25	36	24	40	91	116	85	63	114
22	21,50	22,49	389	11	2	8	19	14	19	18	40	66	49	50	93
23	22,50	23,49	245	3	1	3	10	7	7	17	30	51	40	43	33
24	23,50	24,49	108	0	0	1	2	2	3	6	7	25	15	26	21
25	24,50	25,49	74	0	0	3	0	0	6	4	4	15	14	17	11
26	25,50	26,49	35	0	1	0	0	0	0	1	2	6	9	8	8
27	26,50	27,49	30	0	0	0	0	0	0	0	0	6	12	10	2
28	27,50	28,49	9	0	0	0	0	0	0	0	0	1	5	3	0
29	28,50	29,49	6	0	0	0	0	0	0	0	2	1	0	1	2
30	29,50	30,49	4	0	0	0	0	0	0	0	0	0	3	0	1
31	30,50	31,49	0	0	0	0	0	0	0	0	0	0	0	0	0
32	31,50	32,49	0	0	0	0	0	0	0	0	0	0	0	0	0
33	32,50	33,49	0	0	0	0	0	0	0	0	0	0	0	0	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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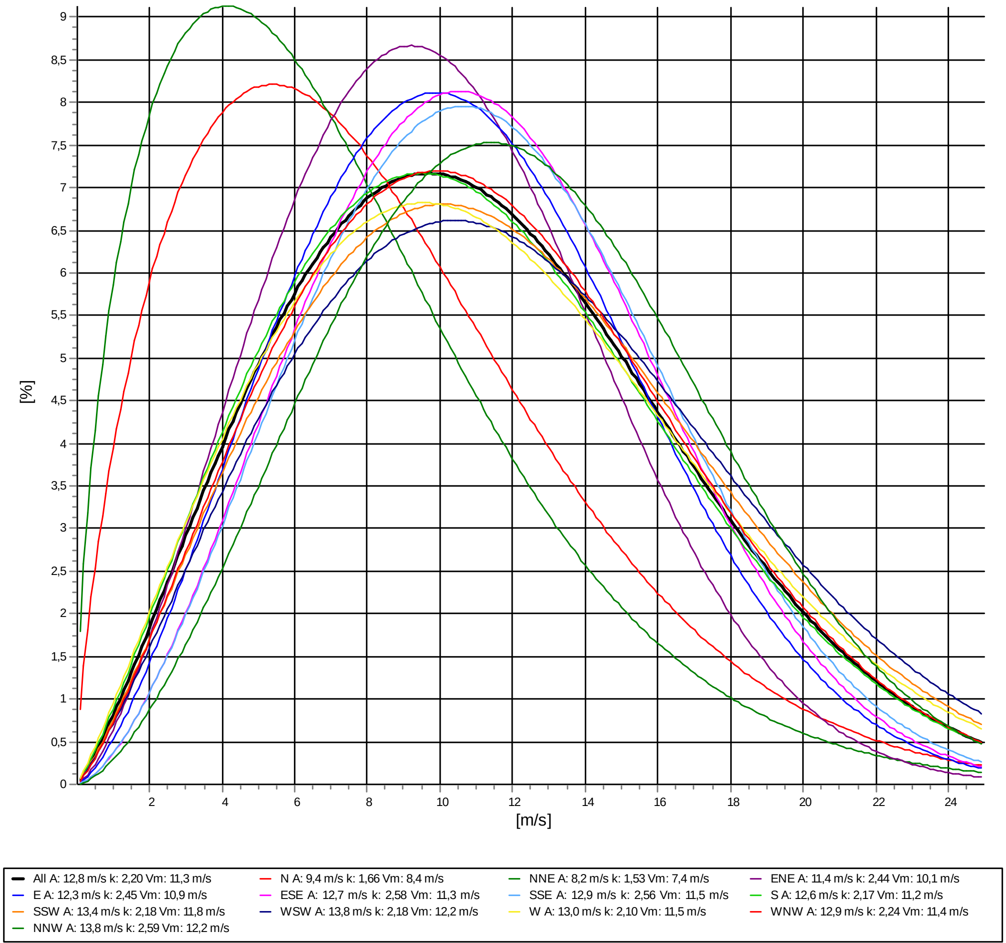
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **270,00m - MCP LT - 270m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,41	1,658	4,12	8,41
1-NNE	8,21	1,532	3,00	7,39
2-ENE	11,43	2,440	4,91	10,14
3-E	12,25	2,453	5,78	10,87
4-ESE	12,74	2,580	7,26	11,31
5-SSE	12,93	2,557	6,52	11,48
6-S	12,63	2,166	7,75	11,19
7-SSW	13,37	2,180	10,31	11,84
8-WSW	13,77	2,182	12,33	12,19
9-W	13,00	2,102	12,34	11,52
10-WNW	12,90	2,241	13,69	11,43
11-NNW	13,79	2,587	11,97	12,24
Mean	**12,77**	**2,198**	**100,00**	**11,31**



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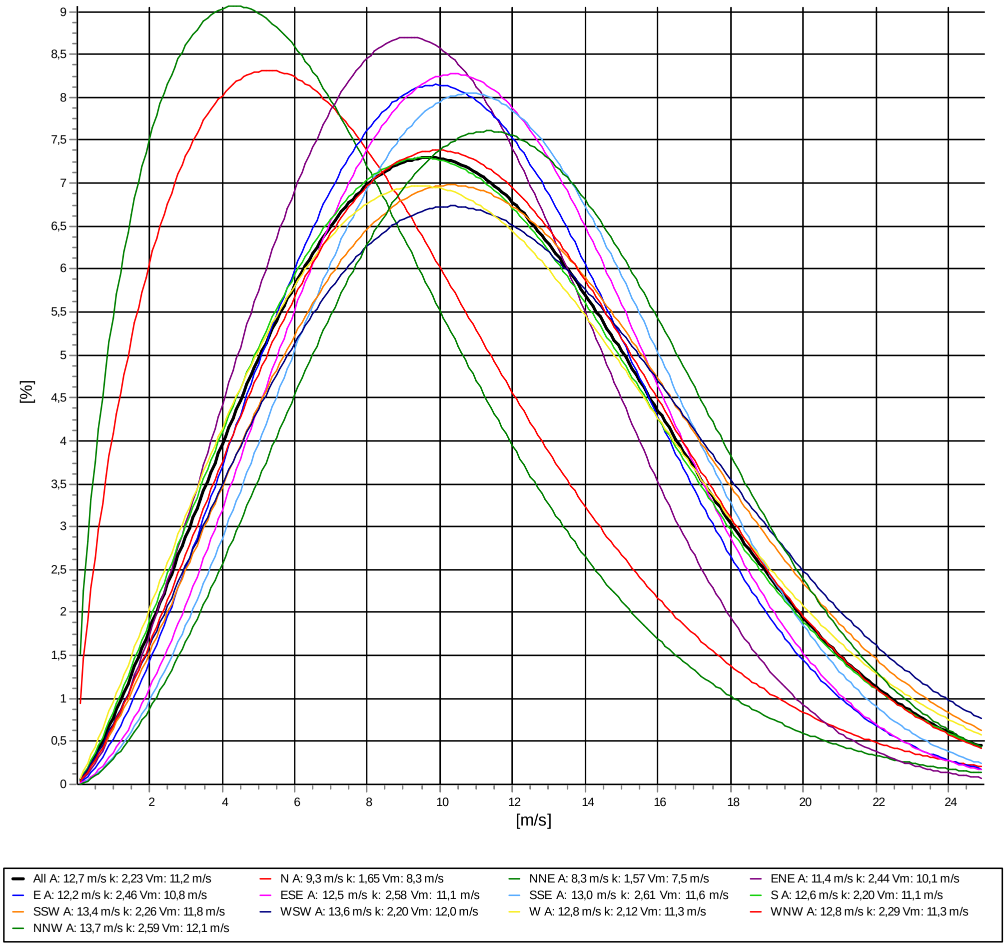
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **240,00m - MCP LT - 240m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,27	1,650	4,07	8,29
1-NNE	8,34	1,569	3,00	7,49
2-ENE	11,38	2,437	4,94	10,09
3-E	12,22	2,456	5,91	10,84
4-ESE	12,54	2,584	7,27	11,14
5-SSE	13,00	2,613	6,59	11,55
6-S	12,56	2,200	7,76	11,12
7-SSW	13,38	2,257	10,26	11,85
8-WSW	13,60	2,198	12,27	12,04
9-W	12,80	2,118	12,31	11,33
10-WNW	12,77	2,286	13,59	11,31
11-NNW	13,68	2,594	12,03	12,15
Mean	**12,67**	**2,227**	**100,00**	**11,22**



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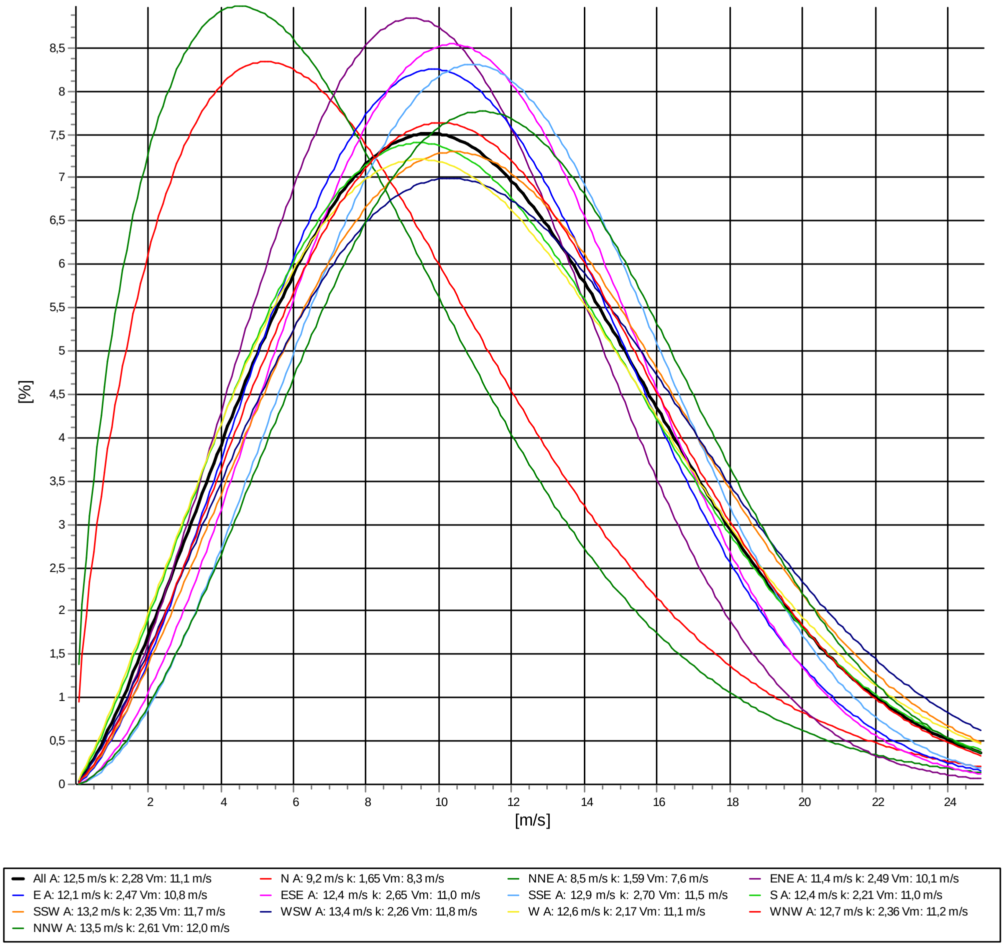
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **200,00m - MCP LT - 200m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,24	1,647	4,01	8,26
1-NNE	8,45	1,589	2,97	7,58
2-ENE	11,38	2,487	5,04	10,09
3-E	12,13	2,472	6,13	10,76
4-ESE	12,38	2,647	7,26	11,01
5-SSE	12,95	2,701	6,57	11,52
6-S	12,43	2,213	7,82	11,01
7-SSW	13,20	2,352	10,35	11,69
8-WSW	13,35	2,258	12,23	11,83
9-W	12,58	2,171	12,15	11,14
10-WNW	12,67	2,364	13,51	11,22
11-NNW	13,45	2,606	11,97	11,95
Mean	**12,53**	**2,281**	**100,00**	**11,10**



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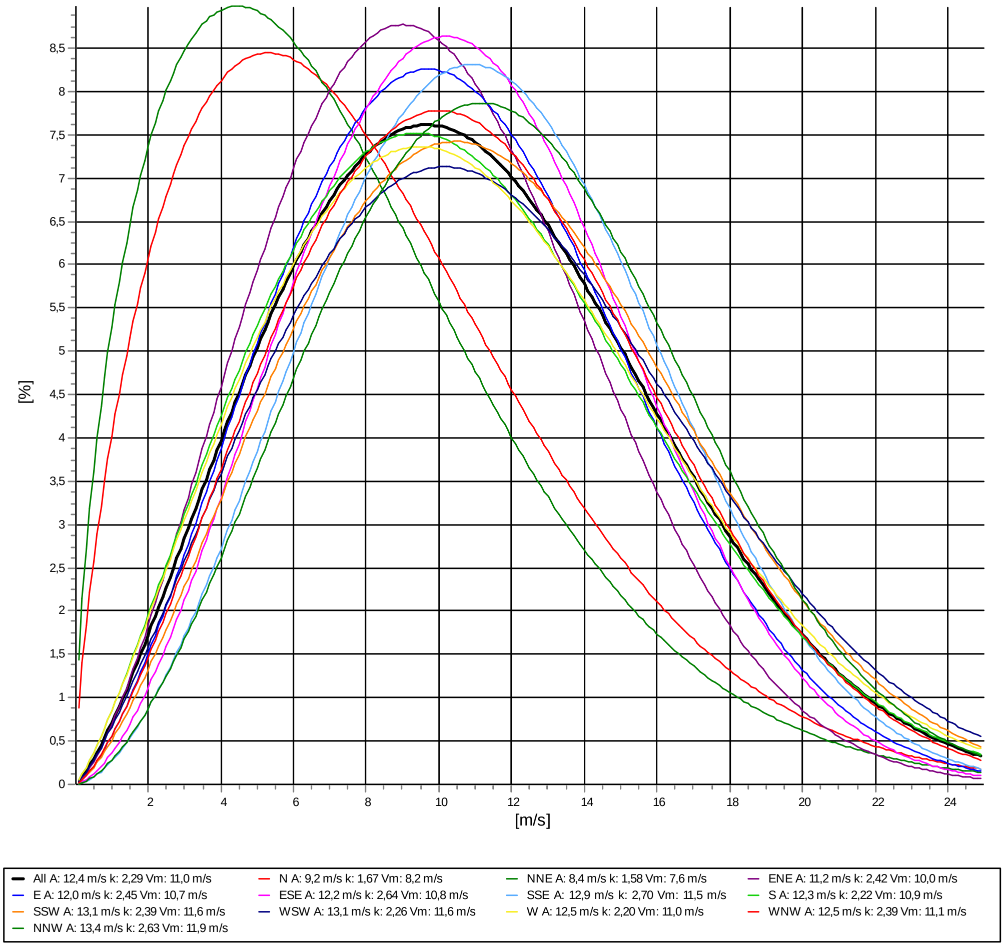
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **180,00m - MCP LT - 180m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,18	1,670	4,01	8,20
1-NNE	8,43	1,578	3,07	7,57
2-ENE	11,23	2,421	5,04	9,95
3-E	12,02	2,447	6,24	10,66
4-ESE	12,20	2,635	7,19	10,84
5-SSE	12,93	2,699	6,68	11,50
6-S	12,26	2,219	7,85	10,86
7-SSW	13,13	2,388	10,29	11,64
8-WSW	13,13	2,264	12,14	11,63
9-W	12,46	2,205	12,19	11,04
10-WNW	12,55	2,393	13,40	11,12
11-NNW	13,40	2,635	11,89	11,90
Mean	**12,40**	**2,293**	**100,00**	**10,99**



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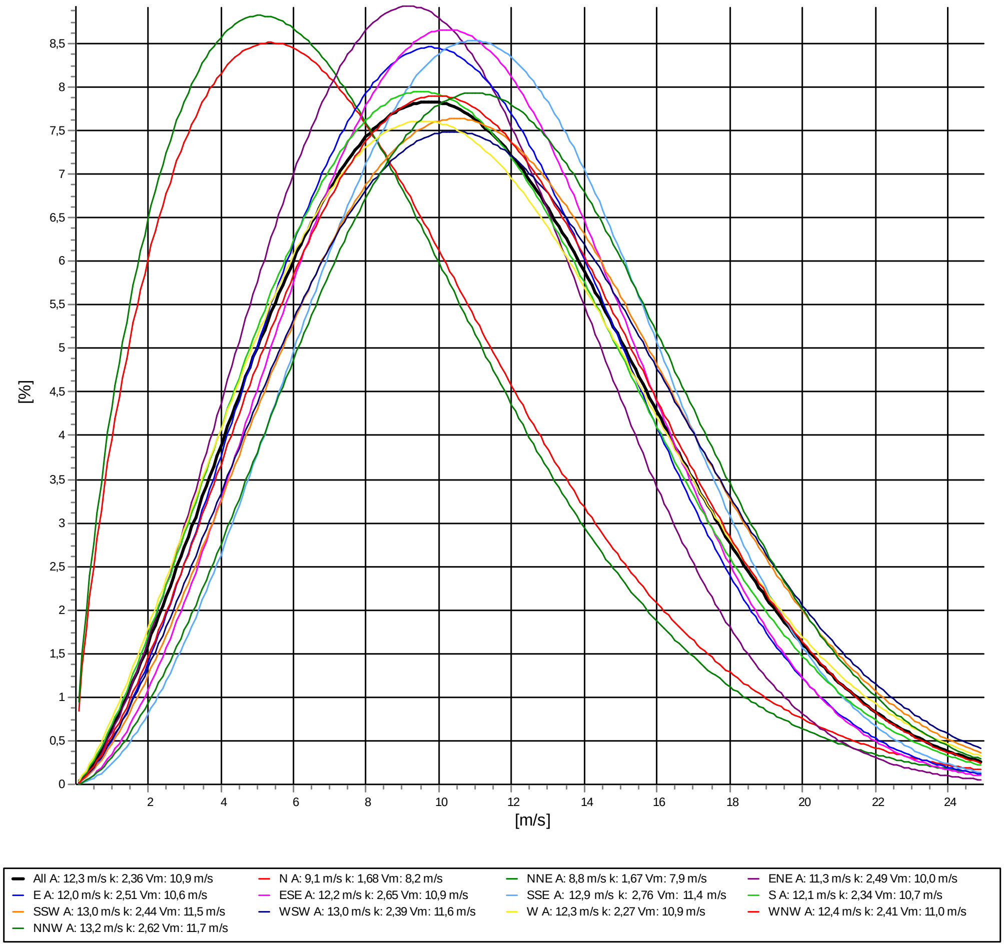
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **150,00m - MCP LT - 150m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,15	1,685	3,99	8,17
1-NNE	8,79	1,670	3,05	7,85
2-ENE	11,28	2,490	5,08	10,01
3-E	11,97	2,506	6,40	10,62
4-ESE	12,22	2,648	7,09	10,86
5-SSE	12,85	2,765	6,61	11,44
6-S	12,08	2,343	7,97	10,70
7-SSW	12,99	2,445	10,28	11,52
8-WSW	13,03	2,393	12,12	11,55
9-W	12,33	2,272	12,09	10,92
10-WNW	12,43	2,412	13,33	11,02
11-NNW	13,21	2,617	11,98	11,73
Mean	**12,31**	**2,355**	**100,00**	**10,91**



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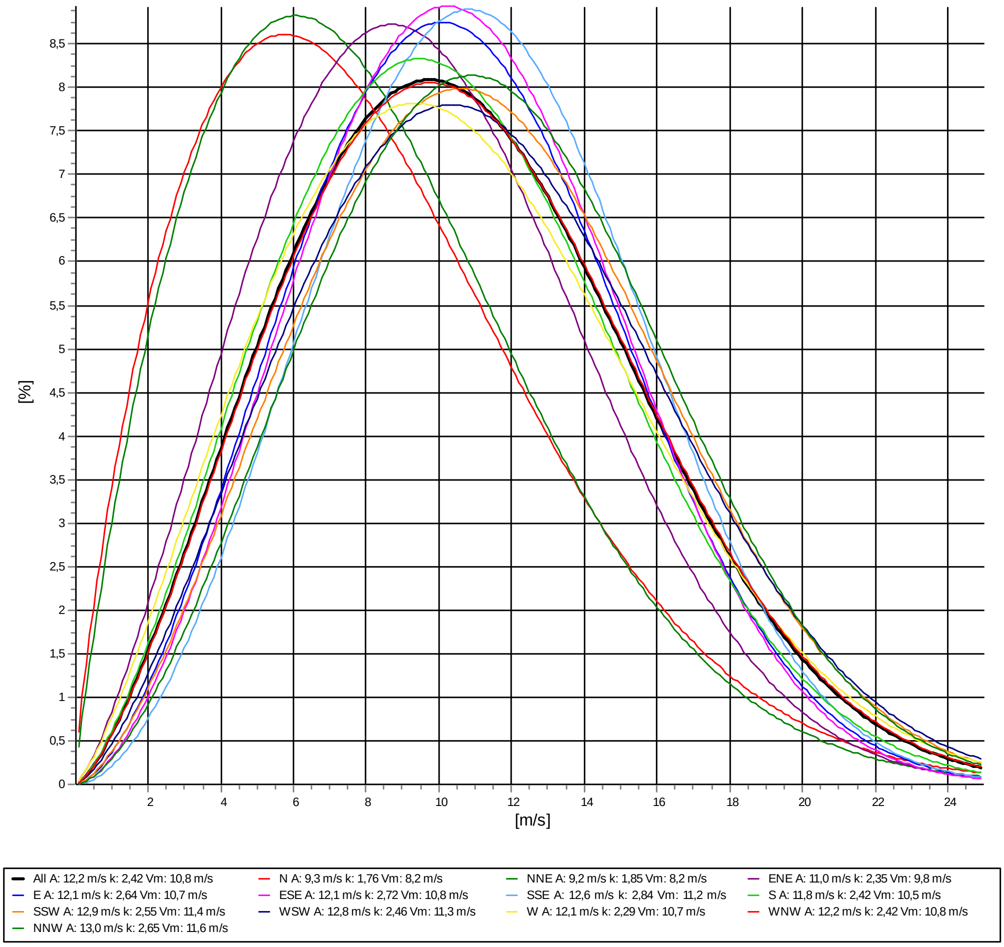
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **120,00m - MCP LT - 120m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,25	1,765	3,82	8,24
1-NNE	9,25	1,845	3,03	8,21
2-ENE	11,03	2,350	5,22	9,77
3-E	12,07	2,643	6,45	10,73
4-ESE	12,11	2,721	7,32	10,77
5-SSE	12,62	2,845	6,68	11,25
6-S	11,82	2,421	7,90	10,48
7-SSW	12,85	2,552	10,22	11,41
8-WSW	12,78	2,460	12,19	11,33
9-W	12,05	2,286	11,87	10,67
10-WNW	12,20	2,416	13,50	10,82
11-NNW	13,02	2,654	11,81	11,57
Mean	**12,15**	**2,416**	**100,00**	**10,77**



