



Long-Term Corrected Wind Data

Lozenets

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1 Introduction

This document present the data and the method used to create the long-term wind data series for the project Lozenets.

1.1 Revision History

Rev	Date	Significant changes
<i>Older versions</i>		
0	2024-09-20	Initial Draft

1.2 Copyright

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2 Wind Measurements

2.1 Setup Description

The first measurement campaign was performed with a 100m tall tubular met mast located in the Dobrich province at the coordinates N 43° 46' 33,6", E 27° 44' 33.3" .

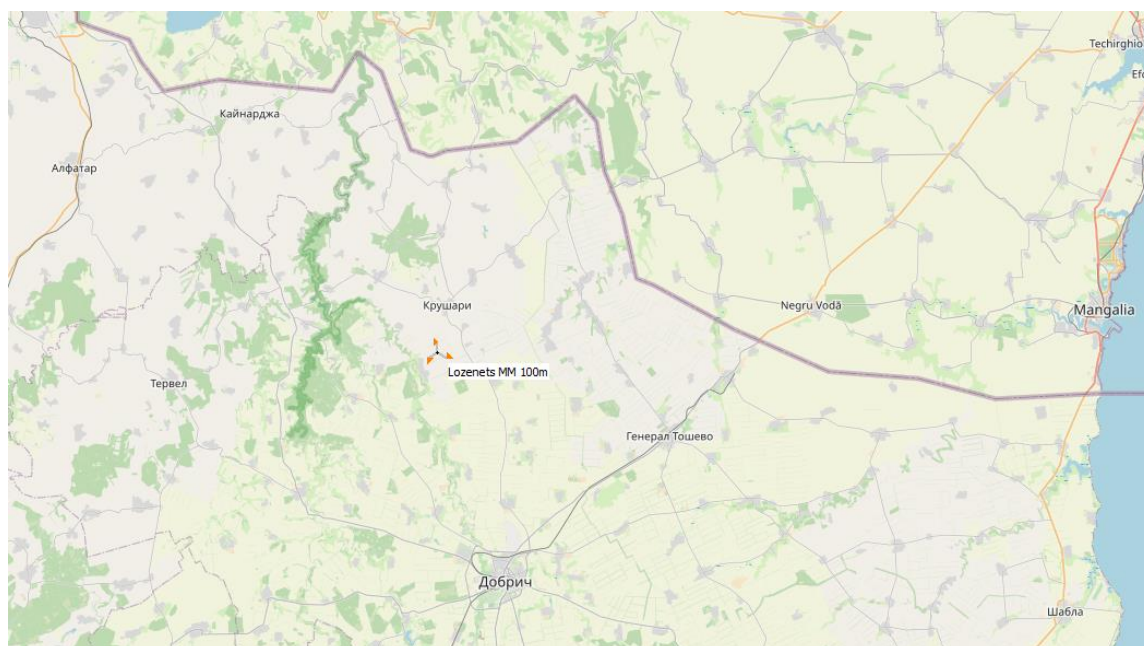


Figure 1: Lozenets Met Mast Location

It was installed on 12-02-2009 and operated from 12-02-2009 to 29-01-2014. Table 1 summarizes the equipment used on the mast. The met mast design is considered IECcompliant and all the anemometers have been calibrated by Deutsch WindGuard Wind Tunnel Service according to terms of IEC 61400-12-1 and MEASNET.

Table 1: Lozenets Met Mast Instruments

Sensor	Name	Manufacturer	Model	Serial number	Height	Direction
Anemometer	A1	Thies	4.3350.00.000	0806153	100m	-
Anemometer	A2	Thies	4.3350.00.000	0806149	98m	348°
Anemometer	A3	Thies	4.3350.00.000	1005388	74m	351°
Anemometer	A4	Thies	4.3350.00.000	0806151	40m	358°
Anemometer	A5	Thies	4.3350.00.000	0706084	24m	357°
Wind Vane	WF1	Thies	4.3150.00.212	0808694	98m	172°
Wind Vane	WF2	Thies	4.3150.00.212	0808688	40m	178°
Thermo/Hygrom	-	KP	-	60380	24m	180°
Thermometer	-	TP	-	66892	97.5m	172°
Barometer	-	In logger	-	-	5m	-
Data Logger	-	Meteo	32 X	C08 0016	5m	355°

2.2 Measurements description

2.2.1 DATA QUALITY CONTROL

The raw data from the met mast underwent a quality check and a filtering in order to remove the bad quality data. The recovery rate for all anemometers is summarized in Table 2.