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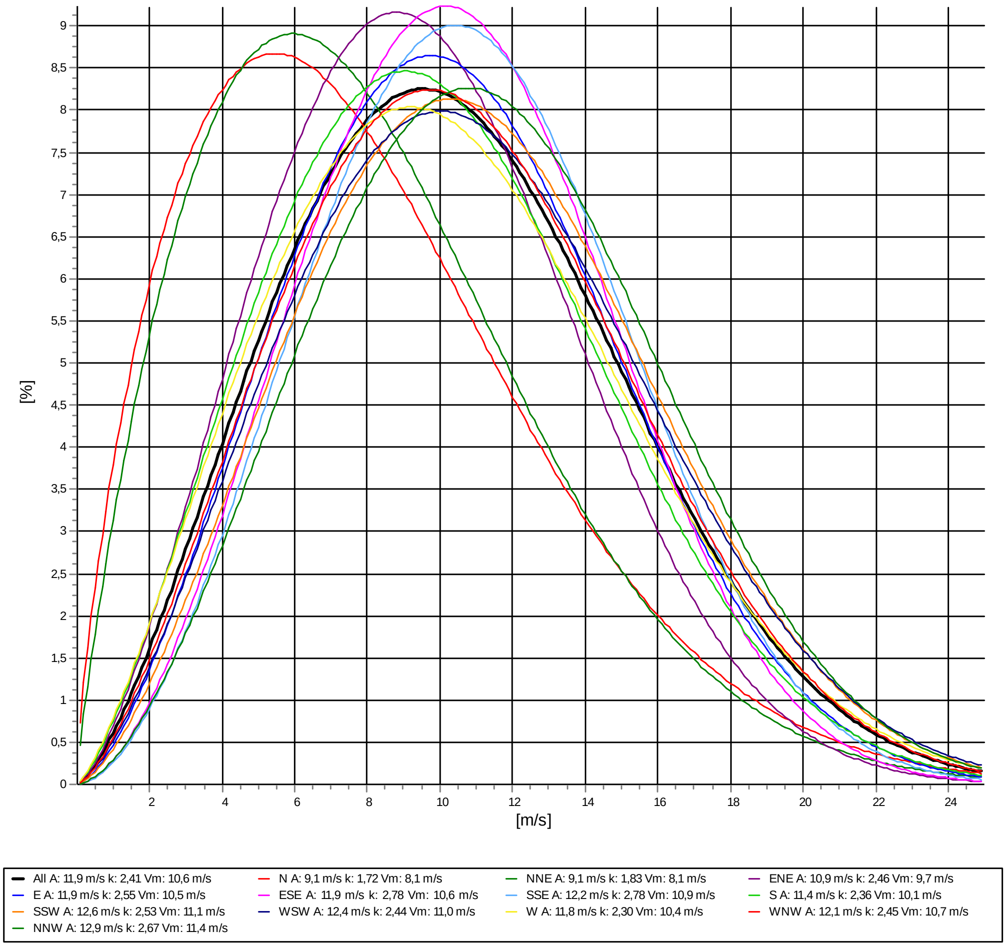
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **100,00m - MCP LT - 100m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,07	1,721	3,80	8,08
1-NNE	9,13	1,833	3,11	8,11
2-ENE	10,89	2,462	5,33	9,66
3-E	11,86	2,549	6,54	10,52
4-ESE	11,92	2,778	7,24	10,61
5-SSE	12,24	2,783	6,83	10,90
6-S	11,41	2,361	7,97	10,11
7-SSW	12,56	2,534	10,20	11,14
8-WSW	12,42	2,445	12,13	11,02
9-W	11,79	2,302	11,80	10,44
10-WNW	12,06	2,451	13,43	10,69
11-NNW	12,87	2,666	11,62	11,44
Mean	**11,90**	**2,413**	**100,00**	**10,55**



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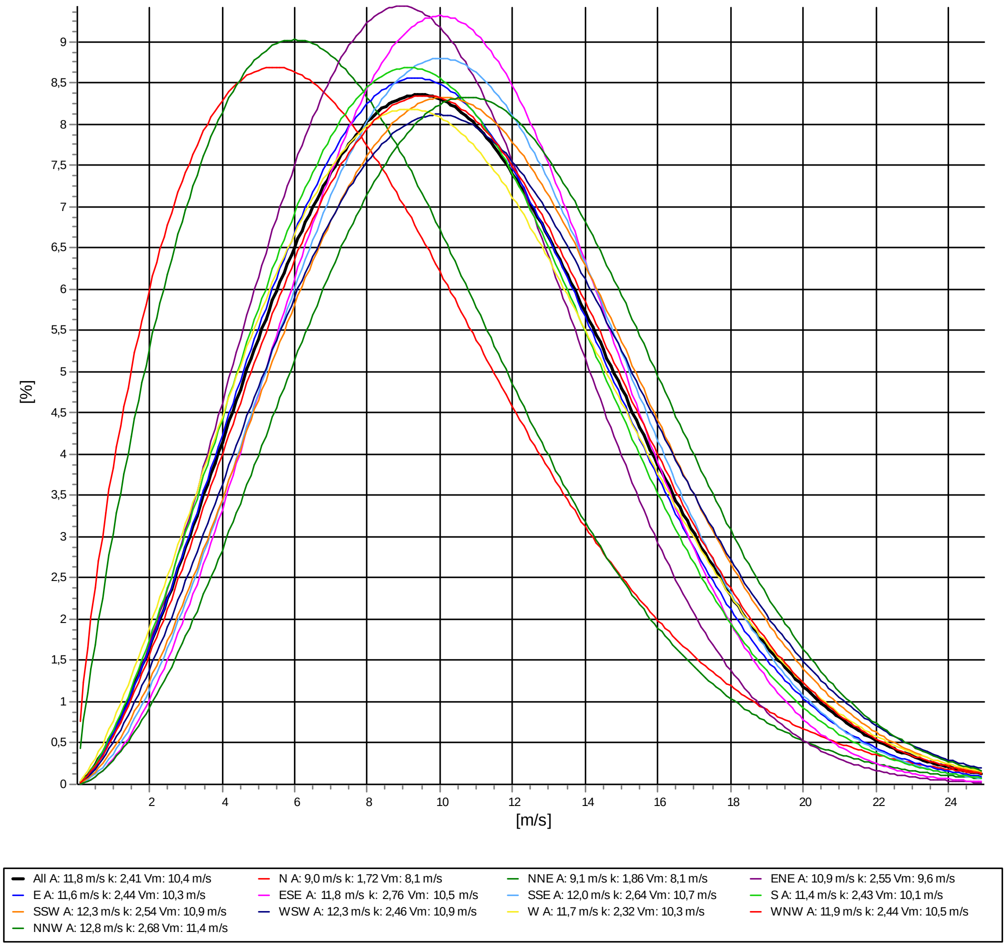
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **90,00m - MCP LT - 90m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,04	1,716	3,75	8,06
1-NNE	9,08	1,857	3,24	8,06
2-ENE	10,87	2,546	5,36	9,65
3-E	11,58	2,442	6,61	10,27
4-ESE	11,77	2,762	7,25	10,47
5-SSE	12,00	2,642	6,81	10,67
6-S	11,38	2,431	7,95	10,09
7-SSW	12,30	2,543	10,27	10,92
8-WSW	12,30	2,463	12,05	10,91
9-W	11,66	2,324	11,76	10,34
10-WNW	11,88	2,442	13,41	10,53
11-NNW	12,81	2,675	11,54	11,39
Mean	**11,76**	**2,414**	**100,00**	**10,43**



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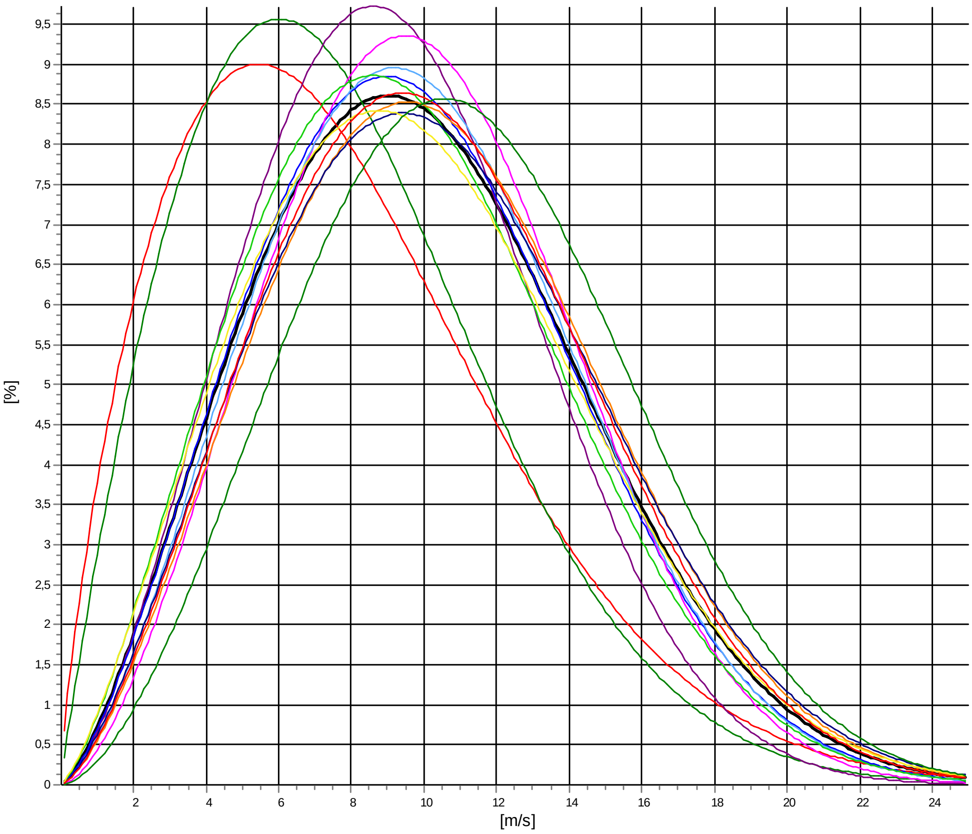
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **60,00m - MCP LT - 60m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,82	1,755	3,81	7,85
1-NNE	8,77	1,932	3,09	7,78
2-ENE	10,49	2,532	5,63	9,31
3-E	11,16	2,431	6,61	9,89
4-ESE	11,31	2,650	7,33	10,05
5-SSE	11,27	2,498	6,75	10,00
6-S	10,86	2,352	8,08	9,63
7-SSW	11,76	2,480	10,28	10,43
8-WSW	11,73	2,421	11,83	10,40
9-W	11,23	2,297	11,73	9,95
10-WNW	11,59	2,475	13,48	10,28
11-NNW	12,54	2,699	11,36	11,15
Mean	**11,32**	**2,389**	**100,00**	**10,03**



All A: 11,3 m/s k: 2,39 Vm: 10,0 m/s
N A: 8,8 m/s k: 1,75 Vm: 7,9 m/s
NNE A: 8,8 m/s k: 1,93 Vm: 7,8 m/s
ENE A: 10,5 m/s k: 2,53 Vm: 9,3 m/s
E A: 11,2 m/s k: 2,43 Vm: 9,9 m/s
ESE A: 11,3 m/s k: 2,65 Vm: 10,1 m/s
SSE A: 11,3 m/s k: 2,50 Vm: 10,0 m/s
S A: 10,9 m/s k: 2,35 Vm: 9,6 m/s
SSW A: 11,8 m/s k: 2,48 Vm: 10,4 m/s
WSW A: 11,7 m/s k: 2,42 Vm: 10,4 m/s
W A: 11,2 m/s k: 2,30 Vm: 9,9 m/s
WNW A: 11,6 m/s k: 2,47 Vm: 10,3 m/s
NNW A: 12,5 m/s k: 2,70 Vm: 11,2 m/s

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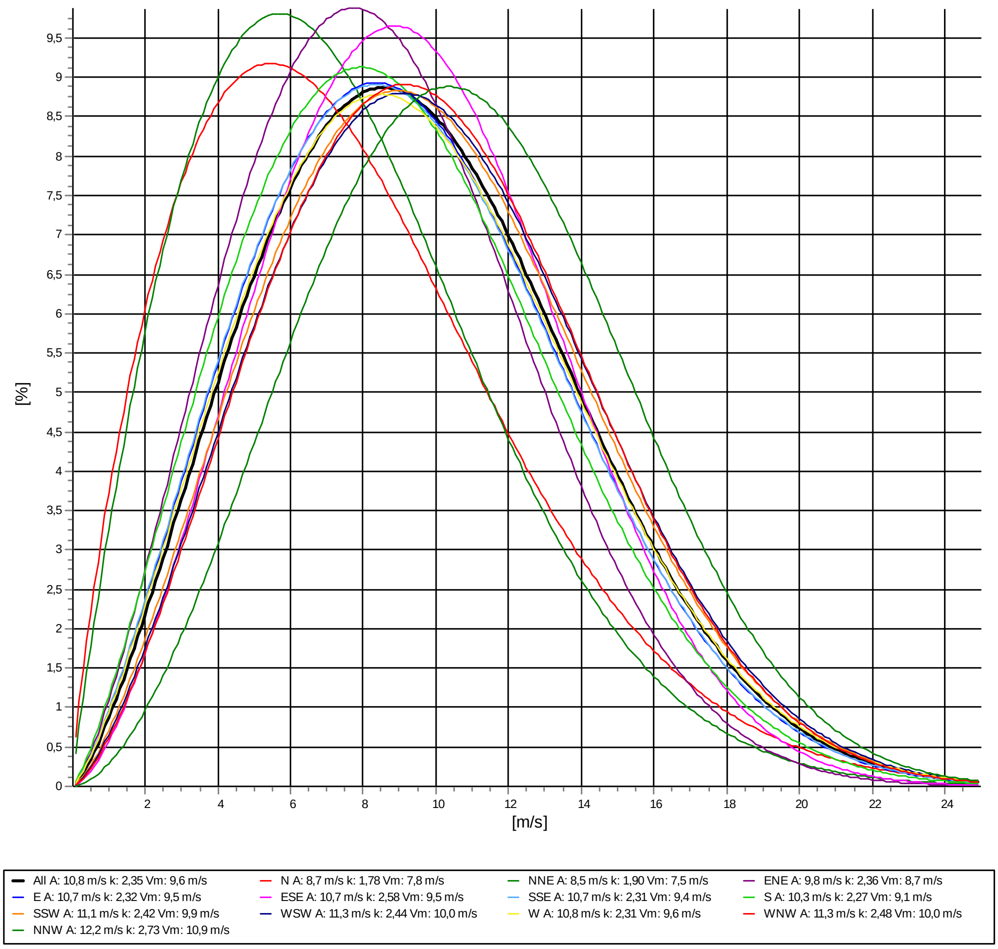
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **40,00m - MCP LT - 40m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,71	1,777	3,83	7,75
1-NNE	8,46	1,897	3,12	7,51
2-ENE	9,76	2,358	5,80	8,65
3-E	10,67	2,321	6,65	9,45
4-ESE	10,72	2,576	7,37	9,52
5-SSE	10,67	2,310	6,76	9,45
6-S	10,26	2,267	8,00	9,09
7-SSW	11,14	2,418	10,33	9,88
8-WSW	11,27	2,445	11,74	10,00
9-W	10,81	2,311	11,73	9,58
10-WNW	11,26	2,479	13,36	9,99
11-NNW	12,23	2,733	11,31	10,88
Mean	**10,85**	**2,348**	**100,00**	**9,61**



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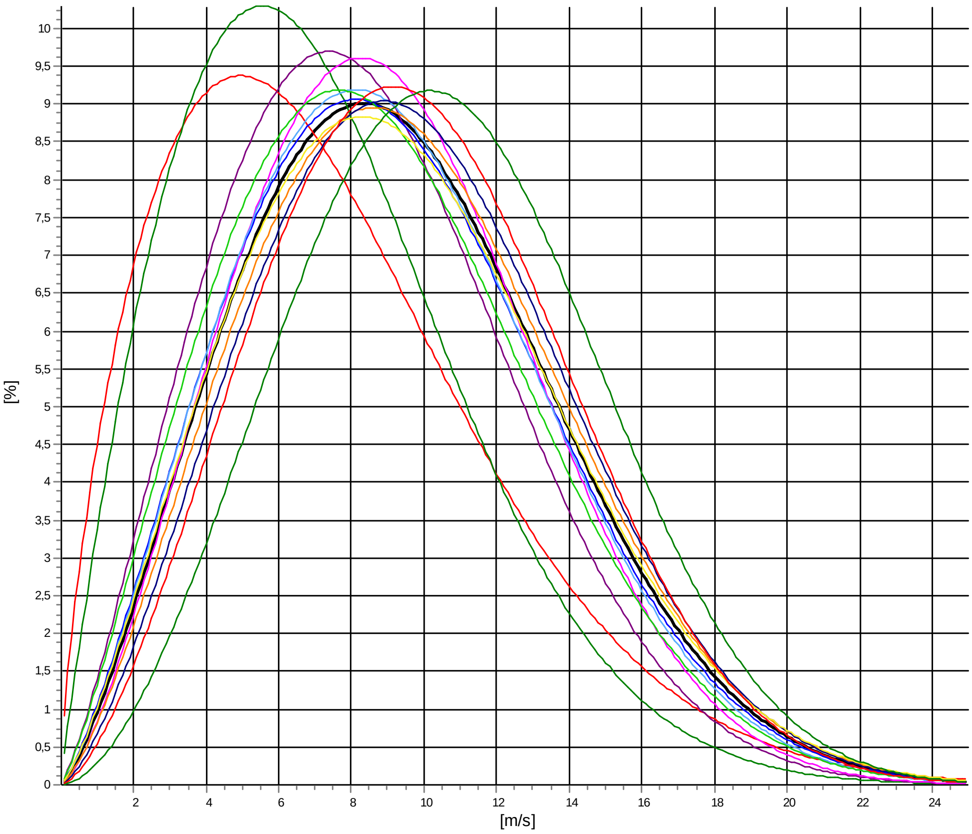
Meteo data report - Weibull data overview

Mast: Buoy 1 WS170 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **30,00m - MCP LT - 30m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,34	1,701	3,85	7,44
1-NNE	8,12	1,922	3,17	7,21
2-ENE	9,59	2,244	5,61	8,49
3-E	10,42	2,293	6,90	9,23
4-ESE	10,28	2,431	7,29	9,12
5-SSE	10,36	2,319	6,71	9,18
6-S	10,04	2,220	8,09	8,89
7-SSW	10,85	2,380	10,21	9,62
8-WSW	11,03	2,459	11,76	9,78
9-W	10,67	2,286	11,77	9,45
10-WNW	11,13	2,555	13,35	9,88
11-NNW	11,96	2,767	11,31	10,64
Mean	**10,60**	**2,328**	**100,00**	**9,39**



- All A: 10,6 m/s k: 2,33 Vm: 9,4 m/s
- N A: 8,3 m/s k: 1,70 Vm: 7,4 m/s
- NNE A: 8,1 m/s k: 1,92 Vm: 7,2 m/s
- ENE A: 9,6 m/s k: 2,24 Vm: 8,5 m/s
- E A: 10,4 m/s k: 2,29 Vm: 9,2 m/s
- ESE A: 10,3 m/s k: 2,43 Vm: 9,1 m/s
- SSE A: 10,4 m/s k: 2,32 Vm: 9,2 m/s
- S A: 10,0 m/s k: 2,22 Vm: 8,9 m/s
- SSW A: 10,9 m/s k: 2,38 Vm: 9,6 m/s
- WSW A: 11,0 m/s k: 2,46 Vm: 9,8 m/s
- W A: 10,7 m/s k: 2,29 Vm: 9,5 m/s
- WNW A: 11,1 m/s k: 2,55 Vm: 9,9 m/s
- NNW A: 12,0 m/s k: 2,77 Vm: 10,6 m/s

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

270,00m - MCP LT - 270m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,20	8,66	7,62	9,52	10,00	10,91	11,00	11,11	12,16	12,39	11,55	11,34	11,98
0		0,49	355	26	12	18	13	25	54	39	30	37	27	42	32
1	0,50	1,49	1406	116	123	154	99	95	104	91	159	162	141	89	73
2	1,50	2,49	3273	329	321	272	308	252	242	197	289	292	285	246	240
3	2,50	3,49	5490	441	423	511	451	413	297	437	359	495	601	610	452
4	3,50	4,49	7462	477	480	512	600	801	501	489	434	665	903	881	719
5	4,50	5,49	9521	687	679	646	550	804	712	779	857	682	1121	1232	772
6	5,50	6,49	10412	675	762	683	657	586	566	866	873	1193	1440	1250	861
7	6,50	7,49	11139	581	495	463	818	855	720	1044	1174	1275	1462	1394	858
8	7,50	8,49	11072	396	318	505	844	675	647	983	1296	1406	1238	1538	1226
9	8,50	9,49	11561	362	307	663	654	692	653	965	1181	1417	1614	1719	1334
10	9,50	10,49	12116	405	382	585	457	799	747	974	1214	1319	1511	2180	1543
11	10,50	11,49	12197	275	325	786	512	1100	830	774	1167	1773	1609	1687	1359
12	11,50	12,49	12242	234	271	662	854	948	833	1088	1202	1698	1517	1600	1335
13	12,50	13,49	10641	245	207	486	714	876	764	895	927	1384	1330	1521	1292
14	13,50	14,49	9945	328	200	527	566	813	569	570	950	1481	1210	1416	1315
15	14,50	15,49	8981	305	98	396	543	797	632	508	899	1130	975	1296	1402
16	15,50	16,49	8162	196	88	338	370	612	622	567	990	1021	1036	1232	1090
17	16,50	17,49	6650	146	50	184	346	472	437	514	844	1033	915	846	863
18	17,50	18,49	5091	118	38	162	291	408	377	350	612	787	771	618	559
19	18,50	19,49	4664	88	35	99	188	353	276	325	658	806	606	579	651
20	19,50	20,49	3137	77	18	55	75	215	181	363	487	502	360	409	395
21	20,50	21,49	2620	43	8	59	89	201	211	305	361	487	288	244	324
22	21,50	22,49	1914	18	14	33	36	102	85	190	259	401	224	260	292
23	22,50	23,49	1727	8	4	26	14	77	61	118	374	379	233	212	221
24	23,50	24,49	951	11	4	3	7	38	45	74	146	211	170	99	143
25	24,50	25,49	884	11	1	4	2	23	21	51	177	164	208	123	99
26	25,50	26,49	626	4	2	2	1	3	9	34	133	156	139	79	64
27	26,50	27,49	382	2	2	1	0	2	5	28	57	136	84	34	31
28	27,50	28,49	253	0	1	1	0	0	3	19	38	74	64	32	21
29	28,50	29,49	170	0	2	0	0	0	0	14	30	54	39	19	12
30	29,50	30,49	99	0	0	0	0	0	1	3	10	41	20	17	7
31	30,50	31,49	68	0	2	0	0	0	0	3	9	23	16	10	5
32	31,50	32,49	33	0	0	0	0	0	0	1	3	9	14	5	1
33	32,50	33,49	34	0	2	0	0	0	0	0	3	8	11	5	5
34	33,50	34,49	19	0	0	0	0	0	0	0	3	2	6	6	2
35	34,50	35,49	13	0	0	0	0	0	0	0	0	4	7	2	0
36	35,50	36,49	3	0	0	0	0	0	0	0	1	0	2	0	0
37	36,50	37,49	3	0	0	0	0	0	0	0	0	0	2	0	1
38	37,50	38,49	1	0	0	0	0	0	0	0	1	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	2	0	0	0	0	0	0	0	0	1	1	0	0
41	40,50		1	0	0	0	0	0	0	0	0	0	1	0	0

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

240,00m - MCP LT - 240m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,12	8,61	7,54	9,64	9,90	10,88	11,05	11,05	12,07	12,29	11,36	11,27	11,85
0		0,49	342	29	21	16	13	26	48	32	31	35	36	34	21
1	0,50	1,49	1456	114	169	145	129	91	100	109	138	160	141	78	82
2	1,50	2,49	3315	295	354	275	274	253	220	212	284	283	296	302	267
3	2,50	3,49	5431	430	413	520	450	463	280	371	325	526	593	597	463
4	3,50	4,49	7519	508	481	552	637	663	519	483	461	718	887	869	741
5	4,50	5,49	9491	703	625	599	658	786	675	810	797	698	1153	1219	768
6	5,50	6,49	10761	742	765	651	645	622	633	900	971	1153	1494	1247	938
7	6,50	7,49	11146	511	512	426	798	890	684	1019	1204	1316	1519	1403	864
8	7,50	8,49	11536	381	340	577	986	645	733	988	1343	1469	1354	1568	1152
9	8,50	9,49	11704	402	321	633	669	719	643	975	1222	1330	1540	1842	1408
10	9,50	10,49	11707	394	399	646	405	719	763	918	1102	1260	1510	2062	1529
11	10,50	11,49	12412	238	345	653	593	1084	745	921	1322	1768	1629	1765	1349
12	11,50	12,49	12206	277	200	709	805	1014	890	1029	1195	1660	1491	1630	1306
13	12,50	13,49	10864	258	209	577	784	809	756	914	1016	1405	1249	1531	1356
14	13,50	14,49	10058	313	190	506	556	907	698	555	985	1465	1202	1307	1374
15	14,50	15,49	8665	271	109	423	571	717	681	485	762	1176	971	1325	1174
16	15,50	16,49	8087	224	84	290	408	523	571	523	1056	1054	1005	1231	1118
17	16,50	17,49	6802	122	48	267	304	477	499	573	831	1017	928	867	869
18	17,50	18,49	5246	106	34	170	257	500	368	312	639	836	703	684	637
19	18,50	19,49	4339	72	37	99	197	311	253	369	609	720	586	561	525
20	19,50	20,49	3125	51	26	60	75	218	237	310	532	534	319	327	436
21	20,50	21,49	2438	71	12	57	67	169	176	285	346	516	212	244	283
22	21,50	22,49	1949	12	11	48	44	95	70	201	262	398	270	276	262
23	22,50	23,49	1509	10	7	26	14	69	57	94	264	342	221	190	215
24	23,50	24,49	1067	6	3	6	8	31	53	74	272	196	183	111	124
25	24,50	25,49	670	6	4	4	3	18	17	44	128	136	163	93	54
26	25,50	26,49	517	3	3	2	0	2	8	35	99	142	84	59	80
27	26,50	27,49	332	5	0	1	0	2	5	26	41	112	70	32	38
28	27,50	28,49	227	7	1	2	0	0	4	15	33	71	43	28	23
29	28,50	29,49	165	1	2	0	0	0	0	11	19	47	55	20	10
30	29,50	30,49	79	0	2	0	0	0	1	1	10	31	17	10	7
31	30,50	31,49	60	0	1	0	0	0	0	4	6	16	19	9	5
32	31,50	32,49	32	0	1	0	0	0	0	0	4	9	11	7	0
33	32,50	33,49	27	0	1	0	0	0	0	0	0	5	13	4	4
34	33,50	34,49	20	0	0	0	0	0	0	0	3	4	6	5	2
35	34,50	35,49	7	0	0	0	0	0	0	0	1	0	5	1	0
36	35,50	36,49	2	0	0	0	0	0	0	0	0	0	2	0	0
37	36,50	37,49	4	0	0	0	0	0	0	0	1	0	2	0	1
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	2	0	0	0	0	0	0	0	0	1	1	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		1	0	0	0	0	0	0	0	0	0	1	0	0

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29/03/2023 10.20

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

200,00m - MCP LT - 200m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,96	8,53	7,56	9,56	9,77	10,83	11,03	10,90	11,91	12,05	11,12	11,10	11,67
0		0,49	370	23	21	19	25	49	30	35	32	34	28	48	26
1	0,50	1,49	1462	120	163	136	127	94	91	116	147	145	142	97	84
2	1,50	2,49	3328	285	351	285	226	230	196	238	339	262	334	308	274
3	2,50	3,49	5645	432	442	582	555	432	302	340	290	561	590	616	503
4	3,50	4,49	7542	535	537	480	635	642	519	480	469	674	911	912	748
5	4,50	5,49	9623	740	664	632	746	704	679	741	808	733	1178	1209	789
6	5,50	6,49	11087	696	791	698	764	602	654	1021	1037	1198	1484	1254	888
7	6,50	7,49	11432	550	469	409	827	856	749	998	1213	1379	1602	1476	904
8	7,50	8,49	11394	393	334	450	845	693	724	1061	1344	1446	1358	1545	1201
9	8,50	9,49	11787	390	348	768	808	723	634	976	1094	1300	1469	1883	1394
10	9,50	10,49	11987	355	365	649	408	779	848	942	1169	1356	1561	2051	1504
11	10,50	11,49	12995	238	344	672	681	1178	745	1036	1357	1816	1700	1835	1393
12	11,50	12,49	11963	260	221	752	784	867	876	958	1180	1642	1410	1590	1423
13	12,50	13,49	11147	252	188	486	706	927	819	936	1141	1581	1297	1445	1369
14	13,50	14,49	10025	346	254	537	615	863	764	472	949	1449	1196	1305	1275
15	14,50	15,49	8806	275	120	429	499	803	644	450	895	1109	1004	1330	1248
16	15,50	16,49	8340	230	75	296	423	531	673	551	988	1147	1082	1251	1093
17	16,50	17,49	6467	101	57	224	371	571	485	474	863	982	810	797	732
18	17,50	18,49	5287	92	36	162	288	368	327	418	804	823	752	570	647
19	18,50	19,49	3763	73	35	95	186	257	278	363	474	489	446	510	557
20	19,50	20,49	2968	64	28	72	78	182	191	267	452	622	233	358	421
21	20,50	21,49	2300	46	17	52	46	149	175	283	291	447	283	270	241
22	21,50	22,49	1752	8	10	49	24	81	75	161	306	362	250	233	193
23	22,50	23,49	1346	10	6	15	15	55	62	96	293	253	195	174	172
24	23,50	24,49	873	4	4	5	9	23	44	56	160	163	182	109	114
25	24,50	25,49	563	6	4	3	2	11	8	36	114	143	89	64	83
26	25,50	26,49	405	19	1	3	0	3	8	34	64	111	80	40	42
27	26,50	27,49	249	1	1	0	0	0	4	13	43	84	41	35	27
28	27,50	28,49	159	0	1	0	0	0	3	18	21	49	34	18	15
29	28,50	29,49	96	0	1	0	0	0	0	3	17	36	19	10	10
30	29,50	30,49	54	0	2	0	0	0	1	3	3	16	11	14	4
31	30,50	31,49	39	0	1	0	0	0	0	1	5	11	14	4	3
32	31,50	32,49	33	0	2	0	0	0	0	0	0	5	16	7	3
33	32,50	33,49	19	0	0	0	0	0	0	0	3	3	6	4	3
34	33,50	34,49	7	0	0	0	0	0	0	0	1	3	1	2	0
35	34,50	35,49	1	0	0	0	0	0	0	0	0	1	0	0	0
36	35,50	36,49	3	0	0	0	0	0	0	0	1	0	1	0	1
37	36,50	37,49	1	0	0	0	0	0	0	0	0	0	1	0	0
38	37,50	38,49	1	0	0	0	0	0	0	0	1	0	0	0	0
39	38,50	39,49	1	0	0	0	0	0	0	0	0	0	1	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 10.20

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

180,00m - MCP LT - 180m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,85	8,41	7,62	9,55	9,73	10,81	10,92	10,83	11,78	11,84	10,97	11,01	11,57
0		0,49	365	25	19	21	24	31	55	26	27	28	21	59	29
1	0,50	1,49	1484	159	166	146	106	73	102	125	149	142	124	94	98
2	1,50	2,49	3245	274	322	250	237	196	196	224	327	300	327	287	305
3	2,50	3,49	5793	482	439	570	539	468	335	319	315	580	568	662	516
4	3,50	4,49	7625	560	554	504	730	624	489	460	473	692	940	867	732
5	4,50	5,49	9386	698	576	650	651	686	676	742	784	740	1146	1223	814
6	5,50	6,49	11755	726	842	757	826	661	693	1041	1188	1200	1550	1343	928
7	6,50	7,49	11012	563	456	395	781	761	668	1002	1179	1471	1531	1325	880
8	7,50	8,49	11776	382	338	511	810	694	788	1145	1263	1441	1434	1672	1298
9	8,50	9,49	12074	380	305	724	877	853	672	991	1089	1376	1543	1967	1297
10	9,50	10,49	12146	370	378	750	447	839	753	889	1218	1499	1581	1929	1493
11	10,50	11,49	12942	252	311	683	699	1204	832	1064	1294	1801	1605	1732	1465
12	11,50	12,49	12244	273	244	744	658	825	928	1101	1208	1656	1495	1699	1413
13	12,50	13,49	11210	245	209	500	726	913	836	833	1269	1578	1280	1418	1403
14	13,50	14,49	10336	336	240	629	689	896	753	509	1024	1395	1119	1363	1383
15	14,50	15,49	8902	255	129	423	507	812	670	443	915	1273	969	1369	1137
16	15,50	16,49	8186	244	84	289	381	605	651	596	981	1096	1120	1189	950
17	16,50	17,49	6117	87	62	203	326	500	451	495	883	860	769	720	761
18	17,50	18,49	4998	90	37	166	311	340	292	381	669	739	653	664	656
19	18,50	19,49	3819	69	27	92	182	248	276	368	513	608	383	467	586
20	19,50	20,49	2721	42	26	88	77	169	223	268	395	550	251	275	357
21	20,50	21,49	2134	65	19	48	28	124	150	237	317	428	262	266	190
22	21,50	22,49	1905	11	11	34	22	85	72	147	335	367	296	269	256
23	22,50	23,49	1005	11	5	12	14	50	43	73	221	187	131	109	149
24	23,50	24,49	750	2	7	3	10	17	39	49	145	146	121	102	109
25	24,50	25,49	527	6	3	1	0	13	4	33	88	125	100	60	94
26	25,50	26,49	307	11	1	1	0	2	8	30	51	90	50	32	31
27	26,50	27,49	230	8	1	2	0	0	5	17	37	68	37	29	26
28	27,50	28,49	123	0	1	0	0	0	2	10	15	47	18	16	14
29	28,50	29,49	79	0	2	0	0	0	0	7	8	20	18	15	9
30	29,50	30,49	43	0	2	0	0	0	0	0	3	7	17	9	5
31	30,50	31,49	37	0	0	0	0	0	1	3	2	10	15	6	0
32	31,50	32,49	23	0	2	0	0	0	0	0	3	2	6	5	5
33	32,50	33,49	10	0	0	0	0	0	0	0	0	2	4	3	1
34	33,50	34,49	5	0	0	0	0	0	0	0	1	4	0	0	0
35	34,50	35,49	3	0	0	0	0	0	0	0	1	0	1	0	1
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	2	0	0	0	0	0	0	0	1	0	1	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	1	0	0	0	0	0	0	0	0	0	1	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 10.20

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

150,00m - MCP LT - 150m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,71	8,29	7,55	9,42	9,79	10,77	10,94	10,43	11,72	11,62	10,78	10,91	11,38
0		0,49	369	32	33	38	19	12	29	32	24	43	35	40	32
1	0,50	1,49	1433	159	148	153	74	83	111	143	116	127	131	98	90
2	1,50	2,49	3348	343	304	294	240	231	227	247	295	304	304	296	263
3	2,50	3,49	5956	511	455	583	577	499	384	325	282	554	635	622	529
4	3,50	4,49	7911	560	575	491	629	644	494	621	491	690	960	936	820
5	4,50	5,49	9549	678	574	703	695	700	583	801	726	844	1196	1234	815
6	5,50	6,49	11447	719	854	676	781	601	680	987	1105	1188	1628	1338	890
7	6,50	7,49	11087	541	477	536	708	659	842	992	1184	1524	1473	1235	916
8	7,50	8,49	11763	363	321	691	866	691	692	1082	1231	1247	1574	1721	1284
9	8,50	9,49	11946	347	287	709	809	814	678	1120	1293	1344	1402	1843	1300
10	9,50	10,49	13020	452	493	681	548	989	768	944	1145	1665	1651	2124	1560
11	10,50	11,49	12712	289	266	577	648	1011	819	1171	1365	1577	1570	1900	1519
12	11,50	12,49	13279	251	219	777	925	1140	966	954	1238	1830	1622	1905	1452
13	12,50	13,49	11423	208	263	567	753	844	855	815	1182	1729	1340	1463	1404
14	13,50	14,49	9699	285	233	475	597	963	710	570	1084	1369	1069	1171	1173
15	14,50	15,49	9703	259	130	522	468	880	661	602	1124	1271	1260	1342	1184
16	15,50	16,49	8047	198	104	333	470	642	664	567	958	1129	821	1163	998
17	16,50	17,49	6037	117	62	211	219	450	444	520	789	882	751	810	782
18	17,50	18,49	4486	86	39	141	305	323	401	305	597	704	485	564	536
19	18,50	19,49	3418	113	23	81	149	232	328	248	520	599	359	297	469
20	19,50	20,49	2548	53	13	108	115	148	199	210	386	472	285	278	281
21	20,50	21,49	2215	26	6	46	51	88	152	134	380	368	284	400	280
22	21,50	22,49	1523	10	4	20	16	90	62	99	258	304	217	222	221
23	22,50	23,49	768	10	4	11	9	31	32	66	135	117	130	90	133
24	23,50	24,49	634	5	0	5	3	22	29	46	131	98	130	77	88
25	24,50	25,49	367	4	1	1	5	7	14	27	78	86	61	35	48
26	25,50	26,49	208	2	0	0	0	0	5	17	33	56	42	33	20
27	26,50	27,49	159	4	2	0	0	0	4	12	24	52	30	16	15
28	27,50	28,49	101	13	0	0	0	0	0	5	12	18	21	13	19
29	28,50	29,49	43	1	0	0	0	0	0	3	3	9	13	10	4
30	29,50	30,49	41	0	0	0	0	0	0	0	3	8	12	11	7
31	30,50	31,49	31	0	1	0	0	0	0	0	1	4	13	7	5
32	31,50	32,49	18	0	0	0	0	0	0	0	2	3	7	4	2
33	32,50	33,49	12	0	1	0	0	0	0	0	1	2	5	2	1
34	33,50	34,49	6	0	0	0	0	0	0	0	0	0	5	1	0
35	34,50	35,49	5	1	0	0	0	0	0	0	1	1	2	0	0
36	35,50	36,49	4	0	0	0	0	0	0	0	0	0	4	0	0
37	36,50	37,49	3	0	0	0	0	0	0	0	1	0	2	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		1	0	0	0	0	0	0	0	0	0	1	0	0

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

120,00m - MCP LT - 120m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,55	8,18	7,61	9,50	9,82	10,60	10,64	10,37	11,44	11,35	10,55	10,68	11,26
0		0,49	337	44	21	26	3	12	27	37	24	34	41	41	27
1	0,50	1,49	1485	141	176	138	75	86	107	119	122	164	112	127	118
2	1,50	2,49	3325	281	293	300	192	230	249	215	247	358	320	381	259
3	2,50	3,49	5851	402	518	459	482	529	378	430	372	507	625	645	504
4	3,50	4,49	7946	519	509	558	617	661	475	592	513	699	1028	1018	757
5	4,50	5,49	9961	741	579	630	842	673	656	838	808	839	1327	1179	849
6	5,50	6,49	11124	769	852	772	711	760	624	915	1063	1116	1388	1262	892
7	6,50	7,49	11590	520	526	679	665	735	765	1135	1138	1463	1640	1341	983
8	7,50	8,49	12035	395	281	663	910	690	741	1144	1332	1336	1499	1803	1241
9	8,50	9,49	12500	410	383	727	747	808	687	966	1232	1387	1582	2101	1470
10	9,50	10,49	13093	413	427	692	637	1007	845	1138	1260	1523	1707	1925	1519
11	10,50	11,49	13619	301	237	536	652	1195	990	1088	1419	1894	1732	2085	1490
12	11,50	12,49	13120	196	279	710	856	1071	1123	985	1390	1845	1380	1785	1500
13	12,50	13,49	11734	267	279	654	798	961	858	677	1322	1673	1382	1443	1420
14	13,50	14,49	10433	312	218	520	680	879	738	668	1309	1401	1182	1268	1258
15	14,50	15,49	9717	184	147	521	586	927	720	638	1157	1352	1039	1306	1140
16	15,50	16,49	7584	162	107	412	314	577	513	682	976	1026	918	1066	831
17	16,50	17,49	5629	122	43	199	318	425	430	424	725	734	675	787	747
18	17,50	18,49	4089	61	36	141	245	274	275	291	580	728	425	489	544
19	18,50	19,49	2850	68	21	73	114	207	204	238	383	478	317	281	466
20	19,50	20,49	2250	46	19	64	66	121	142	219	353	366	246	305	303
21	20,50	21,49	1857	27	12	44	48	109	103	145	273	334	277	311	174
22	21,50	22,49	1154	12	7	25	16	89	51	73	162	172	163	152	232
23	22,50	23,49	804	6	8	28	21	33	36	62	136	105	138	104	127
24	23,50	24,49	435	8	6	3	2	16	17	43	89	82	70	51	48
25	24,50	25,49	290	3	2	0	2	10	13	27	41	67	49	27	49
26	25,50	26,49	196	5	1	0	0	1	3	15	31	59	30	24	27
27	26,50	27,49	113	0	1	1	0	0	3	4	18	25	24	20	17
28	27,50	28,49	69	0	0	0	0	0	1	7	5	11	19	11	15
29	28,50	29,49	58	0	2	0	0	0	0	3	3	7	14	17	12
30	29,50	30,49	27	0	0	0	0	0	0	0	2	6	12	5	2
31	30,50	31,49	19	0	0	0	0	0	0	0	2	5	8	2	2
32	31,50	32,49	13	0	1	0	0	0	0	0	0	0	12	0	0
33	32,50	33,49	4	0	0	0	0	0	0	0	0	1	2	1	0
34	33,50	34,49	3	0	0	0	0	0	0	0	1	1	0	0	1
35	34,50	35,49	3	0	0	0	0	0	0	0	0	1	1	1	0
36	35,50	36,49	2	0	0	0	0	0	0	0	0	1	0	0	1
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		1	0	0	0	0	0	0	0	0	0	1	0	0

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29/03/2023 10.20

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

100,00m - MCP LT - 100m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,35	8,02	7,63	9,37	9,76	10,35	10,43	10,12	11,18	11,11	10,32	10,57	11,12
0		0,49	316	41	14	4	23	15	32	31	21	26	40	49	20
1	0,50	1,49	1541	195	151	133	53	89	79	121	164	169	152	128	107
2	1,50	2,49	3388	296	336	296	233	208	219	236	265	334	352	359	254
3	2,50	3,49	6038	410	540	464	473	518	411	463	364	544	622	677	552
4	3,50	4,49	8079	500	510	564	634	652	551	640	521	707	1066	978	756
5	4,50	5,49	10129	747	627	630	883	749	637	769	819	832	1375	1207	854
6	5,50	6,49	11344	780	829	811	700	670	655	1037	1087	1160	1423	1261	931
7	6,50	7,49	12198	549	511	761	690	761	812	1233	1152	1482	1779	1472	996
8	7,50	8,49	12326	419	314	710	910	745	744	1192	1342	1454	1396	1753	1347
9	8,50	9,49	12652	413	366	792	770	844	762	1015	1284	1374	1585	2057	1390
10	9,50	10,49	14088	363	446	634	699	1082	1011	1129	1317	1794	1843	2171	1599
11	10,50	11,49	14091	238	281	592	686	1320	1133	1148	1513	2049	1689	1901	1541
12	11,50	12,49	13096	235	312	845	926	1033	1056	985	1481	1673	1438	1717	1395
13	12,50	13,49	11270	270	297	611	780	891	754	660	1353	1530	1272	1444	1408
14	13,50	14,49	10513	298	217	443	833	949	669	689	1187	1446	1190	1308	1284
15	14,50	15,49	9344	192	172	458	394	774	673	633	1162	1395	1070	1293	1128
16	15,50	16,49	7273	164	99	413	353	517	514	730	954	857	839	1040	793
17	16,50	17,49	5122	88	40	193	298	315	410	325	715	765	592	694	687
18	17,50	18,49	3387	67	32	112	183	262	251	189	419	549	364	394	565
19	18,50	19,49	2680	51	28	83	136	158	200	248	380	506	262	243	385
20	19,50	20,49	2364	59	11	64	95	121	120	191	329	378	299	396	301
21	20,50	21,49	1509	14	13	41	43	103	88	108	192	213	220	273	201
22	21,50	22,49	978	20	4	17	19	49	40	72	158	145	133	125	196
23	22,50	23,49	592	4	6	8	11	25	27	47	120	86	101	82	75
24	23,50	24,49	375	7	4	2	10	5	20	37	48	64	72	40	66
25	24,50	25,49	259	8	4	0	3	1	7	21	37	66	39	28	45
26	25,50	26,49	139	1	1	1	0	0	4	10	26	34	23	18	21
27	26,50	27,49	70	0	0	0	0	0	1	7	5	11	19	17	10
28	27,50	28,49	78	0	1	0	0	0	0	5	3	8	20	26	15
29	28,50	29,49	32	0	0	0	0	0	0	0	1	5	13	5	8
30	29,50	30,49	25	0	0	0	0	0	0	0	2	4	13	4	2
31	30,50	31,49	9	0	0	0	0	0	0	0	1	2	6	0	0
32	31,50	32,49	7	0	1	0	0	0	0	0	0	2	4	0	0
33	32,50	33,49	3	0	0	0	0	0	0	0	1	0	0	1	1
34	33,50	34,49	2	0	0	0	0	0	0	0	0	0	1	0	1
35	34,50	35,49	2	0	0	0	0	0	0	0	0	1	0	1	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	1	0	0	0	0	0	0	0	0	0	1	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 10.20

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

90,00m - MCP LT - 90m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,26	7,98	7,61	9,29	9,64	10,20	10,19	10,11	10,99	10,88	10,29	10,53	11,13
0		0,49	306	49	15	1	14	18	37	32	9	31	29	51	20
1	0,50	1,49	1521	183	149	117	58	74	80	106	188	179	151	124	112
2	1,50	2,49	3349	289	335	308	213	213	250	237	260	350	318	339	237
3	2,50	3,49	6152	443	579	529	509	490	364	415	394	609	675	659	486
4	3,50	4,49	7987	536	544	539	636	631	559	578	517	705	1024	920	798
5	4,50	5,49	10565	706	591	612	855	780	678	882	960	957	1423	1196	925
6	5,50	6,49	11519	782	798	771	674	777	819	1044	1058	1185	1419	1307	885
7	6,50	7,49	12650	568	604	748	829	840	888	1284	1278	1497	1683	1464	967
8	7,50	8,49	12654	488	287	740	836	730	851	1171	1304	1455	1477	1946	1369
9	8,50	9,49	13052	423	429	855	824	814	870	1077	1347	1400	1532	2159	1322
10	9,50	10,49	14269	375	412	789	715	1111	1019	1214	1505	1871	1767	2024	1467
11	10,50	11,49	14060	221	321	685	771	1223	1242	1066	1671	1878	1586	1858	1538
12	11,50	12,49	12695	237	285	648	797	1068	935	881	1515	1735	1466	1739	1389
13	12,50	13,49	11034	256	315	550	741	874	685	605	1260	1581	1296	1430	1441
14	13,50	14,49	10379	335	208	501	678	811	704	761	1189	1499	1174	1286	1233
15	14,50	15,49	9407	196	180	505	451	825	610	665	1102	1384	1083	1351	1055
16	15,50	16,49	7126	126	97	282	367	496	459	715	931	729	903	1112	909
17	16,50	17,49	4640	115	48	147	215	281	394	307	632	602	527	634	738
18	17,50	18,49	3385	76	50	171	254	232	219	177	410	576	394	358	468
19	18,50	19,49	2605	57	17	95	113	139	175	281	352	476	185	301	414
20	19,50	20,49	2264	44	9	66	81	120	146	172	341	370	303	320	292
21	20,50	21,49	1403	13	7	35	38	85	70	121	211	166	221	246	190
22	21,50	22,49	847	10	5	14	14	37	37	80	131	106	155	120	138
23	22,50	23,49	549	6	4	4	12	17	31	45	95	76	65	68	126
24	23,50	24,49	354	4	1	1	6	6	11	26	50	64	57	34	94
25	24,50	25,49	217	2	1	0	0	2	7	18	31	57	39	39	21
26	25,50	26,49	129	3	1	0	0	0	6	13	11	17	35	21	22
27	26,50	27,49	86	1	3	0	0	0	1	6	8	13	25	16	13
28	27,50	28,49	36	0	0	0	0	0	1	2	1	4	13	11	4
29	28,50	29,49	28	0	1	0	0	0	0	4	1	3	10	6	3
30	29,50	30,49	20	0	0	0	0	0	0	0	3	4	6	2	5
31	30,50	31,49	14	0	0	0	0	0	0	0	0	2	7	3	2
32	31,50	32,49	12	0	1	0	0	0	0	0	1	1	2	4	3
33	32,50	33,49	3	0	0	0	0	0	0	0	0	0	1	1	1
34	33,50	34,49	1	0	0	0	0	0	0	0	1	0	0	0	0
35	34,50	35,49	1	0	0	0	0	0	0	0	0	0	1	0	0
36	35,50	36,49	1	0	0	0	0	0	0	0	0	0	1	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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29/03/2023 10.20

Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

60,00m - MCP LT - 60m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			9,91	7,89	7,50	8,99	9,37	9,86	9,69	9,66	10,55	10,51	9,90	10,27	10,79
0		0,49	310	23	19	1	2	11	34	38	44	44	47	23	24
1	0,50	1,49	1531	150	152	109	61	93	81	107	160	183	189	140	106
2	1,50	2,49	3454	298	310	342	177	199	315	286	254	276	322	369	306
3	2,50	3,49	6455	527	500	502	534	441	438	467	335	674	786	737	514
4	3,50	4,49	8685	546	521	600	723	815	633	659	617	794	1056	902	819
5	4,50	5,49	10490	659	622	673	763	754	610	955	1008	984	1389	1156	917
6	5,50	6,49	12589	828	820	857	725	892	796	1189	1224	1275	1635	1384	964
7	6,50	7,49	13238	610	534	827	938	836	980	1278	1411	1460	1622	1600	1142
8	7,50	8,49	13859	407	411	760	969	987	962	1287	1450	1614	1606	2033	1373
9	8,50	9,49	13895	429	439	699	750	784	1008	1248	1599	1820	1701	2043	1375
10	9,50	10,49	15487	434	530	926	902	1264	1297	1137	1825	1796	1789	1997	1590
11	10,50	11,49	14625	218	403	946	832	1142	1063	965	1509	1965	1820	2071	1691
12	11,50	12,49	12013	224	302	676	918	977	811	795	1381	1578	1347	1647	1357
13	12,50	13,49	10775	298	259	551	553	796	715	839	1299	1538	1182	1436	1309
14	13,50	14,49	10302	281	172	526	622	840	522	843	1319	1480	1145	1346	1206
15	14,50	15,49	7779	159	83	355	393	644	525	539	963	993	964	1199	962
16	15,50	16,49	5864	122	63	225	299	408	389	444	761	791	701	810	851
17	16,50	17,49	4297	113	54	159	256	281	278	254	484	655	518	575	670
18	17,50	18,49	3104	60	32	83	179	203	165	261	457	516	320	356	472
19	18,50	19,49	2076	41	17	46	62	126	152	210	252	328	201	313	328
20	19,50	20,49	1789	52	6	48	64	98	106	126	236	237	238	309	269
21	20,50	21,49	1045	15	4	30	33	69	53	82	151	128	159	153	168
22	21,50	22,49	681	11	4	9	9	28	30	53	119	102	122	72	122
23	22,50	23,49	402	1	3	8	10	10	12	30	59	65	57	67	80
24	23,50	24,49	215	7	2	0	1	3	8	16	22	54	36	34	32
25	24,50	25,49	153	5	1	0	0	0	2	13	20	27	32	26	27
26	25,50	26,49	71	0	2	0	0	0	2	7	6	8	14	14	18
27	26,50	27,49	59	1	1	0	0	0	0	2	6	8	14	16	11
28	27,50	28,49	35	1	0	0	0	0	0	2	1	3	18	7	3
29	28,50	29,49	23	1	0	0	0	0	0	0	3	4	8	4	3
30	29,50	30,49	8	1	0	0	0	0	0	0	0	2	3	0	2
31	30,50	31,49	5	0	0	0	0	0	0	0	1	0	2	0	2
32	31,50	32,49	3	0	0	0	0	0	0	0	0	0	3	0	0
33	32,50	33,49	3	0	0	0	0	0	0	0	1	0	1	1	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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Meteo data report - Frequency distribution (TAB file data)

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

40,00m - MCP LT - 40m - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			9,51	7,81	7,24	8,47	8,97	9,44	9,25	9,16	10,05	10,06	9,53	10,01	10,49
0		0,49	397	19	21	13	20	7	19	54	52	71	61	32	28
1	0,50	1,49	1616	102	168	119	99	79	73	160	158	205	165	151	137
2	1,50	2,49	3756	307	360	352	180	263	361	304	249	308	395	372	305
3	2,50	3,49	6839	520	536	515	570	509	413	430	401	787	880	757	521
4	3,50	4,49	9388	571	578	697	851	886	631	780	691	789	1099	881	934
5	4,50	5,49	11356	713	630	797	764	784	768	1017	1160	1152	1499	1219	853
6	5,50	6,49	13598	868	875	890	810	935	995	1438	1287	1342	1715	1475	968
7	6,50	7,49	14854	561	467	969	1153	1099	1067	1486	1585	1714	1779	1745	1229
8	7,50	8,49	14723	403	508	954	908	903	1192	1345	1674	1752	1625	2050	1409
9	8,50	9,49	15184	482	587	901	937	882	1149	1268	1802	1965	1627	2100	1484
10	9,50	10,49	15731	391	557	1074	841	1344	1232	948	1739	1927	1840	2170	1668
11	10,50	11,49	13569	203	325	707	952	1001	776	941	1419	1841	1798	2054	1552
12	11,50	12,49	11117	248	289	532	652	832	663	777	1364	1353	1289	1559	1559
13	12,50	13,49	10510	275	264	460	507	751	582	812	1312	1697	1178	1415	1257
14	13,50	14,49	9293	284	116	360	550	755	565	723	1133	1201	1105	1370	1131
15	14,50	15,49	7008	154	84	300	415	624	496	484	774	924	874	1031	848
16	15,50	16,49	5134	137	47	199	332	334	287	336	649	786	475	721	831
17	16,50	17,49	3352	82	45	93	165	228	261	149	377	484	445	514	509
18	17,50	18,49	2689	60	13	68	118	161	174	260	380	401	286	344	424
19	18,50	19,49	2090	55	9	77	77	113	114	182	285	277	225	356	320
20	19,50	20,49	1358	23	7	34	48	77	76	94	181	170	170	219	259
21	20,50	21,49	728	11	4	13	17	40	39	58	84	111	137	74	140
22	21,50	22,49	429	9	3	5	8	20	13	31	60	74	61	55	90
23	22,50	23,49	246	8	2	1	5	2	8	21	18	56	45	45	35
24	23,50	24,49	140	3	0	0	0	2	4	13	20	30	30	21	17
25	24,50	25,49	80	2	1	0	0	0	2	7	9	10	16	12	21
26	25,50	26,49	64	1	2	0	1	0	0	4	2	9	18	20	7
27	26,50	27,49	25	0	0	0	0	0	0	2	2	3	11	4	3
28	27,50	28,49	28	1	0	0	0	0	0	0	2	4	11	6	4
29	28,50	29,49	10	1	0	0	0	0	0	0	0	2	4	0	3
30	29,50	30,49	4	0	0	0	0	0	0	0	0	0	3	0	1
31	30,50	31,49	4	0	0	0	0	0	0	0	1	0	2	1	0
32	31,50	32,49	0	0	0	0	0	0	0	0	0	0	0	0	0
33	32,50	33,49	0	0	0	0	0	0	0	0	0	0	0	0	0
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

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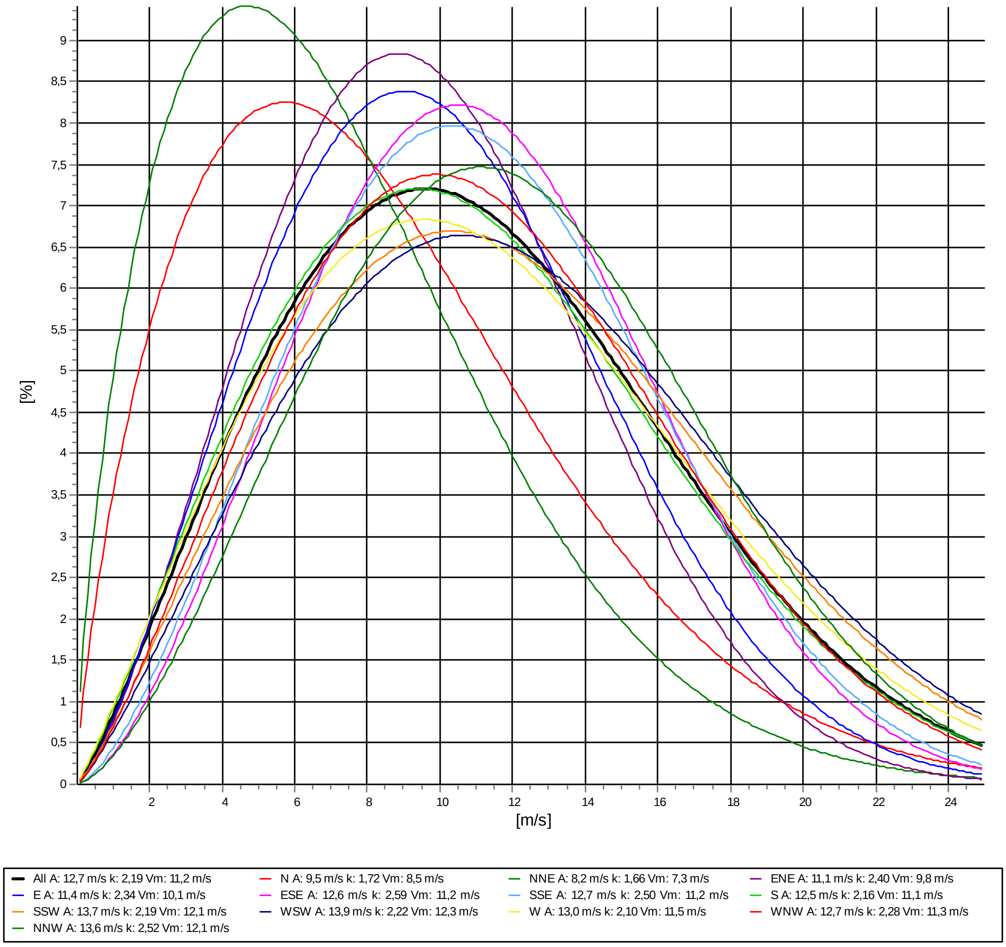
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **270,00m - MCP LT - 270m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,52	1,717	3,77	8,49
1-NNE	8,20	1,657	3,24	7,33
2-ENE	11,06	2,400	5,04	9,81
3-E	11,43	2,338	5,74	10,13
4-ESE	12,64	2,591	7,44	11,23
5-SSE	12,67	2,498	6,39	11,24
6-S	12,54	2,158	7,79	11,11
7-SSW	13,65	2,192	10,39	12,09
8-WSW	13,91	2,224	12,95	12,32
9-W	12,99	2,104	12,66	11,51
10-WNW	12,74	2,278	13,42	11,29
11-NNW	13,61	2,520	11,18	12,08
Mean	**12,67**	**2,189**	**100,00**	**11,22**



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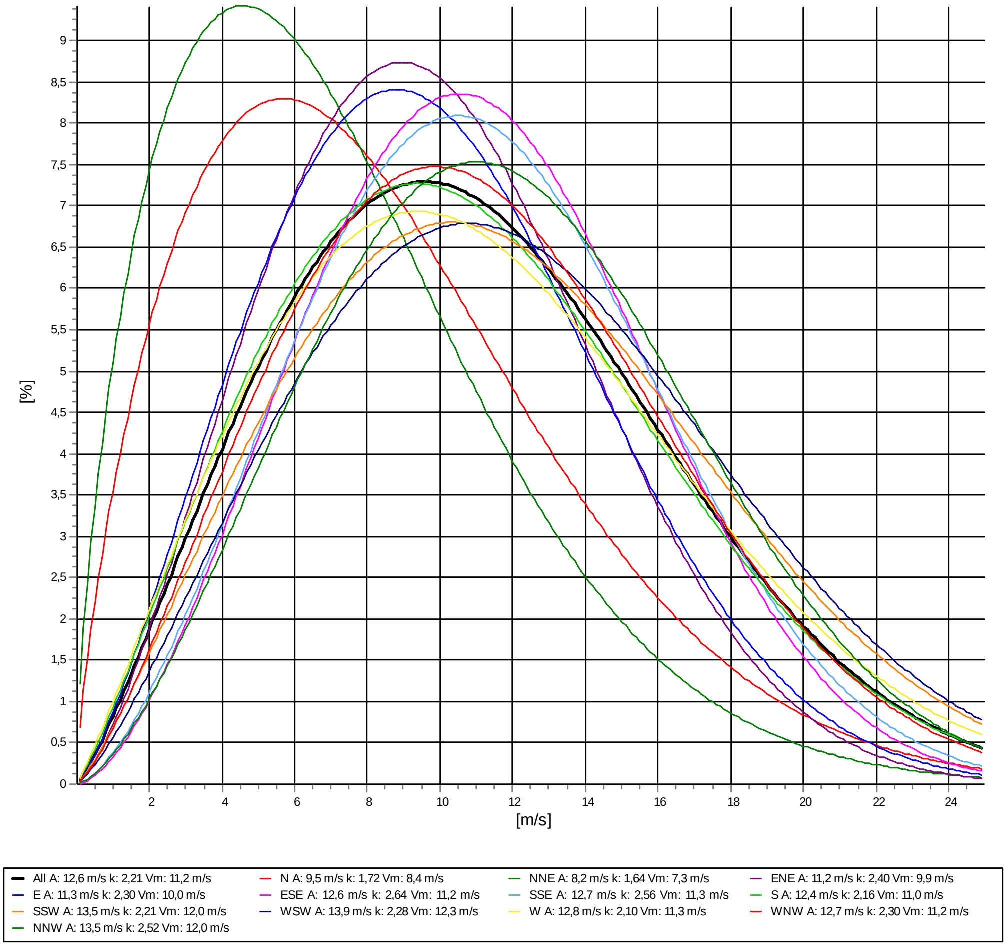
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **240,00m - MCP LT - 240m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,47	1,717	3,74	8,44
1-NNE	8,16	1,637	3,27	7,30
2-ENE	11,21	2,404	5,10	9,94
3-E	11,27	2,303	5,90	9,99
4-ESE	12,63	2,641	7,31	11,22
5-SSE	12,73	2,562	6,49	11,30
6-S	12,44	2,162	7,76	11,02
7-SSW	13,54	2,214	10,45	11,99
8-WSW	13,87	2,281	12,90	12,28
9-W	12,77	2,096	12,54	11,31
10-WNW	12,67	2,300	13,43	11,22
11-NNW	13,47	2,515	11,11	11,96
Mean	**12,59**	**2,207**	**100,00**	**11,15**



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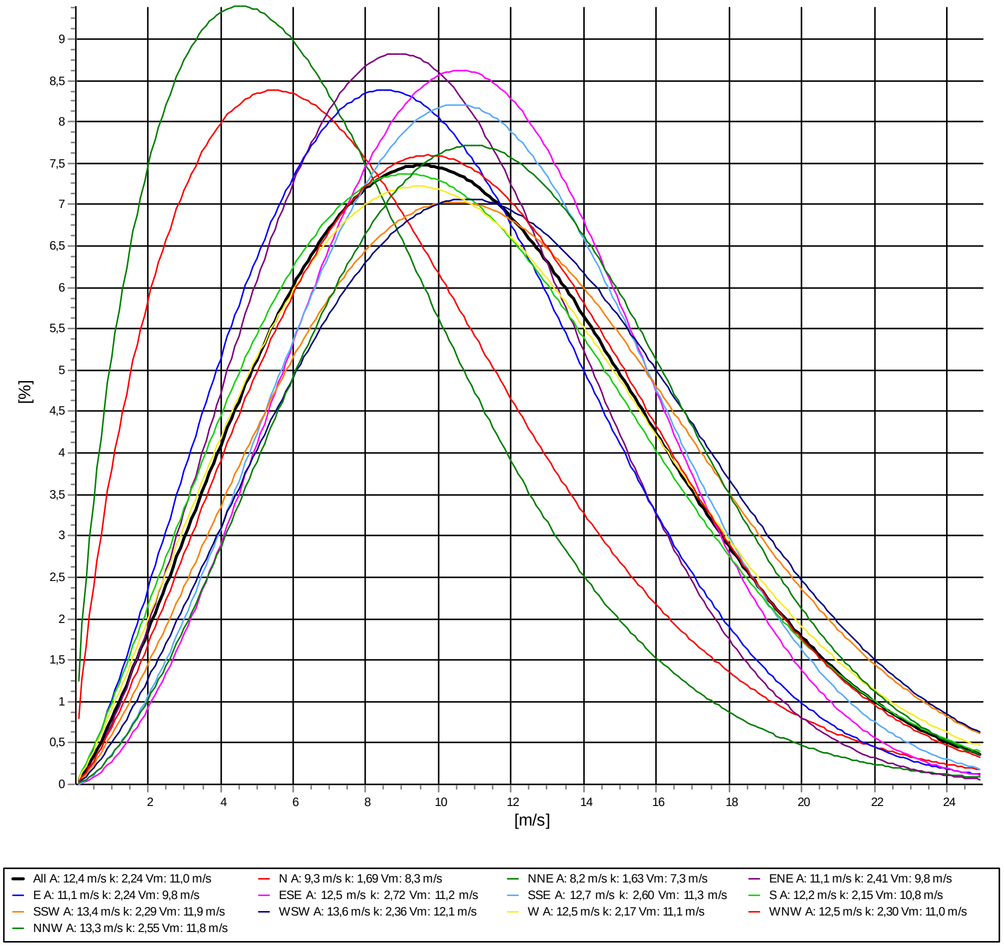
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **200,00m - MCP LT - 200m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,30	1,691	3,73	8,30
1-NNE	8,16	1,629	3,36	7,30
2-ENE	11,11	2,408	5,11	9,85
3-E	11,08	2,244	6,10	9,82
4-ESE	12,54	2,720	7,23	11,16
5-SSE	12,68	2,597	6,62	11,27
6-S	12,22	2,150	7,74	10,83
7-SSW	13,42	2,292	10,48	11,89
8-WSW	13,64	2,356	12,80	12,08
9-W	12,55	2,165	12,44	11,11
10-WNW	12,47	2,301	13,33	11,05
11-NNW	13,28	2,546	11,06	11,79
Mean	**12,42**	**2,240**	**100,00**	**11,00**



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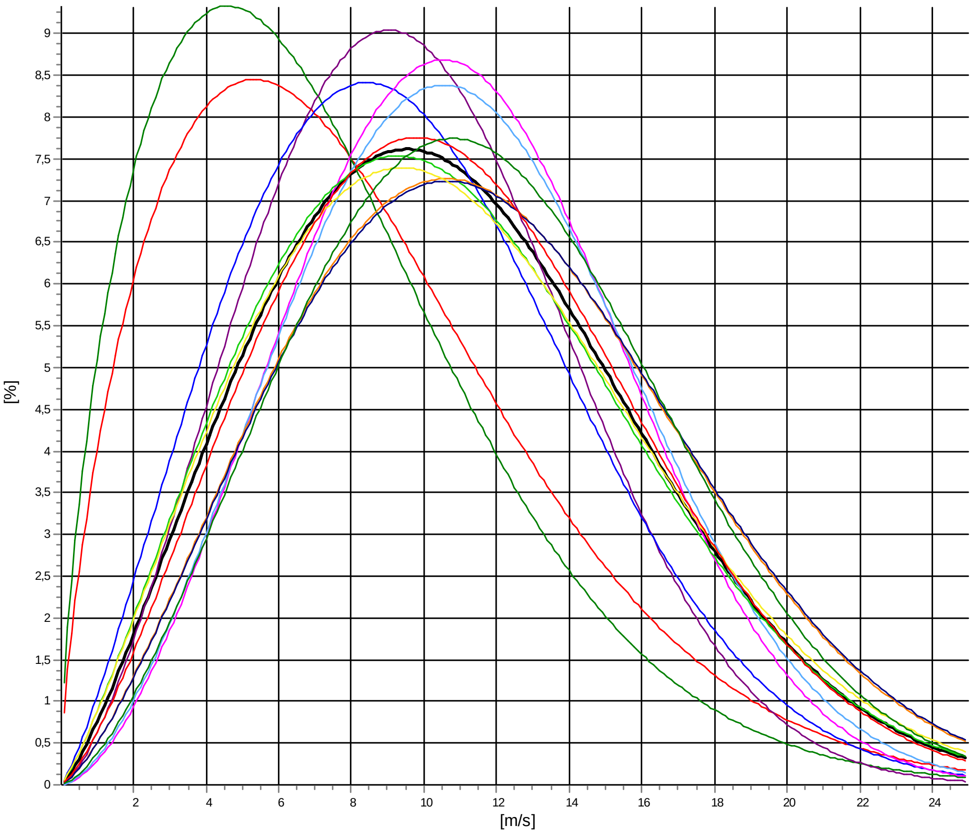
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **180,00m - MCP LT - 180m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,18	1,673	3,78	8,20
1-NNE	8,22	1,631	3,32	7,36
2-ENE	11,11	2,485	5,25	9,86
3-E	11,00	2,229	6,08	9,74
4-ESE	12,46	2,721	7,24	11,08
5-SSE	12,61	2,646	6,65	11,21
6-S	12,19	2,208	7,77	10,80
7-SSW	13,35	2,373	10,49	11,83
8-WSW	13,40	2,374	12,85	11,88
9-W	12,37	2,195	12,26	10,96
10-WNW	12,41	2,351	13,26	11,00
11-NNW	13,17	2,531	11,06	11,69
Mean	**12,32**	**2,272**	**100,00**	**10,91**



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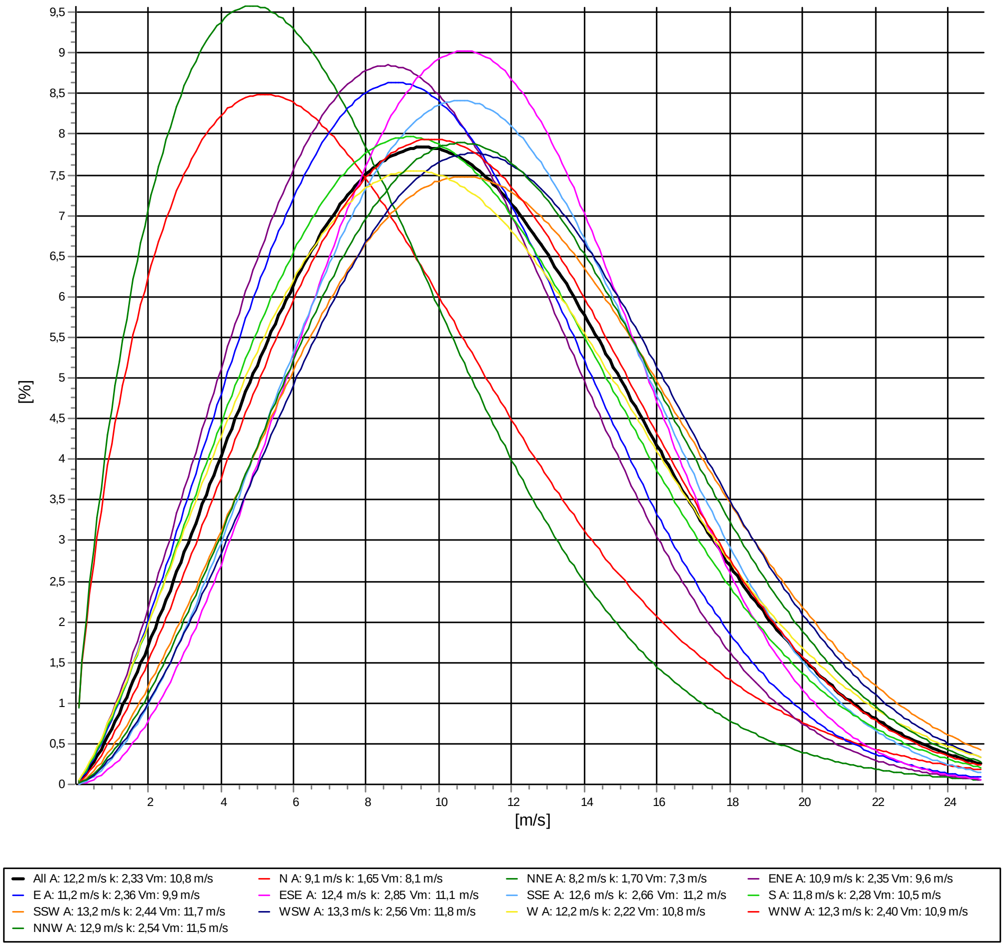
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **150,00m - MCP LT - 150m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,09	1,654	3,79	8,12
1-NNE	8,17	1,704	3,36	7,29
2-ENE	10,87	2,348	5,38	9,63
3-E	11,16	2,357	6,09	9,89
4-ESE	12,45	2,846	7,30	11,09
5-SSE	12,64	2,664	6,75	11,23
6-S	11,81	2,282	7,79	10,47
7-SSW	13,25	2,440	10,38	11,75
8-WSW	13,26	2,561	12,67	11,77
9-W	12,22	2,221	12,28	10,82
10-WNW	12,32	2,400	13,29	10,92
11-NNW	12,94	2,536	10,92	11,49
Mean	**12,19**	**2,328**	**100,00**	**10,80**