Table 2: Lozenets Met Mast Recovery rate

Sensor	Available Data	Enabled Data	Valid Period [years]
A1	99.9%	73.6%	3.9
A2	99.9%	73.6%	3.9
A3	99.9%	73.7%	3.9
A4	99.9%	73.3%	3.9
A5	99.9%	73.7%	3.9

2.2.2 MEASUREMENTS RESULTS

The following Weibull curve and energy rose have been calculated using the filtered data from the top anemometer located at 100m. Over the measurements period, the average wind speed at 100m was 6.44 m/s and the main wind direction was South (180 degrees).

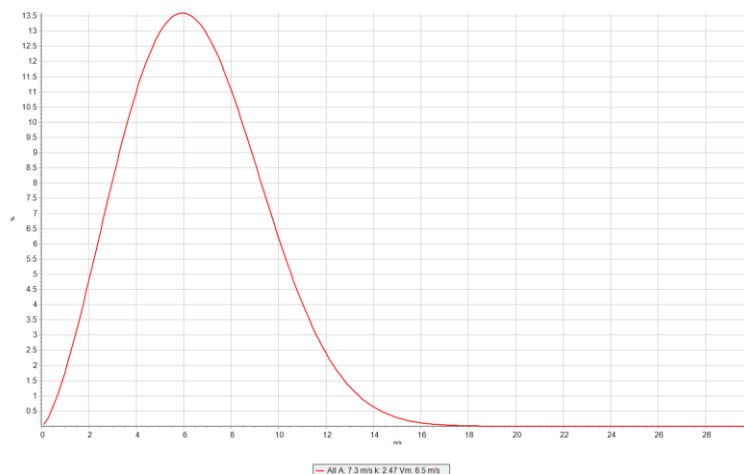


Figure 2: Lozenets Met Mast Weibull Curve at 100m

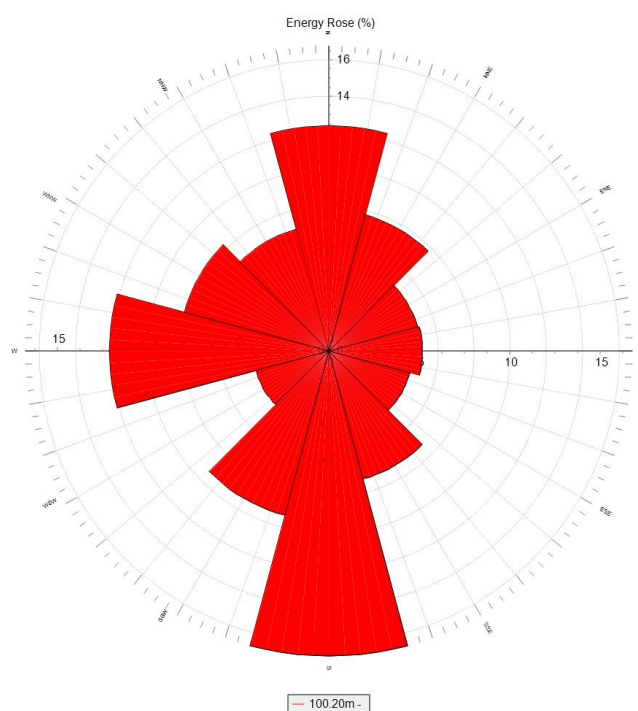


Figure 3: Lozenets Met Mast Energy Rose at 100m

The wind shear has been evaluated using the data from A2,A3 and A4. It has been calculated in a matrix composed of 6 seasonal bins, 12 diurnal bins and 12 sectors. The average wind shear for the area is 0.27.



Figure 4: Lozenets Met Mast Wind Shear

3 Long-term reference

The long-term reference wind data chosen for the analysis is the EMD-WRF (ERA5). The location of the chosen point is shown on Figure 5.