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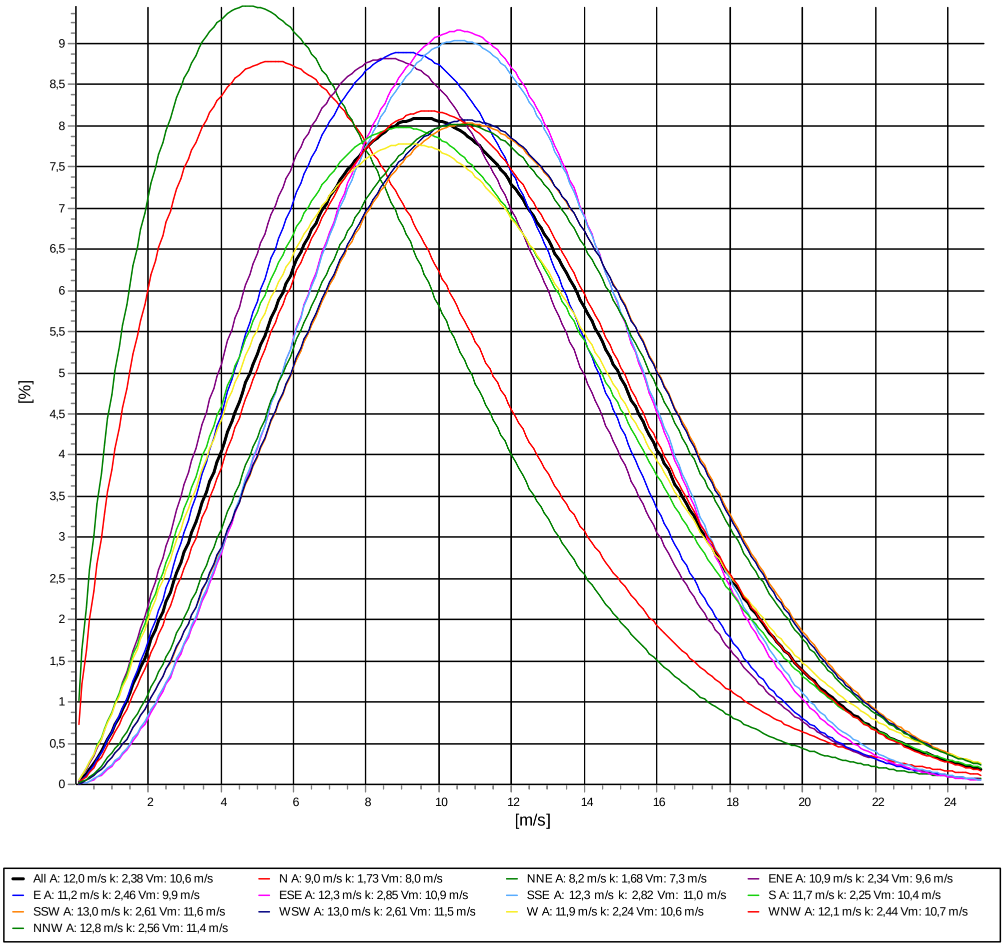
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **120,00m - MCP LT - 120m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,96	1,727	3,66	7,99
1-NNE	8,22	1,679	3,42	7,34
2-ENE	10,88	2,342	5,46	9,64
3-E	11,22	2,463	6,05	9,95
4-ESE	12,28	2,847	7,46	10,94
5-SSE	12,33	2,817	6,72	10,98
6-S	11,69	2,254	7,88	10,35
7-SSW	13,01	2,607	10,55	11,56
8-WSW	12,97	2,612	12,43	11,52
9-W	11,94	2,243	12,20	10,58
10-WNW	12,09	2,436	13,33	10,72
11-NNW	12,81	2,557	10,85	11,38
Mean	**12,01**	**2,380**	**100,00**	**10,65**



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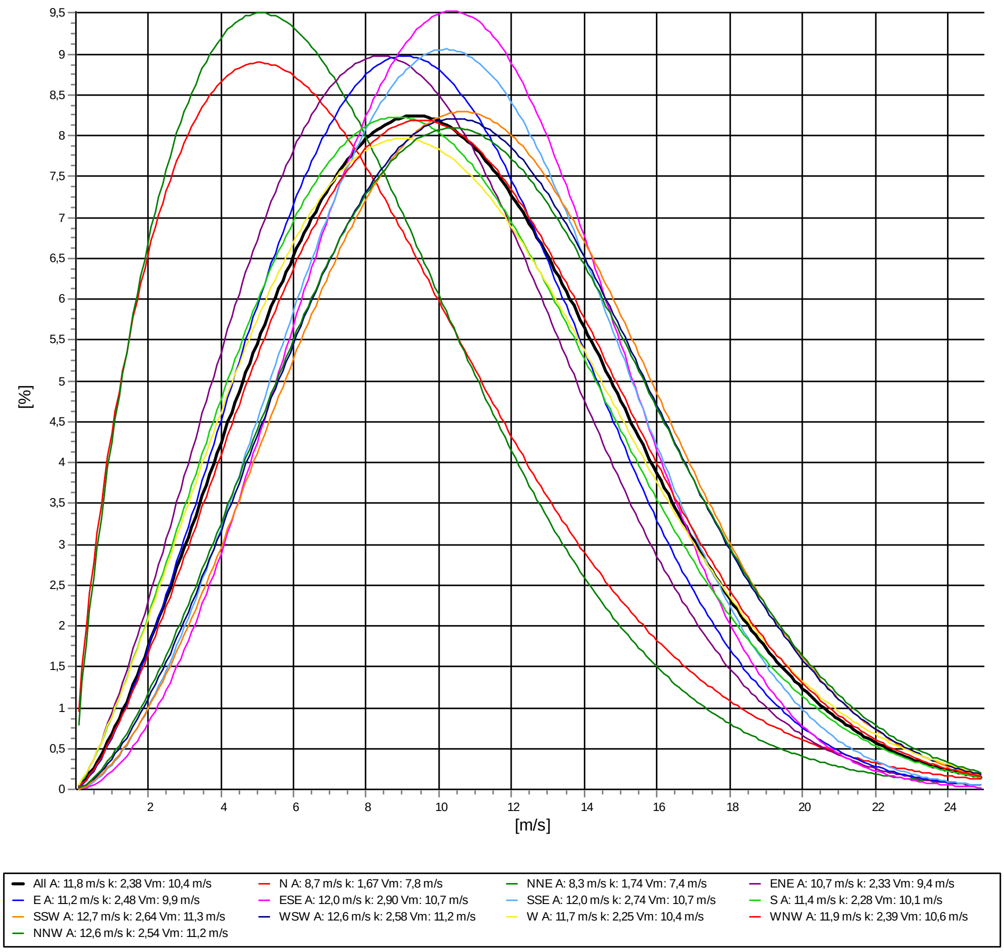
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **100,00m - MCP LT - 100m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,72	1,673	3,67	7,79
1-NNE	8,32	1,741	3,52	7,41
2-ENE	10,66	2,334	5,52	9,45
3-E	11,16	2,476	6,18	9,90
4-ESE	11,98	2,901	7,33	10,69
5-SSE	12,03	2,744	6,78	10,70
6-S	11,42	2,278	7,97	10,11
7-SSW	12,73	2,641	10,51	11,31
8-WSW	12,61	2,580	12,36	11,20
9-W	11,69	2,249	12,16	10,35
10-WNW	11,91	2,393	13,21	10,55
11-NNW	12,62	2,538	10,80	11,20
Mean	**11,77**	**2,375**	**100,00**	**10,43**



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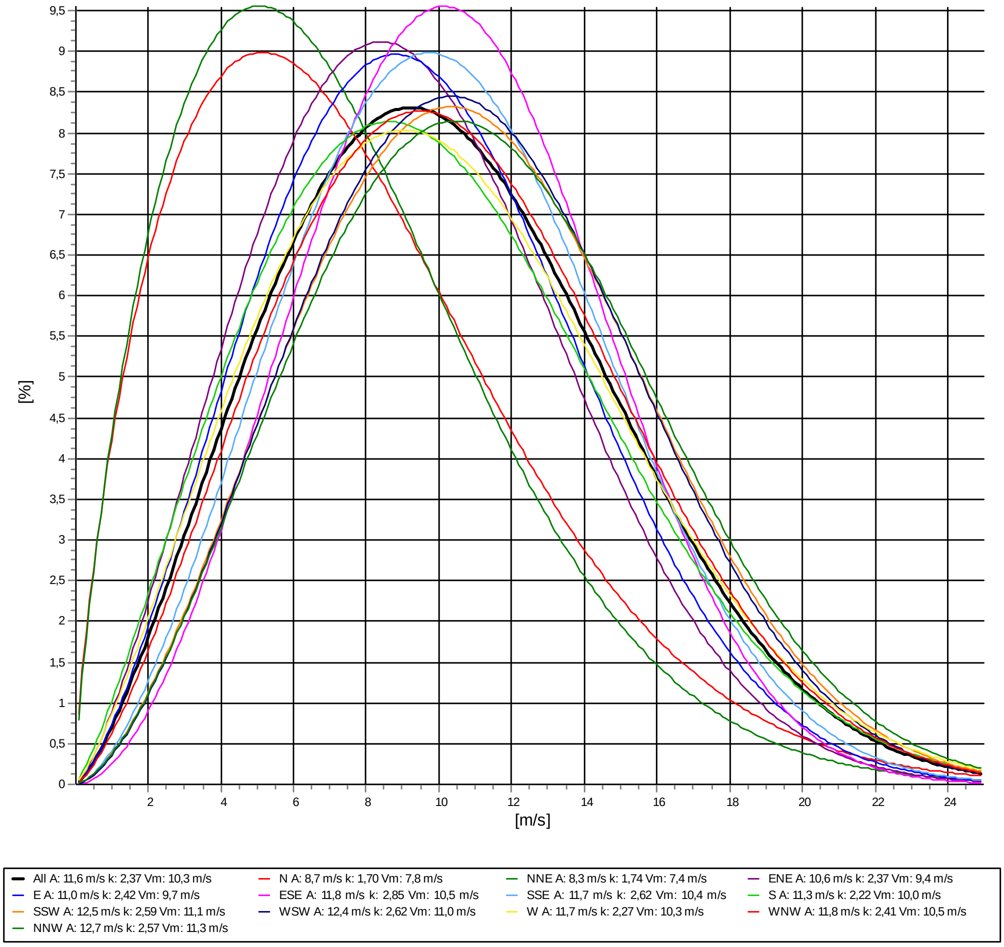
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **90,00m - MCP LT - 90m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,69	1,697	3,73	7,75
1-NNE	8,27	1,741	3,59	7,37
2-ENE	10,60	2,365	5,54	9,40
3-E	10,98	2,419	6,10	9,73
4-ESE	11,79	2,854	7,24	10,51
5-SSE	11,69	2,625	6,93	10,39
6-S	11,32	2,215	7,98	10,02
7-SSW	12,47	2,587	10,70	11,08
8-WSW	12,41	2,620	12,31	11,03
9-W	11,67	2,270	12,01	10,33
10-WNW	11,85	2,407	13,20	10,50
11-NNW	12,67	2,571	10,66	11,25
Mean	**11,64**	**2,367**	**100,00**	**10,32**



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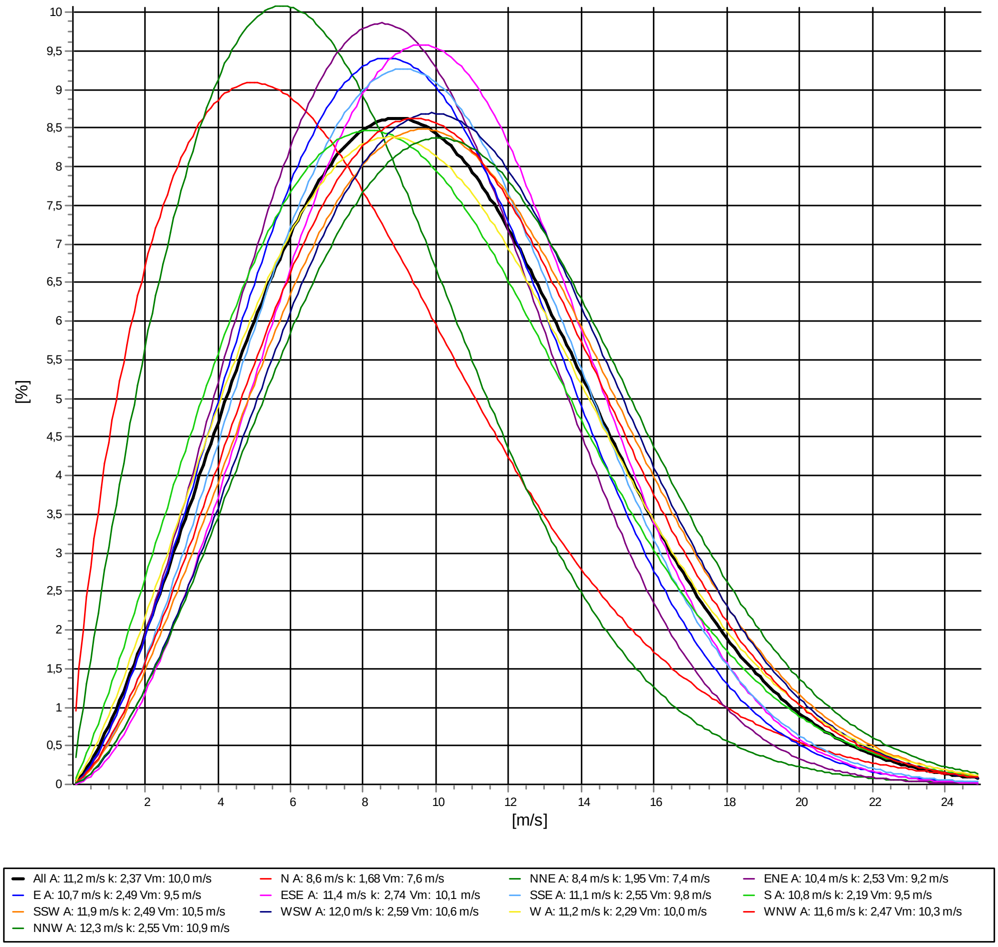
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **60,00m - MCP LT - 60m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,55	1,681	3,72	7,64
1-NNE	8,36	1,947	3,57	7,42
2-ENE	10,35	2,533	5,68	9,19
3-E	10,68	2,485	6,15	9,48
4-ESE	11,35	2,737	7,24	10,10
5-SSE	11,07	2,551	6,84	9,83
6-S	10,78	2,190	8,06	9,55
7-SSW	11,85	2,486	10,82	10,51
8-WSW	11,96	2,591	12,21	10,62
9-W	11,25	2,289	12,00	9,97
10-WNW	11,61	2,473	13,03	10,30
11-NNW	12,26	2,551	10,67	10,88
Mean	**11,24**	**2,374**	**100,00**	**9,96**



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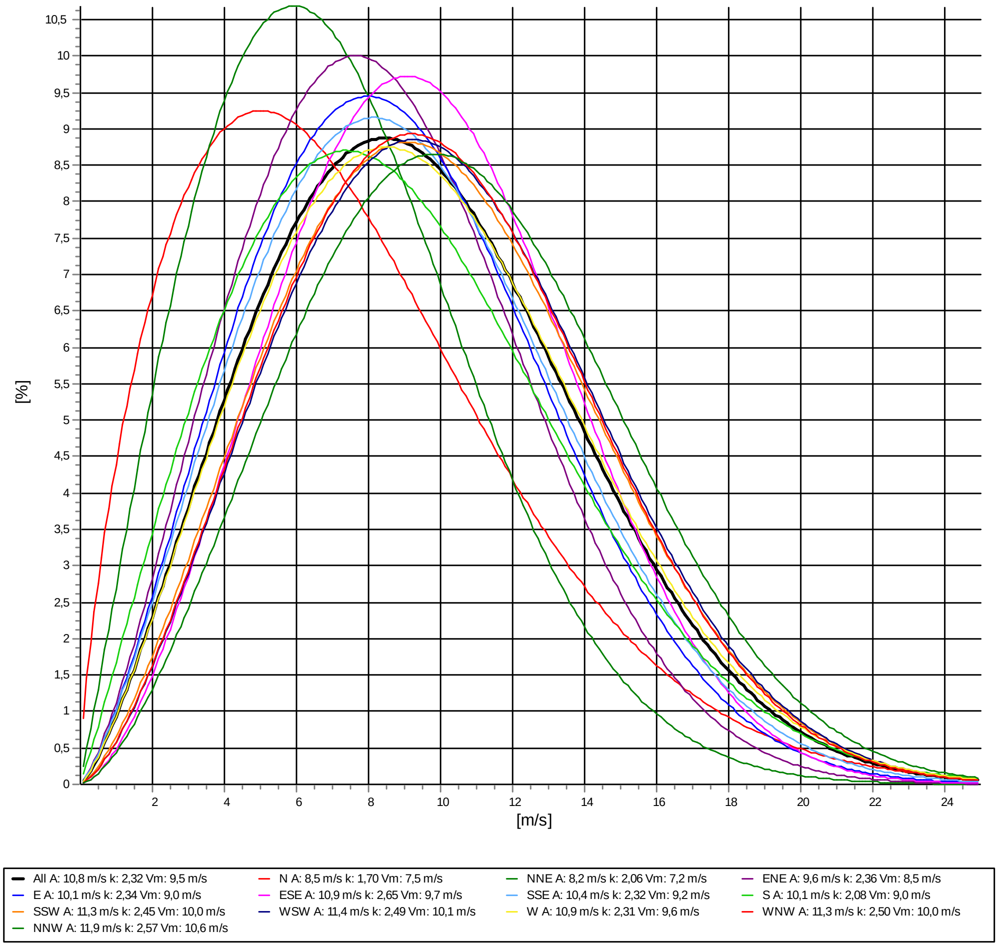
Meteo data report - Weibull data overview

Mast: Buoy 2 WS181 LT; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **40,00m - MCP LT - 40m - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,45	1,701	3,70	7,54
1-NNE	8,18	2,058	3,71	7,25
2-ENE	9,65	2,359	5,78	8,55
3-E	10,14	2,338	6,26	8,99
4-ESE	10,87	2,645	7,20	9,66
5-SSE	10,40	2,317	6,82	9,21
6-S	10,13	2,082	8,06	8,97
7-SSW	11,26	2,448	10,76	9,99
8-WSW	11,38	2,493	12,23	10,10
9-W	10,86	2,312	11,90	9,62
10-WNW	11,30	2,498	12,99	10,03
11-NNW	11,92	2,568	10,58	10,58
Mean	**10,76**	**2,324**	**100,00**	**9,53**



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Meteo data report - Frequency distribution (TAB file data)

Mast: North Sea position 3; North Sea position 3; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

150,00m - Scaled Buoy 1+2 gradient

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,87	8,19	8,31	9,79	10,34	10,55	11,18	10,85	11,38	11,55	10,93	11,10	11,71
0		0,49	313	33	33	60	6	7	27	23	30	49	28	8	9
1	0,50	1,49	1569	150	135	167	155	112	86	134	123	166	104	94	143
2	1,50	2,49	3440	299	297	412	271	305	194	286	310	246	279	249	292
3	2,50	3,49	4879	465	344	318	382	434	197	311	432	437	510	642	407
4	3,50	4,49	7550	570	452	486	496	711	495	481	500	707	1009	899	744
5	4,50	5,49	8887	774	447	575	649	641	563	559	687	912	1173	1095	812
6	5,50	6,49	11191	879	632	564	862	671	750	850	1086	1245	1397	1309	946
7	6,50	7,49	11424	612	451	545	693	635	852	1180	1300	1293	1326	1432	1105
8	7,50	8,49	11579	421	417	602	684	730	754	1206	1366	1409	1505	1395	1090
9	8,50	9,49	12103	414	229	480	868	952	588	1130	1207	1380	1530	1996	1329
10	9,50	10,49	12776	354	221	616	742	956	560	887	1249	1682	1687	1988	1834
11	10,50	11,49	12535	288	210	640	731	798	887	960	1227	1521	1632	1985	1656
12	11,50	12,49	13474	393	323	868	884	997	974	1024	1220	1562	1530	1867	1832
13	12,50	13,49	12033	309	315	520	757	871	908	947	1360	1509	1310	1657	1570
14	13,50	14,49	10008	225	215	410	598	862	767	868	1099	1210	1229	1309	1216
15	14,50	15,49	9428	262	168	391	648	899	650	579	1034	1329	1093	1104	1271
16	15,50	16,49	8357	149	156	424	561	563	645	569	946	1060	864	1214	1206
17	16,50	17,49	6035	131	85	231	369	449	463	507	637	686	730	858	889
18	17,50	18,49	5010	88	80	226	381	309	384	418	536	638	680	591	679
19	18,50	19,49	3951	90	51	172	276	162	259	315	464	661	475	422	604
20	19,50	20,49	2547	44	28	83	87	129	214	232	277	385	283	323	462
21	20,50	21,49	2109	20	29	66	51	84	163	197	354	358	167	289	331
22	21,50	22,49	1474	18	18	22	23	85	87	117	189	314	197	233	171
23	22,50	23,49	948	13	10	17	18	39	64	63	150	150	144	133	147
24	23,50	24,49	600	0	0	5	20	15	32	58	103	92	90	86	99
25	24,50	25,49	360	0	5	3	3	10	18	31	60	68	65	48	49
26	25,50	26,49	236	2	2	0	4	3	8	16	33	51	35	42	40
27	26,50	27,49	174	0	0	0	0	0	3	17	27	46	30	29	22
28	27,50	28,49	137	0	1	0	0	0	2	7	10	40	32	27	18
29	28,50	29,49	65	0	0	0	0	0	1	3	5	18	16	9	13
30	29,50	30,49	54	0	0	0	0	0	0	1	2	12	22	10	7
31	30,50	31,49	25	0	0	0	0	0	0	0	1	9	5	7	3
32	31,50	32,49	23	0	2	0	0	0	1	0	1	5	3	8	3
33	32,50	33,49	12	0	0	0	0	0	0	0	0	3	5	3	1
34	33,50	34,49	7	0	0	0	0	0	0	0	1	0	2	2	2
35	34,50	35,49	2	0	0	0	0	0	0	0	0	0	1	0	1
36	35,50	36,49	1	0	0	0	0	0	0	0	0	1	0	0	0
37	36,50	37,49	1	0	0	0	0	0	0	0	0	0	1	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	2	0	0	0	0	0	0	0	0	1	1	0	0
40	39,50	40,49	1	0	0	0	0	0	0	0	0	0	1	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

Project:
Energy Island North Sea

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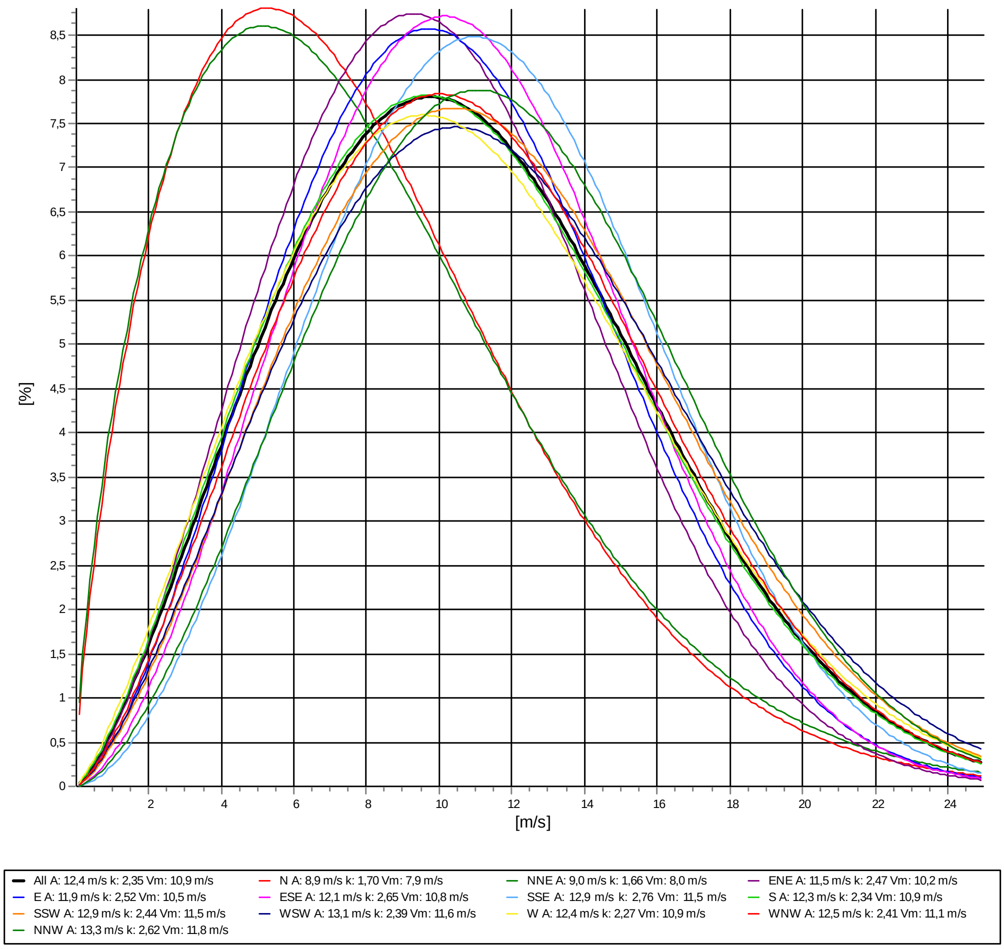
Calculated:
29/03/2023 10.22

Meteo data report - Weibull data overview

Mast: North Sea position 3; North Sea position 3; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **150,00m - Scaled Buoy 1+2 gradient**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,88	1,703	3,99	7,92
1-NNE	8,99	1,661	3,05	8,03
2-ENE	11,45	2,473	5,08	10,16
3-E	11,86	2,523	6,40	10,53
4-ESE	12,14	2,648	7,09	10,79
5-SSE	12,92	2,762	6,61	11,50
6-S	12,26	2,338	7,97	10,87
7-SSW	12,92	2,443	10,28	11,46
8-WSW	13,09	2,395	12,12	11,60
9-W	12,35	2,272	12,09	10,94
10-WNW	12,52	2,410	13,33	11,10
11-NNW	13,29	2,617	11,98	11,81
Mean	**12,35**	**2,354**	**100,00**	**10,94**



Appendix E. Long-term Corrected Datasets: Thor, FINO3, Harald B,

Project:
Secondary data

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Calculated:
29/03/2023 10.45

Meteo data report - Frequency distribution (TAB file data)

Mast: Thor FLidar - filtered; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

150,00m - MCP LT - EMD-WRF - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,53	7,37	7,96	9,14	9,36	10,03	10,49	11,02	11,54	11,42	10,84	11,11	10,63
0		0,49	483	20	42	52	40	18	55	33	26	52	49	49	47
1	0,50	1,49	1870	111	152	152	117	116	114	176	173	191	214	167	187
2	1,50	2,49	3838	205	293	407	386	356	296	274	214	374	461	274	298
3	2,50	3,49	5189	338	379	409	498	429	403	304	374	519	603	484	449
4	3,50	4,49	7612	454	515	508	604	622	497	443	632	752	827	941	817
5	4,50	5,49	9457	635	453	587	778	684	701	644	787	1083	1063	1140	902
6	5,50	6,49	11907	866	491	684	638	747	831	894	1099	1399	1545	1601	1112
7	6,50	7,49	12712	595	680	845	575	875	839	806	991	1301	1991	2116	1098
8	7,50	8,49	11530	442	655	646	780	791	614	892	1218	1323	1621	1684	864
9	8,50	9,49	12061	452	476	806	1050	961	858	779	1085	1083	1552	1839	1120
10	9,50	10,49	13160	424	400	942	1120	1093	1056	1036	1204	1380	1701	1813	991
11	10,50	11,49	13367	228	402	1019	993	1092	1331	1003	1349	1568	1800	1855	727
12	11,50	12,49	12667	257	442	946	671	976	1150	951	1374	1692	1595	1673	940
13	12,50	13,49	11793	180	218	472	732	862	839	987	1317	1663	1506	1922	1095
14	13,50	14,49	10483	77	172	524	667	696	783	808	1075	1419	1361	1954	947
15	14,50	15,49	9362	67	137	312	525	586	839	681	1043	1254	1507	1711	700
16	15,50	16,49	7241	75	92	213	349	398	517	607	761	1210	1180	1146	693
17	16,50	17,49	5605	53	96	196	245	445	476	503	583	814	747	784	663
18	17,50	18,49	4329	31	60	122	97	294	337	304	699	642	639	758	346
19	18,50	19,49	3117	10	18	54	57	132	161	353	503	521	428	545	335
20	19,50	20,49	2388	5	4	39	28	92	87	221	469	486	310	404	243
21	20,50	21,49	1659	2	5	24	10	82	99	141	238	344	237	280	197
22	21,50	22,49	1314	2	1	5	10	31	62	156	257	225	160	214	191
23	22,50	23,49	808	2	1	1	5	14	46	105	156	164	119	132	63
24	23,50	24,49	494	1	1	0	0	3	8	47	88	112	91	90	53
25	24,50	25,49	306	1	0	0	0	1	9	36	56	62	61	49	31
26	25,50	26,49	208	0	0	1	0	0	3	21	44	59	39	26	15
27	26,50	27,49	144	0	1	1	0	1	2	16	22	38	33	18	12
28	27,50	28,49	87	0	0	0	0	0	0	11	10	27	23	14	2
29	28,50	29,49	50	0	0	0	0	0	0	0	8	8	15	12	7
30	29,50	30,49	33	0	0	0	0	0	0	0	4	7	8	13	1
31	30,50	31,49	17	0	0	0	0	0	0	1	2	2	5	6	1
32	31,50	32,49	16	0	0	0	0	0	0	2	2	3	5	4	0
33	32,50	33,49	5	0	0	0	0	0	0	0	0	1	2	2	0
34	33,50	34,49	4	0	0	0	0	0	0	0	1	1	2	0	0
35	34,50	35,49	2	0	0	0	0	0	0	0	0	1	1	0	0
36	35,50	36,49	1	0	0	0	0	0	0	0	0	0	1	0	0
37	36,50	37,49	1	0	0	0	0	0	0	0	0	0	1	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

Project:
Secondary data

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Calculated:
29/03/2023 10.45

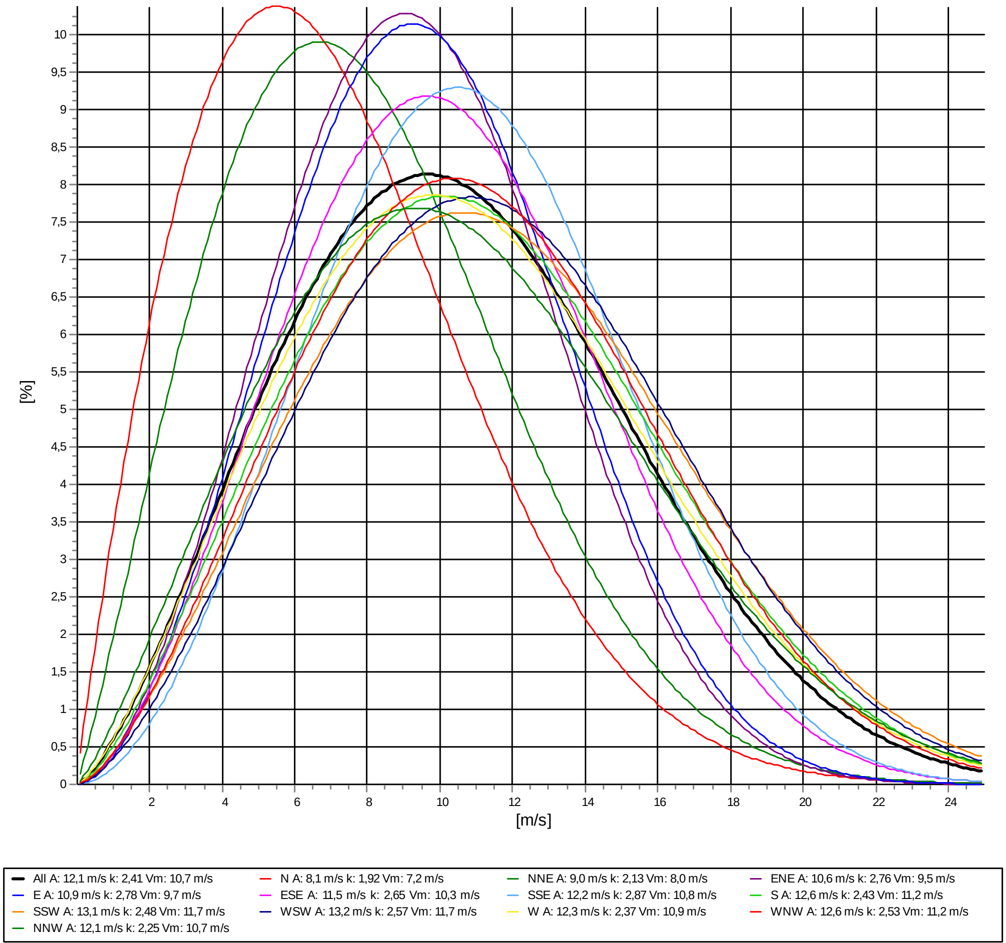
Meteo data report - Weibull data overview

Mast: Thor FLidar - filtered; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Height: **150,00m - MCP LT - EMD-WRF - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,06	1,924	3,16	7,15
1-NNE	9,03	2,128	3,53	8,00
2-ENE	10,64	2,757	5,69	9,47
3-E	10,85	2,779	6,26	9,66
4-ESE	11,54	2,652	7,07	10,25
5-SSE	12,16	2,866	7,42	10,84
6-S	12,60	2,434	7,55	11,17
7-SSW	13,14	2,477	10,19	11,66
8-WSW	13,17	2,567	12,42	11,69
9-W	12,34	2,374	13,41	10,93
10-WNW	12,63	2,533	14,67	11,21
11-NNW	12,10	2,247	8,64	10,72
Mean	**12,07**	**2,412**	**100,00**	**10,70**



Project:
Secondary data

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Calculated:
29/03/2023 10.37

Meteo data report - Frequency distribution (TAB file data)

Mast: FINO3 merged; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

91,00m - MCP LT - ERA5 - [Matrix]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,13	8,11	7,46	8,07	9,66	10,57	9,91	9,98	11,26	11,28	10,64	10,05	10,07
0		0,49	464	43	32	40	31	32	14	35	49	31	53	55	49
1	0,50	1,49	1847	166	149	93	142	131	121	116	120	172	221	241	175
2	1,50	2,49	4017	289	299	301	307	340	300	321	322	347	375	459	357
3	2,50	3,49	6215	414	528	651	467	428	444	462	469	504	611	685	552
4	3,50	4,49	8524	590	667	875	655	546	526	598	744	785	802	902	834
5	4,50	5,49	9773	748	622	875	663	547	568	645	769	1017	1078	1226	1015
6	5,50	6,49	11064	674	728	921	703	579	638	825	909	1203	1220	1483	1181
7	6,50	7,49	12336	743	658	759	882	833	702	913	1052	1471	1353	1614	1356
8	7,50	8,49	13317	708	692	688	831	884	949	980	1081	1543	1461	1969	1531
9	8,50	9,49	14067	739	625	690	775	983	881	982	1290	1735	1779	1933	1655
10	9,50	10,49	14497	579	513	742	835	1100	945	1043	1407	1944	1771	2072	1546
11	10,50	11,49	13774	523	387	599	845	1167	901	1033	1497	1948	1738	1797	1339
12	11,50	12,49	13498	387	355	524	842	1199	928	867	1441	2157	1780	1678	1340
13	12,50	13,49	11883	317	332	446	702	950	771	806	1303	1795	1651	1566	1244
14	13,50	14,49	9729	205	167	280	571	876	753	767	1214	1528	1252	1220	896
15	14,50	15,49	7740	151	80	185	459	713	671	597	923	1258	970	1004	729
16	15,50	16,49	5999	130	61	163	410	573	472	372	804	978	770	763	503
17	16,50	17,49	4740	81	37	98	305	444	235	285	792	844	607	551	461
18	17,50	18,49	3645	78	29	85	231	332	111	262	591	719	456	405	346
19	18,50	19,49	2690	42	10	62	147	260	94	148	463	530	347	287	300
20	19,50	20,49	1762	21	2	25	62	149	49	117	302	428	278	123	206
21	20,50	21,49	1307	27	0	5	56	90	58	92	215	294	191	139	140
22	21,50	22,49	764	8	0	4	28	30	26	67	160	191	145	61	44
23	22,50	23,49	582	5	0	0	8	24	4	30	132	167	92	60	60
24	23,50	24,49	477	4	0	1	5	9	1	16	113	132	96	41	59
25	24,50	25,49	238	2	0	0	0	5	1	15	27	70	67	27	24
26	25,50	26,49	109	1	0	0	0	4	0	2	18	30	29	18	7
27	26,50	27,49	121	2	0	0	0	1	0	6	26	16	30	19	21
28	27,50	28,49	69	1	0	0	0	1	0	0	5	15	14	18	15
29	28,50	29,49	29	0	0	0	0	0	0	0	2	10	6	9	2
30	29,50	30,49	24	1	0	0	0	0	0	1	5	2	3	10	2
31	30,50	31,49	11	0	0	0	0	0	0	0	3	2	1	1	4
32	31,50	32,49	3	0	0	0	0	0	0	0	0	0	0	2	1
33	32,50	33,49	3	0	0	0	0	0	0	0	0	1	0	1	1
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	1	0	0	0	0	0	0	0	0	1	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	1	0	0	0	0	0	0	0	0	1	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

Project:
Secondary data

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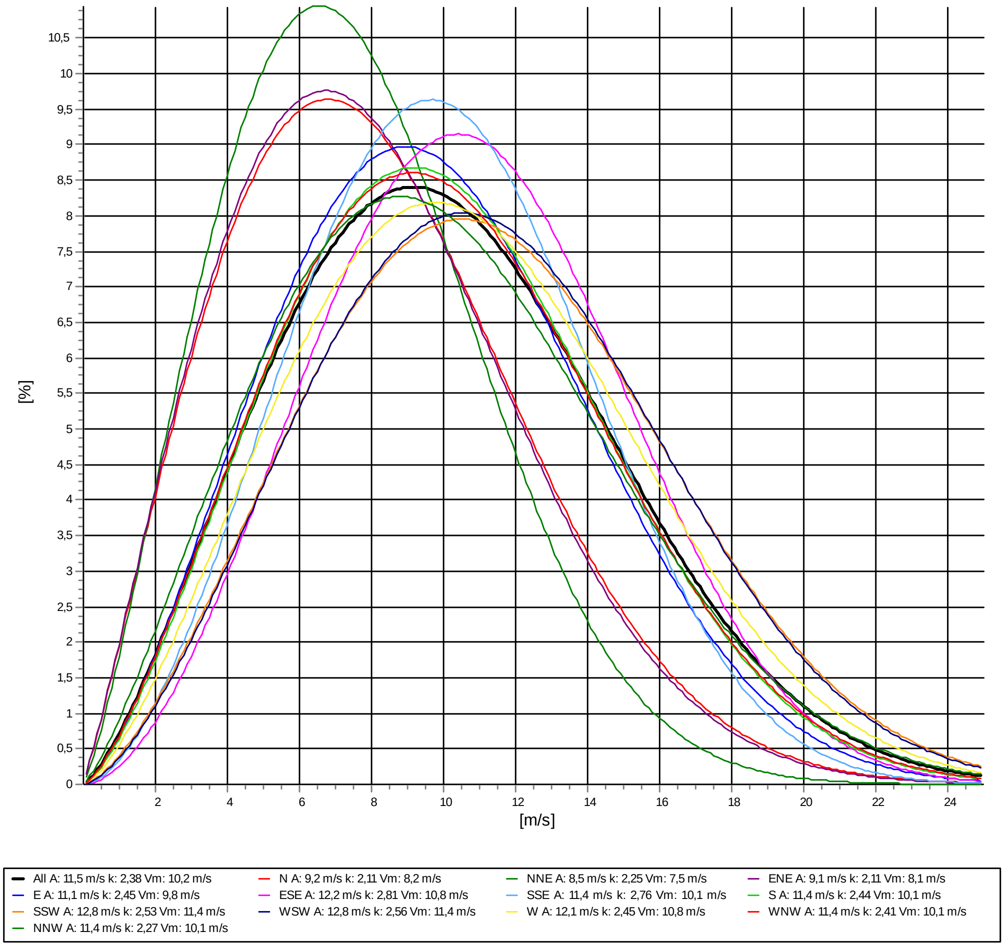
Calculated:
29/03/2023 10.37

Meteo data report - Weibull data overview

Mast: FINO3 merged; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **91,00m - MCP LT - ERA5 - [Matrix]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	9,22	2,108	4,38	8,17
1-NNE	8,51	2,253	3,98	7,54
2-ENE	9,12	2,112	5,20	8,07
3-E	11,09	2,453	6,25	9,83
4-ESE	12,16	2,814	7,55	10,83
5-SSE	11,37	2,762	6,37	10,12
6-S	11,41	2,439	7,07	10,11
7-SSW	12,83	2,533	10,41	11,39
8-WSW	12,81	2,562	13,61	11,37
9-W	12,13	2,448	12,12	10,75
10-WNW	11,40	2,410	12,80	10,11
11-NNW	11,36	2,275	10,26	10,06
Mean	**11,55**	**2,376**	**100,00**	**10,23**



Project:
Secondary data

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Calculated:
29/03/2023 10.47

Meteo data report - Frequency distribution (TAB file data)

Mast: Harald B-6018 10min 4y ; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

69,00m - MCP LT - EMD-WRF - [Regression]

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,20	9,78	8,38	8,71	9,50	10,24	9,91	10,16	10,87	10,68	10,65	10,58	10,17
0		0,49	1364	105	96	118	133	99	89	85	86	131	177	113	132
1	0,50	1,49	2140	134	162	189	175	121	149	142	184	232	236	220	196
2	1,50	2,49	3673	282	255	263	276	268	223	266	312	417	403	364	344
3	2,50	3,49	5625	453	343	425	458	357	372	410	465	608	645	553	536
4	3,50	4,49	7370	591	424	494	519	496	484	571	686	823	894	705	683
5	4,50	5,49	9278	700	505	614	704	591	562	694	865	1074	1115	958	896
6	5,50	6,49	11100	886	535	685	803	691	725	866	1070	1259	1333	1167	1080
7	6,50	7,49	12615	910	617	723	841	780	831	970	1282	1484	1568	1383	1226
8	7,50	8,49	13919	1011	541	704	899	912	962	1238	1532	1673	1688	1387	1372
9	8,50	9,49	15013	932	571	751	986	992	1026	1401	1707	1896	1797	1533	1421
10	9,50	10,49	14885	1010	508	722	1009	1001	1039	1414	1713	1898	1732	1475	1364
11	10,50	11,49	13832	953	449	647	933	966	1024	1155	1596	1753	1627	1380	1349
12	11,50	12,49	12596	806	382	551	814	910	870	1135	1544	1623	1512	1289	1160
13	12,50	13,49	10940	705	319	466	651	772	747	906	1396	1383	1379	1108	1108
14	13,50	14,49	9046	541	229	321	526	696	611	727	1083	1264	1163	1009	876
15	14,50	15,49	7502	473	175	252	416	560	496	586	951	1076	946	823	748
16	15,50	16,49	6145	407	130	194	300	418	375	487	867	899	796	705	567
17	16,50	17,49	4890	323	79	141	269	322	277	390	676	686	677	581	469
18	17,50	18,49	3731	246	63	77	213	258	176	266	528	550	551	466	337
19	18,50	19,49	2819	178	36	53	152	192	143	193	397	419	449	347	260
20	19,50	20,49	2104	121	24	26	91	144	108	156	286	315	354	271	208
21	20,50	21,49	1547	88	20	31	54	100	64	108	220	255	279	195	133
22	21,50	22,49	1081	54	6	22	41	63	42	80	159	173	186	167	88
23	22,50	23,49	705	26	11	16	14	30	25	47	117	116	130	103	70
24	23,50	24,49	503	24	3	8	10	13	15	35	74	92	106	76	47
25	24,50	25,49	298	11	1	2	4	13	6	6	39	60	79	54	23
26	25,50	26,49	219	5	2	2	5	10	6	7	31	44	44	41	22
27	26,50	27,49	129	6	4	0	1	3	0	4	22	20	32	26	11
28	27,50	28,49	79	3	2	0	1	1	0	4	8	10	26	17	7
29	28,50	29,49	63	1	2	1	0	1	0	0	6	10	23	16	3
30	29,50	30,49	40	0	1	0	0	1	0	1	1	6	12	17	1
31	30,50	31,49	24	1	0	0	0	0	0	0	0	4	7	8	4
32	31,50	32,49	18	0	0	0	0	0	0	0	0	2	11	4	1
33	32,50	33,49	13	1	0	0	0	0	0	0	0	1	6	4	1
34	33,50	34,49	6	0	0	0	0	0	0	0	0	0	6	0	0
35	34,50	35,49	4	0	0	0	0	0	0	0	0	0	3	1	0
36	35,50	36,49	1	0	0	0	0	0	0	0	0	1	0	0	0
37	36,50	37,49	2	0	1	0	0	0	0	0	0	0	0	1	0
38	37,50	38,49	1	0	0	0	0	0	0	0	0	1	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

Project:
Secondary data

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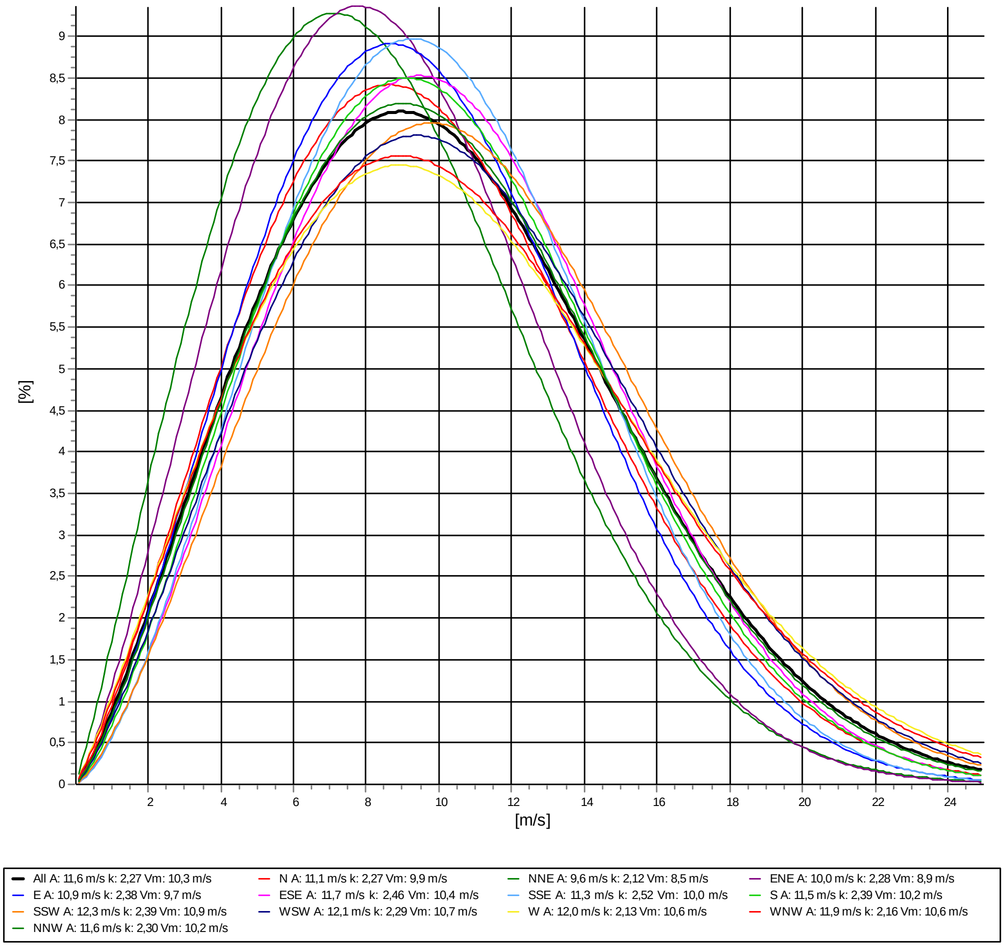
Calculated:
29/03/2023 10.47

Meteo data report - Weibull data overview

Mast: Harald B-6018 10min 4y; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **69,00m - MCP LT - EMD-WRF - [Regression]**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	11,14	2,272	6,84	9,87
1-NNE	9,63	2,123	3,71	8,52
2-ENE	10,04	2,280	4,85	8,90
3-E	10,91	2,382	6,44	9,67
4-ESE	11,70	2,462	6,72	10,38
5-SSE	11,32	2,518	6,53	10,05
6-S	11,46	2,387	8,19	10,15
7-SSW	12,26	2,393	11,35	10,87
8-WSW	12,07	2,285	12,70	10,69
9-W	12,02	2,131	12,54	10,65
10-WNW	11,94	2,157	10,59	10,58
11-NNW	11,55	2,300	9,55	10,24
Mean	**11,58**	**2,268**	**100,00**	**10,25**



Appendix F. Translated to Position 1: Thor, FINO3, Harald B,

Project:
Secondary data

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Calculated:
29/03/2023 10.57

Meteo data report - Frequency distribution (TAB file data)