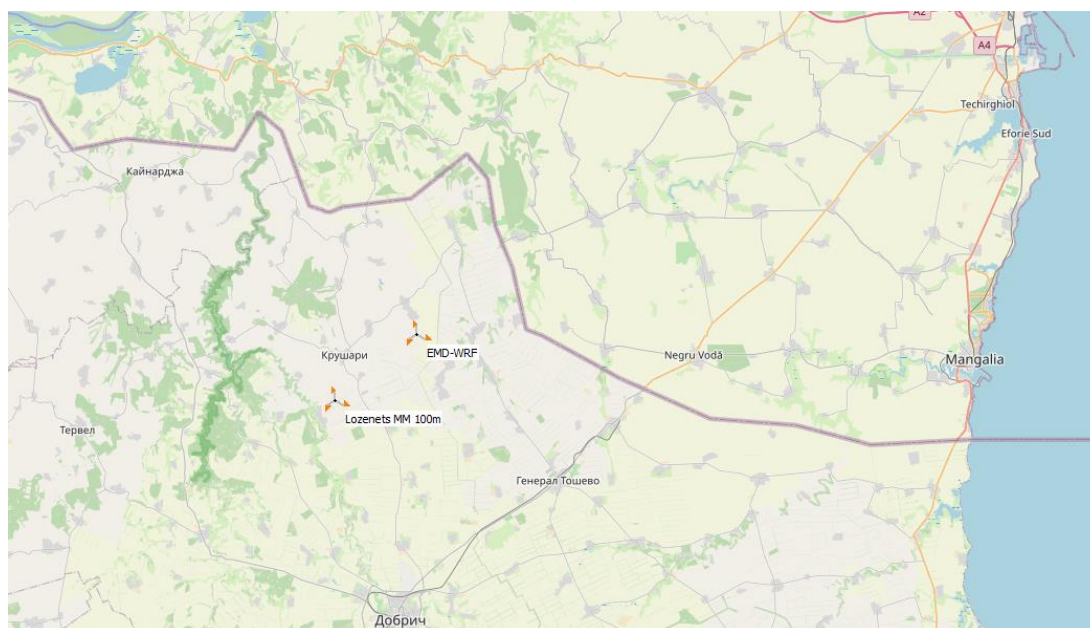


Figure 5: Long-Term Reference Wind Speed Location

The long-term period considered goes from 01-01-2002 to 31-12-2023 and the consistency of the data was assured by submitting it to a MK trend test which the data passed.

4 Long-term correction

4.1 Method

The long-term wind speed at the mast position at 100m was calculated based on the Measure Correlate Predict method using a matrix model.

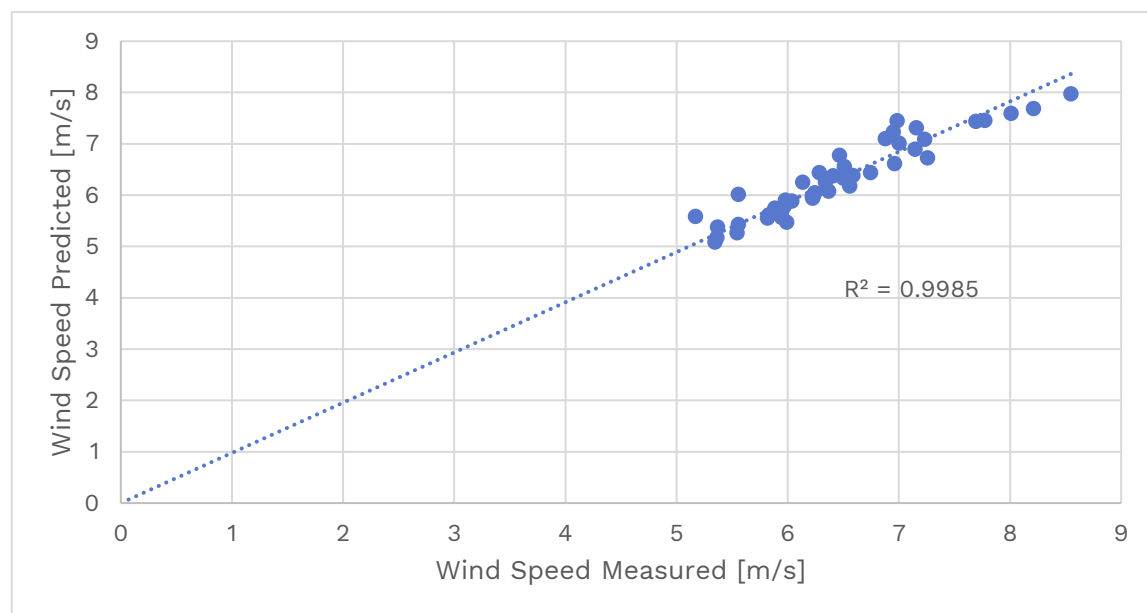


Figure 6: Met Mast Lozenets Wind Speed Prediction VS Measured at 100m

The correlation between the predicted and measured wind speed is very good with a R^2 value of 0.9985. The wind speed at 10m and 150m is then determined through a shear extrapolation of this long term wind speed using the shear matrix in Figure 4. The long-term temperature and air pressure is directly extracted from the EMD-WRF ERA5 dataset.

4.2 Results

The results of the long-term correction are summarized in Table 1.

Table 3: Met Mast Lozenets Long-Term Correction Result Summary

Long-Term Wind Speed at 10m [m/s]	Long-Term Wind Speed at 150m [m/s]	Wind Shear Exponent	Weibull A Parameter at 150m [m/s]	Weibull K Parameter at 150m
3.49	7.09	0.26	8.12	2.46