Mast: Thor to Position 1; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

150,00m -

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,85	7,79	7,29	9,60	10,74	11,27	11,07	11,13	11,66	11,57	10,81	10,94	11,02
0		0,49	27	0	0	11	0	0	0	0	0	5	9	2	0
1	0,50	1,49	659	7	39	79	84	19	36	7	24	96	172	86	10
2	1,50	2,49	2337	77	199	298	165	86	98	121	181	329	387	242	154
3	2,50	3,49	4385	198	347	454	488	353	240	304	249	419	636	379	318
4	3,50	4,49	6130	317	571	398	481	425	391	316	451	697	792	789	502
5	4,50	5,49	8556	427	526	516	688	607	478	516	727	955	1049	1165	902
6	5,50	6,49	11472	666	568	579	807	747	702	752	1009	1416	1523	1567	1136
7	6,50	7,49	13702	694	785	783	681	725	828	977	1142	1320	2027	2226	1514
8	7,50	8,49	12650	440	543	779	737	942	749	909	1205	1419	1770	1757	1400
9	8,50	9,49	11518	375	407	627	628	787	633	946	1259	1088	1612	1960	1196
10	9,50	10,49	13211	323	455	774	1104	967	907	1014	1241	1339	1790	1935	1362
11	10,50	11,49	14061	281	299	859	1175	1107	1208	1123	1439	1642	1848	1975	1105
12	11,50	12,49	13777	145	175	946	1219	1207	1208	1087	1458	1729	1662	1835	1106
13	12,50	13,49	13102	146	153	711	896	997	981	1116	1433	1725	1560	2015	1369
14	13,50	14,49	11329	102	132	438	688	898	733	813	1181	1503	1472	2110	1259
15	14,50	15,49	9714	51	58	418	772	808	846	687	1032	1288	1470	1403	881
16	15,50	16,49	7982	31	21	209	685	663	567	686	794	1242	1178	996	910
17	16,50	17,49	5590	32	15	183	508	520	430	336	604	821	736	746	659
18	17,50	18,49	4911	20	6	153	387	437	357	389	743	669	595	661	494
19	18,50	19,49	3341	7	1	92	253	368	158	244	493	497	418	453	357
20	19,50	20,49	2332	7	1	51	115	155	96	158	366	524	302	290	267
21	20,50	21,49	1678	3	0	27	67	119	94	159	240	322	207	222	218
22	21,50	22,49	1082	0	1	25	33	82	53	83	223	197	155	138	92
23	22,50	23,49	666	2	0	5	19	51	29	46	100	158	100	96	60
24	23,50	24,49	375	1	0	1	8	25	7	31	50	98	78	47	29
25	24,50	25,49	246	2	0	1	9	7	5	17	55	62	39	31	18
26	25,50	26,49	155	1	0	2	1	1	0	14	20	51	41	19	5
27	26,50	27,49	97	0	0	1	0	0	2	0	11	38	23	15	7
28	27,50	28,49	63	0	0	0	0	1	0	1	6	18	21	13	3
29	28,50	29,49	29	0	0	0	0	0	0	1	3	7	6	11	1
30	29,50	30,49	18	0	0	0	0	0	0	0	3	2	6	7	0
31	30,50	31,49	10	0	0	0	0	0	0	0	0	3	5	2	0
32	31,50	32,49	5	0	0	0	0	0	0	0	1	1	3	0	0
33	32,50	33,49	3	0	0	0	0	0	0	0	1	0	2	0	0
34	33,50	34,49	3	0	0	0	0	0	0	0	0	2	1	0	0
35	34,50	35,49	1	0	0	0	0	0	0	0	0	0	1	0	0
36	35,50	36,49	1	0	0	0	0	0	0	0	0	0	1	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

Project:
Secondary data

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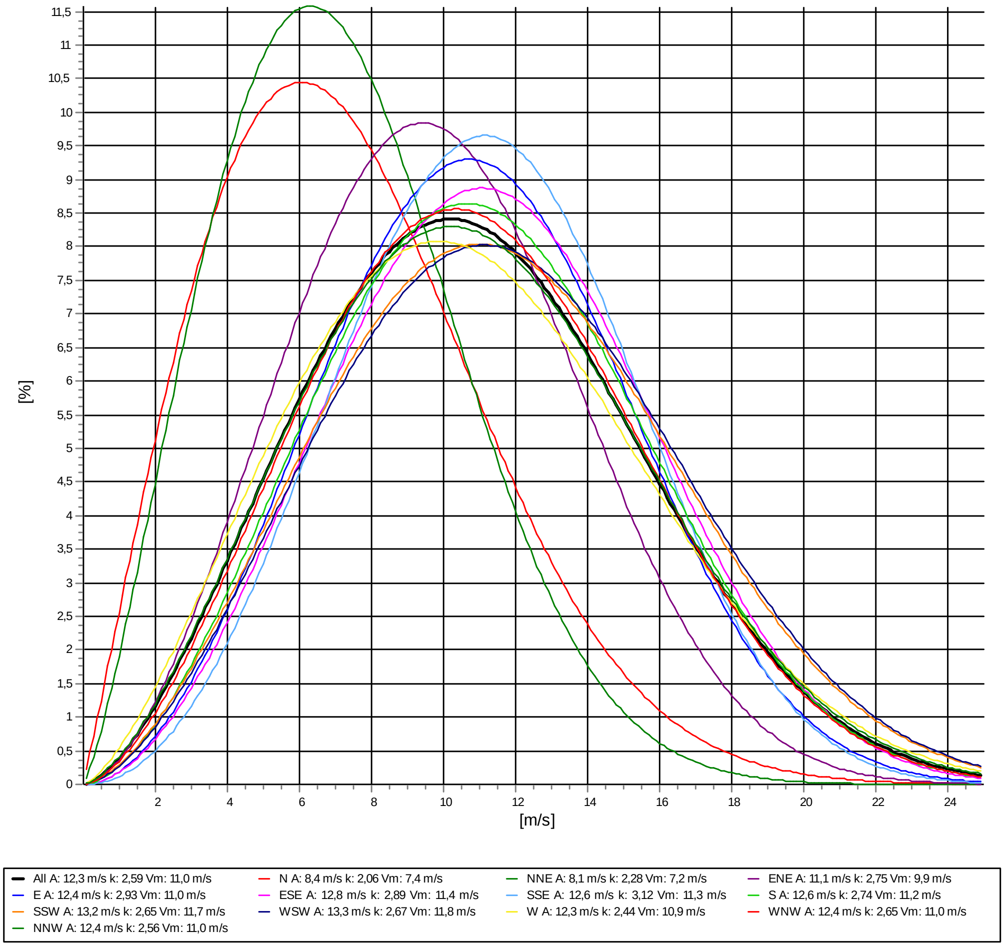
Calculated:
29/03/2023 10.57

Meteo data report - Weibull data overview

Mast: Thor to Position 1; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **150,00m -**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,38	2,061	2,49	7,42
1-NNE	8,13	2,282	3,03	7,20
2-ENE	11,10	2,753	5,38	9,88
3-E	12,37	2,926	7,25	11,03
4-ESE	12,83	2,891	7,48	11,44
5-SSE	12,61	3,123	6,76	11,28
6-S	12,58	2,737	7,34	11,19
7-SSW	13,16	2,649	10,13	11,69
8-WSW	13,27	2,669	12,37	11,80
9-W	12,26	2,440	13,52	10,87
10-WNW	12,36	2,648	14,38	10,99
11-NNW	12,40	2,558	9,89	11,00
Mean	**12,33**	**2,585**	**100,00**	**10,95**



Project:
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Calculated:
29/03/2023 11.22

Meteo data report - Frequency distribution (TAB file data)

Mast: Fino3 to Position 1; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

150,00m - B Synth trans

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,97	7,67	7,33	8,30	9,64	10,99	11,40	11,43	11,95	11,82	11,32	11,63	11,37
0		0,49	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0,50	1,49	177	0	5	51	73	48	0	0	0	0	0	0	0
2	1,50	2,49	722	1	58	105	206	193	46	2	1	16	40	29	25
3	2,50	3,49	2793	133	263	383	428	398	200	79	88	152	222	241	206
4	3,50	4,49	5476	488	586	721	622	464	406	249	255	349	393	511	432
5	4,50	5,49	8154	789	743	837	701	636	553	512	537	556	683	816	791
6	5,50	6,49	10395	1029	788	896	680	510	694	756	816	928	1047	1092	1159
7	6,50	7,49	11752	1049	694	750	854	719	734	838	878	1103	1214	1466	1453
8	7,50	8,49	13513	914	752	684	858	889	844	1103	1181	1430	1444	1780	1634
9	8,50	9,49	14113	748	601	638	787	956	987	1167	1226	1561	1611	1994	1837
10	9,50	10,49	15881	608	483	682	855	1100	1162	1285	1443	1795	1914	2369	2185
11	10,50	11,49	15700	376	367	549	905	1153	1088	1360	1645	1958	1909	2348	2042
12	11,50	12,49	15423	212	191	507	790	1255	1203	1350	1756	2024	1942	2356	1837
13	12,50	13,49	13934	132	100	400	704	1044	1126	1234	1595	1976	1887	2051	1685
14	13,50	14,49	11726	79	66	217	531	959	996	1023	1448	1590	1404	1853	1560
15	14,50	15,49	9551	42	23	178	415	751	965	921	1117	1243	1063	1630	1203
16	15,50	16,49	7576	28	14	127	416	633	851	660	957	920	851	1214	905
17	16,50	17,49	5886	15	11	80	264	516	653	489	828	817	587	974	652
18	17,50	18,49	4221	8	3	75	189	362	387	395	559	582	456	662	543
19	18,50	19,49	2929	4	0	41	95	274	164	228	389	471	312	521	430
20	19,50	20,49	1948	4	0	10	53	162	114	148	274	310	230	322	321
21	20,50	21,49	1246	3	0	5	41	86	77	132	164	197	154	163	224
22	21,50	22,49	862	1	0	1	9	44	66	76	125	163	117	130	130
23	22,50	23,49	480	0	0	1	3	28	39	44	42	111	78	82	52
24	23,50	24,49	323	1	0	0	2	10	11	16	22	45	63	70	83
25	24,50	25,49	173	0	0	0	0	3	2	8	22	23	32	45	38
26	25,50	26,49	83	0	0	0	0	2	2	4	5	10	17	29	14
27	26,50	27,49	53	0	0	0	0	2	0	1	6	13	4	18	9
28	27,50	28,49	48	0	0	0	0	0	0	0	2	0	2	21	23
29	28,50	29,49	21	0	0	0	0	0	0	0	0	2	2	10	7
30	29,50	30,49	15	0	0	0	0	0	0	0	0	1	0	11	3
31	30,50	31,49	10	0	0	0	0	0	0	0	1	0	0	7	2
32	31,50	32,49	3	0	0	0	0	0	0	0	0	0	0	1	2
33	32,50	33,49	3	0	0	0	0	0	0	0	0	1	0	1	1
34	33,50	34,49	0	0	0	0	0	0	0	0	0	0	0	0	0
35	34,50	35,49	0	0	0	0	0	0	0	0	0	0	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

Project:
Secondary data

Licensed user:
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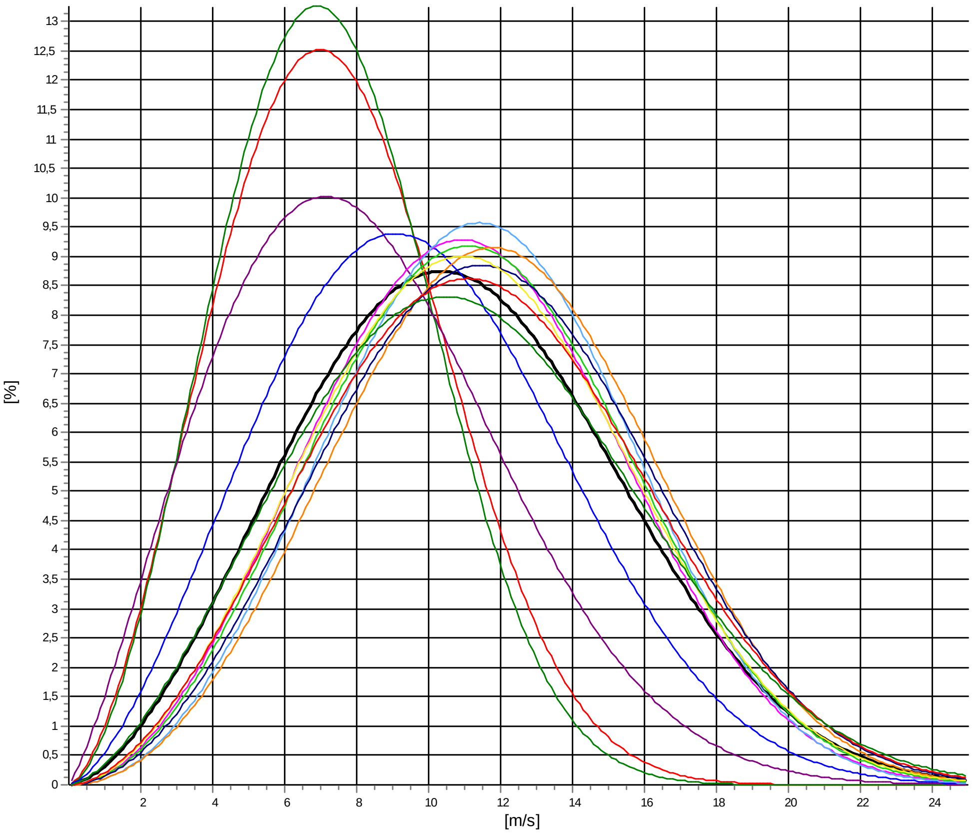
Calculated:
29/03/2023 11.22

Meteo data report - Weibull data overview

Mast: Fino3 to Position 1; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **150,00m - B Synth trans**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,38	2,623	3,80	7,45
1-NNE	8,17	2,725	3,28	7,27
2-ENE	9,29	2,248	4,53	8,22
3-E	11,01	2,574	5,98	9,78
4-ESE	12,55	2,970	7,53	11,20
5-SSE	12,87	3,166	7,63	11,52
6-S	12,74	2,981	8,04	11,37
7-SSW	13,32	3,126	9,92	11,91
8-WSW	13,17	2,970	11,61	11,75
9-W	12,66	2,895	11,23	11,29
10-WNW	12,95	2,826	14,17	11,54
11-NNW	12,59	2,614	12,27	11,18
Mean	**12,30**	**2,702**	**100,00**	**10,94**



All A: 12,3 m/s k: 2,70 Vm: 10,9 m/s — N A: 8,4 m/s k: 2,62 Vm: 7,4 m/s — NNE A: 8,2 m/s k: 2,73 Vm: 7,3 m/s — ENE A: 9,3 m/s k: 2,25 Vm: 8,2 m/s
E A: 11,0 m/s k: 2,57 Vm: 9,8 m/s — ESE A: 12,5 m/s k: 2,97 Vm: 11,2 m/s — SSE A: 12,9 m/s k: 3,17 Vm: 11,5 m/s — S A: 12,7 m/s k: 2,98 Vm: 11,4 m/s
SSW A: 13,3 m/s k: 3,13 Vm: 11,9 m/s — WSW A: 13,2 m/s k: 2,97 Vm: 11,8 m/s — W A: 12,7 m/s k: 2,89 Vm: 11,3 m/s — WNW A: 12,9 m/s k: 2,83 Vm: 11,5 m/s
NNW A: 12,6 m/s k: 2,61 Vm: 11,2 m/s

Project:
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Calculated:
29/03/2023 11.27

Meteo data report - Frequency distribution (TAB file data)

Mast: Harald B to position 1; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

150,00m - E Synth

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,23	9,80	9,08	10,39	10,73	10,91	11,28	11,22	11,88	11,77	11,50	11,85	11,50
0		0,49	1310	104	95	107	130	97	82	79	86	127	171	107	125
1	0,50	1,49	1832	141	137	158	138	108	111	120	152	201	217	191	158
2	1,50	2,49	3158	282	237	183	238	247	194	221	270	357	350	305	274
3	2,50	3,49	4547	465	278	300	353	295	256	330	384	475	564	429	418
4	3,50	4,49	6209	579	402	410	424	448	366	445	537	707	778	590	523
5	4,50	5,49	7781	719	432	439	554	545	461	568	726	892	986	724	735
6	5,50	6,49	9140	850	480	492	669	614	528	721	854	1000	1159	948	825
7	6,50	7,49	10697	945	538	557	705	685	650	808	1097	1251	1342	1129	990
8	7,50	8,49	11815	993	532	602	792	807	714	909	1241	1390	1523	1220	1092
9	8,50	9,49	12789	966	515	618	800	899	797	1155	1422	1545	1582	1255	1235
10	9,50	10,49	13592	980	521	580	866	950	913	1231	1586	1716	1670	1331	1248
11	10,50	11,49	13308	940	433	602	881	899	917	1255	1527	1707	1603	1359	1185
12	11,50	12,49	12565	795	423	661	778	885	911	1120	1476	1602	1435	1234	1245
13	12,50	13,49	11711	675	337	505	798	806	878	1064	1443	1540	1384	1198	1083
14	13,50	14,49	10259	582	301	495	663	747	750	862	1290	1301	1229	1035	1004
15	14,50	15,49	8898	471	222	418	501	631	672	774	1111	1177	1098	927	896
16	15,50	16,49	7500	367	169	322	456	517	550	606	941	1058	909	850	755
17	16,50	17,49	6380	323	134	258	361	426	454	540	823	905	770	741	645
18	17,50	18,49	5028	250	94	204	288	292	346	381	700	735	633	576	529
19	18,50	19,49	4213	180	63	174	255	257	281	337	570	607	540	509	440
20	19,50	20,49	3317	144	42	122	177	196	200	247	472	476	467	449	325
21	20,50	21,49	2495	83	25	87	141	155	163	168	330	362	379	335	267
22	21,50	22,49	1926	59	38	64	114	105	81	145	250	317	316	243	194
23	22,50	23,49	1393	44	13	47	70	75	57	92	177	227	222	212	157
24	23,50	24,49	1051	19	11	23	59	39	51	74	143	172	162	177	121
25	24,50	25,49	735	14	7	24	31	19	29	43	101	119	136	133	79
26	25,50	26,49	518	7	6	15	21	18	19	25	76	87	85	102	57
27	26,50	27,49	387	4	1	16	19	12	9	15	49	73	82	64	43
28	27,50	28,49	246	3	1	7	9	2	6	4	28	59	57	41	29
29	28,50	29,49	150	1	3	1	4	2	1	5	21	19	30	43	20
30	29,50	30,49	136	0	3	4	3	2	0	5	12	23	33	32	19
31	30,50	31,49	67	1	2	2	0	0	0	0	5	8	19	21	9
32	31,50	32,49	44	1	0	0	0	0	0	1	2	7	16	11	6
33	32,50	33,49	35	0	0	1	0	1	0	0	1	6	10	11	5
34	33,50	34,49	29	0	0	0	0	0	0	0	0	5	7	16	1
35	34,50	35,49	24	0	0	0	0	0	0	0	0	1	9	10	4
36	35,50	36,49	17	0	0	0	0	0	0	0	0	1	11	5	0
37	36,50	37,49	4	0	0	0	0	0	0	0	0	1	1	1	1
38	37,50	38,49	9	0	1	0	0	0	0	0	0	0	6	2	0
39	38,50	39,49	3	0	0	0	0	0	0	0	0	1	1	0	1
40	39,50	40,49	1	0	0	0	0	0	0	0	0	0	0	1	0
41	40,50		1	0	0	0	0	0	0	0	0	1	0	0	0

Project:
Secondary data

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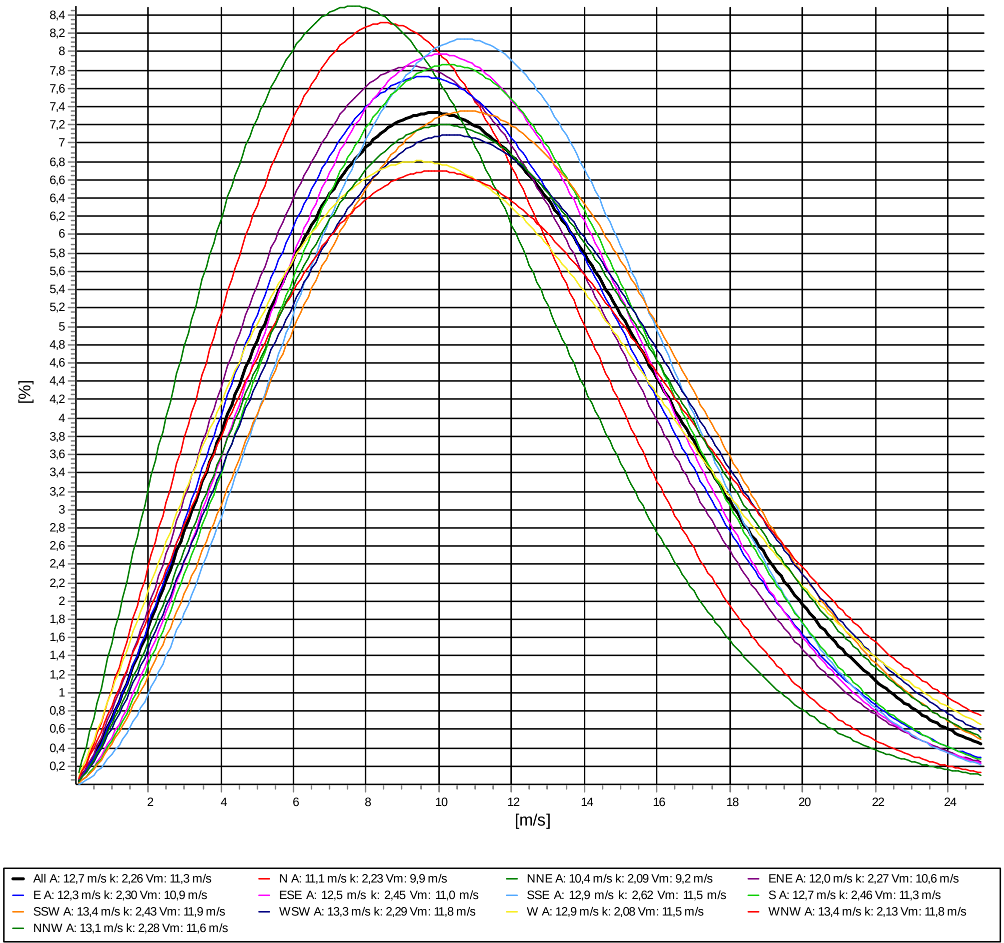
Calculated:
29/03/2023 11.27

Meteo data report - Weibull data overview

Mast: Harald B to position 1; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **150,00m - E Synth**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	11,13	2,230	6,84	9,86
1-NNE	10,41	2,094	3,71	9,22
2-ENE	11,97	2,273	4,85	10,60
3-E	12,28	2,305	6,44	10,88
4-ESE	12,46	2,447	6,72	11,05
5-SSE	12,89	2,621	6,53	11,46
6-S	12,69	2,460	8,19	11,26
7-SSW	13,42	2,426	11,35	11,90
8-WSW	13,30	2,289	12,70	11,79
9-W	12,93	2,077	12,54	11,46
10-WNW	13,35	2,127	10,59	11,82
11-NNW	13,07	2,281	9,55	11,58
Mean	**12,74**	**2,258**	**100,00**	**11,28**



Appendix G. Translated to Position 2: Thor, FINO3, Harald B,

Project:
Secondary data

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Calculated:
29/03/2023 11.19

Meteo data report - Frequency distribution (TAB file data)

Mast: Thor to Position 2; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

150,00m -

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,75	8,05	7,69	9,67	10,36	11,03	11,00	11,16	11,75	11,63	10,70	10,59	10,82
0		0,49	105	0	0	21	2	0	0	0	0	17	42	23	0
1	0,50	1,49	910	17	63	76	82	26	46	20	39	128	214	151	48
2	1,50	2,49	2719	112	214	289	179	141	104	160	227	372	439	266	216
3	2,50	3,49	4684	201	356	465	500	367	288	294	258	457	635	493	370
4	3,50	4,49	6523	326	568	379	456	440	398	344	471	736	815	969	621
5	4,50	5,49	8915	452	545	511	682	661	519	546	763	1036	1067	1177	956
6	5,50	6,49	11932	689	552	586	739	655	765	760	1047	1466	1664	1844	1165
7	6,50	7,49	13319	780	749	794	640	736	844	926	1149	1368	1953	1922	1458
8	7,50	8,49	12251	475	680	794	591	840	800	873	1202	1472	1583	1751	1190
9	8,50	9,49	11829	395	487	622	736	788	671	910	1280	1160	1655	1875	1250
10	9,50	10,49	12834	338	417	783	1061	966	917	1015	1231	1374	1694	1822	1216
11	10,50	11,49	14045	360	425	942	1136	1031	1248	1116	1424	1680	1829	1820	1034
12	11,50	12,49	13729	187	297	990	1025	1110	1228	1112	1452	1780	1589	1771	1188
13	12,50	13,49	12718	186	151	729	712	921	990	1074	1457	1739	1506	1929	1324
14	13,50	14,49	11069	140	178	433	660	824	756	805	1208	1620	1465	1843	1137
15	14,50	15,49	9551	73	122	451	714	747	850	698	1094	1333	1368	1238	863
16	15,50	16,49	7647	47	62	212	548	581	591	712	842	1269	1101	800	882
17	16,50	17,49	5543	51	32	197	407	437	444	390	577	924	752	724	608
18	17,50	18,49	4746	37	13	164	279	395	397	370	758	750	554	566	463
19	18,50	19,49	3284	23	6	104	158	325	176	250	559	551	409	397	326
20	19,50	20,49	2261	8	1	44	67	133	89	151	436	518	293	264	257
21	20,50	21,49	1661	4	1	34	28	103	87	182	241	376	210	186	209
22	21,50	22,49	1139	0	0	20	22	72	59	111	262	245	142	119	87
23	22,50	23,49	700	2	1	5	8	53	30	47	128	177	111	82	56
24	23,50	24,49	415	1	0	1	9	18	6	39	76	123	77	39	26
25	24,50	25,49	248	1	0	0	2	4	6	16	52	70	50	27	20
26	25,50	26,49	173	1	1	1	0	1	0	15	39	59	37	15	4
27	26,50	27,49	110	1	0	1	0	0	2	3	15	41	26	13	8
28	27,50	28,49	74	0	0	0	0	0	1	0	10	27	22	12	2
29	28,50	29,49	32	0	0	0	0	0	0	1	4	10	6	10	1
30	29,50	30,49	26	0	0	0	0	0	0	0	4	6	10	6	0
31	30,50	31,49	10	0	0	0	0	0	0	0	2	3	3	2	0
32	31,50	32,49	8	0	0	0	0	0	0	0	1	3	4	0	0
33	32,50	33,49	2	0	0	0	0	0	0	0	1	0	1	0	0
34	33,50	34,49	3	0	0	0	0	0	0	0	0	1	2	0	0
35	34,50	35,49	2	0	0	0	0	0	0	0	0	1	1	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	1	0	0	0	0	0	0	0	0	0	1	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

Project:
Secondary data

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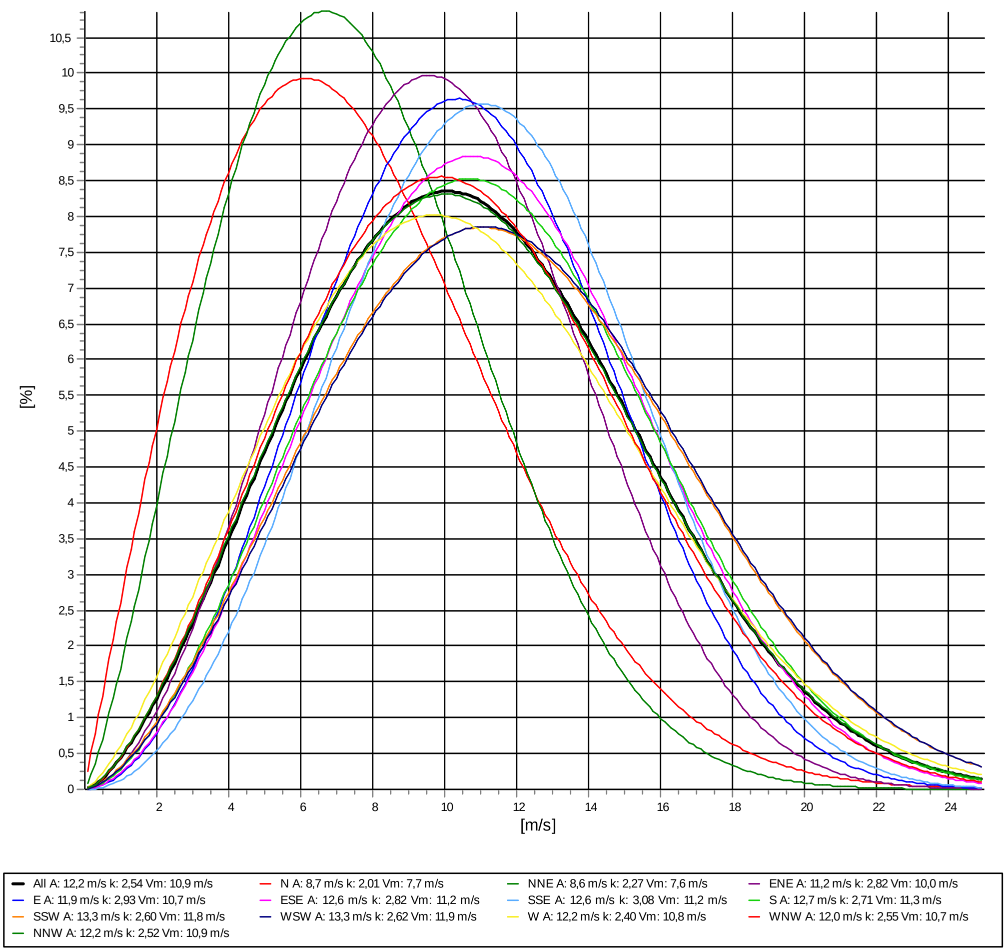
Calculated:
29/03/2023 11.19

Meteo data report - Weibull data overview

Mast: Thor to Position 2; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **150,00m -**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,66	2,007	2,80	7,67
1-NNE	8,63	2,272	3,38	7,65
2-ENE	11,20	2,823	5,51	9,97
3-E	11,95	2,931	6,53	10,66
4-ESE	12,59	2,815	7,06	11,21
5-SSE	12,56	3,080	7,03	11,23
6-S	12,66	2,712	7,39	11,26
7-SSW	13,29	2,601	10,45	11,80
8-WSW	13,34	2,620	13,06	11,85
9-W	12,18	2,395	13,31	10,79
10-WNW	12,01	2,555	13,79	10,66
11-NNW	12,24	2,523	9,69	10,86
Mean	**12,25**	**2,541**	**100,00**	**10,87**



Project:
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29/03/2023 11.24

Meteo data report - Frequency distribution (TAB file data)

Mast: Fino3 to Position 2; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

150,00m - B Synth trans

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			10,86	7,67	7,19	8,18	9,46	10,86	11,26	11,36	11,98	11,85	11,33	11,37	11,09
0		0,49	28	0	0	13	8	7	0	0	0	0	0	0	0
1	0,50	1,49	297	0	23	71	97	93	13	0	0	0	0	0	0
2	1,50	2,49	1461	74	159	172	242	248	94	25	32	59	129	107	120
3	2,50	3,49	3846	321	391	524	445	429	301	126	130	249	288	369	273
4	3,50	4,49	6370	565	614	797	653	501	417	366	347	382	487	643	598
5	4,50	5,49	8421	774	672	831	687	597	598	524	595	669	766	844	864
6	5,50	6,49	10482	918	703	865	697	552	666	747	845	990	1089	1246	1164
7	6,50	7,49	11765	939	659	758	870	753	697	836	879	1134	1237	1604	1399
8	7,50	8,49	13022	769	716	652	828	870	813	1037	1163	1436	1384	1752	1602
9	8,50	9,49	13907	705	562	645	779	956	998	1104	1172	1563	1569	2042	1812
10	9,50	10,49	15273	580	425	662	866	1094	1043	1191	1391	1800	1889	2328	2004
11	10,50	11,49	15154	455	378	562	849	1142	1058	1247	1623	1920	1846	2283	1791
12	11,50	12,49	14697	245	270	521	774	1207	1146	1235	1632	2012	1838	2176	1641
13	12,50	13,49	13512	191	91	387	648	1027	1066	1139	1576	2019	1827	1984	1557
14	13,50	14,49	11353	111	69	261	528	944	901	968	1402	1593	1407	1777	1392
15	14,50	15,49	9254	68	40	165	396	734	914	850	1135	1287	1108	1507	1050
16	15,50	16,49	7370	37	16	135	374	600	833	655	901	979	857	1164	819
17	16,50	17,49	5829	30	8	101	263	523	619	450	880	826	640	912	577
18	17,50	18,49	4286	10	3	65	173	367	394	411	602	679	478	604	500
19	18,50	19,49	3057	10	1	55	82	283	187	237	457	503	367	505	370
20	19,50	20,49	2049	5	0	17	58	147	116	151	287	367	269	316	316
21	20,50	21,49	1342	2	0	7	35	100	78	125	200	238	174	152	231
22	21,50	22,49	918	3	0	1	7	53	53	98	143	170	140	137	113
23	22,50	23,49	598	2	0	1	3	27	43	51	109	143	92	81	46
24	23,50	24,49	389	0	0	0	0	9	17	29	23	97	76	67	71
25	24,50	25,49	206	0	0	0	0	3	3	10	27	28	39	50	46
26	25,50	26,49	119	1	0	0	0	3	3	5	10	20	33	28	16
27	26,50	27,49	60	0	0	0	0	2	0	2	3	12	13	18	10
28	27,50	28,49	58	0	0	0	0	0	0	1	4	7	6	17	23
29	28,50	29,49	29	0	0	0	0	0	0	1	3	1	4	15	5
30	29,50	30,49	20	0	0	0	0	0	0	0	0	3	0	14	3
31	30,50	31,49	8	0	0	0	0	0	0	0	0	0	0	5	3
32	31,50	32,49	5	0	0	0	0	0	0	0	0	0	0	2	3
33	32,50	33,49	3	0	0	0	0	0	0	0	1	0	0	2	0
34	33,50	34,49	1	0	0	0	0	0	0	0	0	0	0	0	1
35	34,50	35,49	1	0	0	0	0	0	0	0	0	1	0	0	0
36	35,50	36,49	0	0	0	0	0	0	0	0	0	0	0	0	0
37	36,50	37,49	0	0	0	0	0	0	0	0	0	0	0	0	0
38	37,50	38,49	0	0	0	0	0	0	0	0	0	0	0	0	0
39	38,50	39,49	0	0	0	0	0	0	0	0	0	0	0	0	0
40	39,50	40,49	0	0	0	0	0	0	0	0	0	0	0	0	0
41	40,50		0	0	0	0	0	0	0	0	0	0	0	0	0

Project:
Secondary data

Licensed user:
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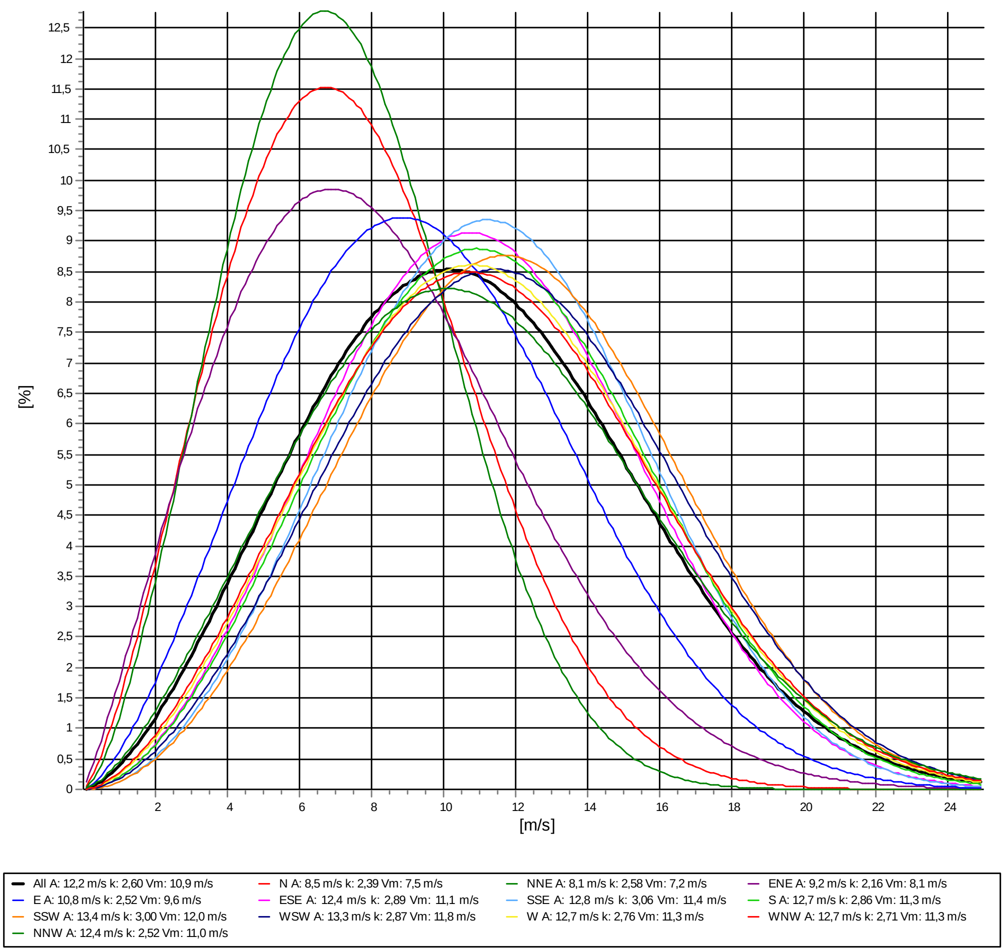
Thomas Sørensen / ts@emd.dk
Calculated:
29/03/2023 11.24

Meteo data report - Weibull data overview

Mast: Fino3 to Position 2; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **150,00m - B Synth trans**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	8,46	2,394	3,89	7,50
1-NNE	8,11	2,580	3,31	7,20
2-ENE	9,18	2,163	4,72	8,13
3-E	10,83	2,522	5,91	9,61
4-ESE	12,45	2,887	7,58	11,10
5-SSE	12,78	3,057	7,46	11,42
6-S	12,71	2,859	7,77	11,33
7-SSW	13,41	2,998	10,03	11,97
8-WSW	13,26	2,872	12,09	11,82
9-W	12,71	2,758	11,45	11,31
10-WNW	12,71	2,713	14,13	11,31
11-NNW	12,35	2,516	11,66	10,96
Mean	**12,22**	**2,603**	**100,00**	**10,86**



Project:
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Calculated:
29/03/2023 12.13

Meteo data report - Frequency distribution (TAB file data)

Mast: Harald B to Position 2; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)

Frequency distribution (TAB file data)

150,00m - E Synth

Bin	Start	End	Sum	0-N	1-NNE	2-ENE	3-E	4-ESE	5-SSE	6-S	7-SSW	8-WSW	9-W	10-WNW	11-NNW
Mean			11,15	9,90	9,07	9,97	10,25	10,87	11,22	11,25	11,88	11,85	11,50	11,74	11,25
0		0,49	1318	105	97	110	131	97	83	79	86	127	170	107	126
1	0,50	1,49	1851	136	135	165	160	111	113	120	149	193	214	192	163
2	1,50	2,49	3182	275	233	193	254	245	187	223	278	354	355	302	283
3	2,50	3,49	4629	444	281	331	399	309	264	326	379	463	547	444	442
4	3,50	4,49	6345	587	409	429	484	448	367	457	559	696	759	606	544
5	4,50	5,49	7856	699	426	462	599	529	467	566	719	851	1022	737	779
6	5,50	6,49	9263	837	493	548	712	626	540	689	868	1003	1127	947	873
7	6,50	7,49	10707	919	531	579	808	688	631	813	1063	1203	1337	1135	1000
8	7,50	8,49	12027	1024	519	646	775	822	730	924	1267	1396	1537	1252	1135
9	8,50	9,49	12851	942	518	642	844	914	829	1124	1394	1494	1581	1290	1279
10	9,50	10,49	13896	975	521	598	958	987	939	1234	1650	1719	1690	1358	1267
11	10,50	11,49	13218	932	444	638	894	861	902	1206	1528	1695	1574	1346	1198
12	11,50	12,49	12811	805	418	672	839	878	899	1173	1514	1643	1483	1246	1241
13	12,50	13,49	11591	702	348	477	706	796	845	1085	1379	1527	1379	1222	1125
14	13,50	14,49	10095	560	288	485	548	754	796	855	1305	1302	1233	980	989
15	14,50	15,49	8822	465	239	366	463	644	664	754	1070	1204	1098	974	881
16	15,50	16,49	7304	397	171	289	397	509	534	591	930	1084	896	807	699
17	16,50	17,49	6350	328	124	248	327	401	433	531	835	947	776	749	651
18	17,50	18,49	5067	253	89	180	269	317	374	429	680	746	657	587	486
19	18,50	19,49	4013	186	57	126	220	239	266	331	570	607	526	471	414
20	19,50	20,49	3220	130	44	99	174	188	191	264	447	478	481	420	304
21	20,50	21,49	2448	107	32	61	110	149	160	171	326	392	376	323	241
22	21,50	22,49	1815	47	28	48	68	118	78	131	263	309	299	252	174
23	22,50	23,49	1354	48	11	33	71	70	51	96	164	232	226	206	146
24	23,50	24,49	964	21	15	26	30	27	46	60	149	164	164	172	90
25	24,50	25,49	722	19	6	19	25	22	32	55	112	139	117	116	60
26	25,50	26,49	511	11	4	10	19	14	15	33	83	86	97	87	52
27	26,50	27,49	347	7	4	6	5	11	5	15	51	73	76	60	34
28	27,50	28,49	225	6	1	6	2	4	5	6	29	54	56	39	17
29	28,50	29,49	156	5	2	4	3	2	1	3	27	24	30	35	20
30	29,50	30,49	114	4	1	0	1	1	0	3	20	19	25	29	11
31	30,50	31,49	76	2	4	1	3	0	0	2	5	9	24	22	4
32	31,50	32,49	57	5	2	1	0	0	0	0	1	8	18	17	5
33	32,50	33,49	43	3	0	0	0	0	0	1	3	8	11	14	3
34	33,50	34,49	21	0	0	0	0	0	0	0	0	3	7	8	3
35	34,50	35,49	20	1	0	0	0	0	0	0	0	2	10	6	1
36	35,50	36,49	13	0	0	0	0	0	0	0	0	0	5	6	2
37	36,50	37,49	8	0	0	0	0	0	0	0	0	2	5	0	1
38	37,50	38,49	5	0	1	0	0	0	0	0	0	0	3	1	0
39	38,50	39,49	3	0	0	0	0	0	0	0	0	1	1	1	0
40	39,50	40,49	1	0	0	0	0	0	0	0	0	0	0	1	0
41	40,50		1	0	0	0	0	0	0	0	0	1	0	0	0

Project:
Secondary data

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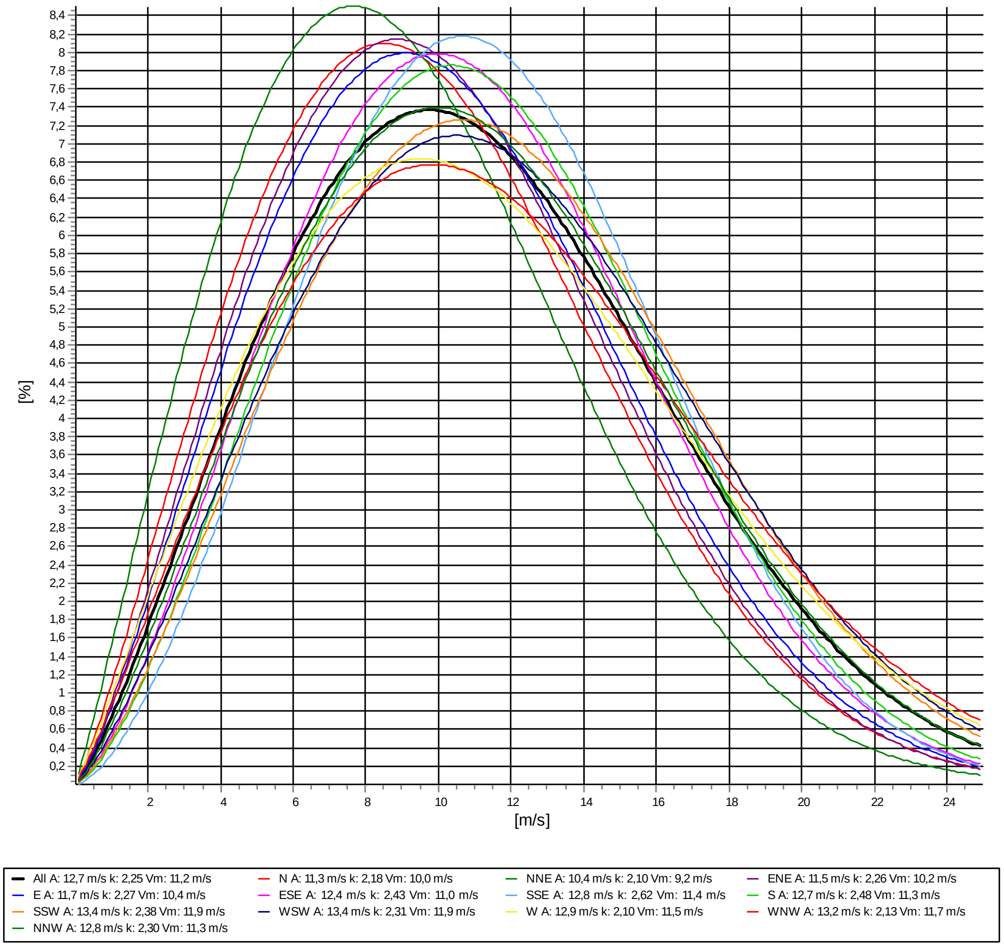
Calculated:
29/03/2023 12.13

Meteo data report - Weibull data overview

Mast: Harald B to Position 2; 20 year period **Period:** Full period: 01/01/2003 - 01/01/2023 (240,0 months)
Height: **150,00m - E Synth**

Weibull data

Sector	A [m/s]	k	f	Mean wind speed [m/s]
0-N	11,25	2,184	6,84	9,97
1-NNE	10,42	2,100	3,71	9,23
2-ENE	11,49	2,264	4,85	10,18
3-E	11,73	2,271	6,44	10,39
4-ESE	12,38	2,435	6,72	10,98
5-SSE	12,81	2,617	6,53	11,38
6-S	12,75	2,475	8,19	11,31
7-SSW	13,39	2,383	11,35	11,87
8-WSW	13,40	2,311	12,70	11,87
9-W	12,95	2,095	12,54	11,47
10-WNW	13,23	2,133	10,59	11,72
11-NNW	12,79	2,299	9,55	11,33
Mean	**12,65**	**2,255**	**100,00**	**11,21**



Appendix H. Normal Turbulence Model (150 m)

Wind speed [m/s]	Turbulence intensity mean value (TI_μ) [%]	Turbulence intensity standard deviation (TI_σ) [%]	Turbulence intensity 90% quantile [%]
3	10.1	5.9	17.6
4	7.9	4.7	13.9
5	6.7	3.9	11.8
6	6.0	3.5	10.4
7	5.6	3.1	9.5
8	5.3	2.8	8.9
9	5.1	2.6	8.5
10	5.0	2.5	8.2
11	5.0	2.4	8.0
12	5.0	2.3	7.9
13	5.0	2.2	7.8
14	5.1	2.1	7.7
15	5.1	2.0	7.7
16	5.2	2.0	7.7
17	5.4	1.9	7.8
18	5.5	1.9	7.9
19	5.7	1.8	8.0
20	5.8	1.8	8.1
21	6.0	1.7	8.2
22	6.1	1.7	8.3
23	6.3	1.7	8.5
24	6.5	1.7	8.6
25	6.7	1.6	8.8

Wind speed [m/s]	Turbulence mean value (σ_μ) [m/s]	Turbulence standard deviation (σ_σ) [m/s]	Turbulence 90% quantile [m/s]
3	0.30	0.18	0.53
4	0.32	0.19	0.56
5	0.34	0.20	0.59
6	0.36	0.21	0.63
7	0.39	0.22	0.67
8	0.42	0.23	0.71
9	0.46	0.24	0.76
10	0.50	0.25	0.82
11	0.55	0.26	0.88
12	0.60	0.27	0.94
13	0.65	0.28	1.01
14	0.71	0.29	1.08
15	0.77	0.30	1.16
16	0.84	0.31	1.24
17	0.91	0.32	1.33
18	0.99	0.33	1.42
19	1.07	0.34	1.51
20	1.16	0.35	1.62
21	1.25	0.37	1.72
22	1.35	0.38	1.83
23	1.45	0.39	1.95
24	1.56	0.40	2.07
25	1.67	0.41	2.19