Monthly Report of Meteorological Conditions

Client: **Worldbank Group**
Site: **Central Highlands**
Month: **January 2019**

	Prepared by	Checked by
Sign	AP	HD
Date	2019-02-05	2019-02-05

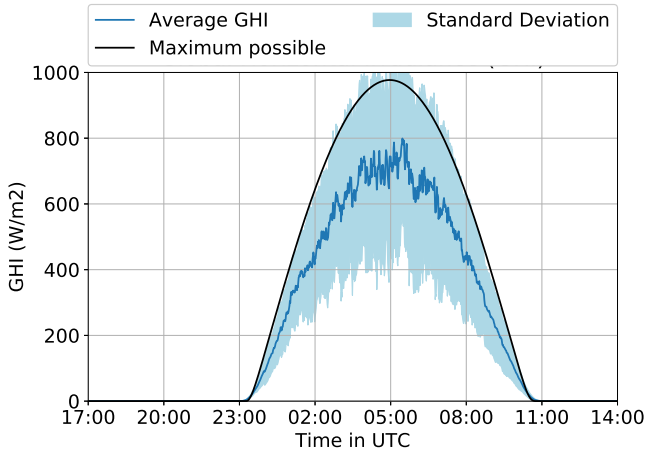
Site code	Latitude	Longitude	Elevation
VNCEH	12.75350°N	107.87610°E	290 m

Summary

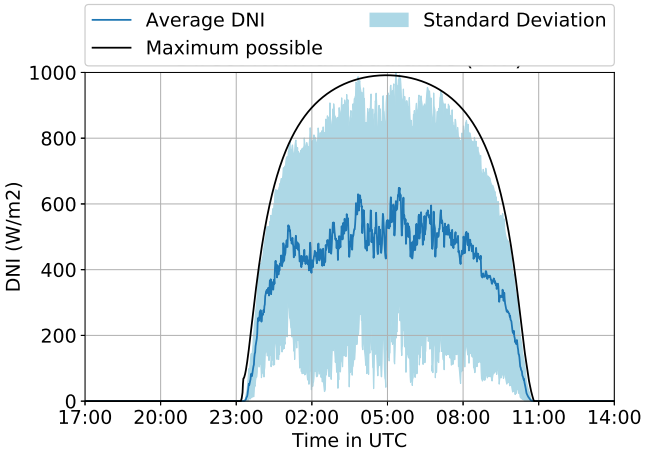
The station was running during 100% of the time during the month. Table 1 gives an overview about the most relevant atmospheric parameters during the month. Figure 1 illustrates the daily radiation averaged over the month.

Parameter	**Symbol**	**Unit**	**Average**	**Min**	**Max**	**Sum***
Global Horizontal Irr. (th. pyr.)	GHI_{th}	W/m^2	204	0	1184	152
Global Tilted Irr. (Ref-Cell 1)	GTI_{rc1}	W/m^2	221	0	1322	164
Global Tilted Irr. (Ref-Cell 2)	GTI_{rc2}	W/m^2	221	0	1322	164
Global Tilted Irr. (Ref-Cell 3)	GTI_{rc3}	W/m^2	220	0	1314	163
Direct Normal Irr. (th. Pyrh.)	DNI_{th}	W/m^2	195	0	957	145
Diffusive Horizontal Irr. (th. Pyr.)	DHI_{th}	W/m^2	80	0	597	60
Temperature (Air)	Temp	°C	24.5	16.4	32.3	-
Temperature (Logger)	$Temp_{lg}$	°C	31.7	21.8	44.5	-
Relative Humidity	RH	%	70	36	88	-
Wind Speed	WS	m/s	4.1	0.0	13.4	-
Wind Gusts	WG	m/s	5.4	0.0	17.1	-
Wind Direction	WD	°	84**	-	-	-
Atmospheric Pressure	AP	hPa	982.7	977.0	987.3	-
Service Button	-	-	-	-	-	94

Table 1: Atmospheric conditions recorded in given month. *insolation in kWh/m^2 **vector average



(a) Global Horizontal Irradiation



(b) Direct Normal Irradiation

Figure 1: Average day calculated from given month. Black curve shows theoretical radiation possible with clear skies all over the month and optimistically low aerosol contents in the atmosphere. Standard deviation marked in light blue gives an idea about the inter-monthly variations at a certain time of the day. Variation is often expected to be highest in the afternoon when the ground is heated up significantly and cumulus clouds form irregularly within the atmospheric boundary layer.

Radiation Measurements

A qualitative estimation of cloudy and sunny periods throughout the month can be achieved by taking a quick glance at figure 2 and 4. Figure 3 illustrates the distribution of irradiance values. It allows to easily capture the relative time the radiation exceeded a certain threshold.

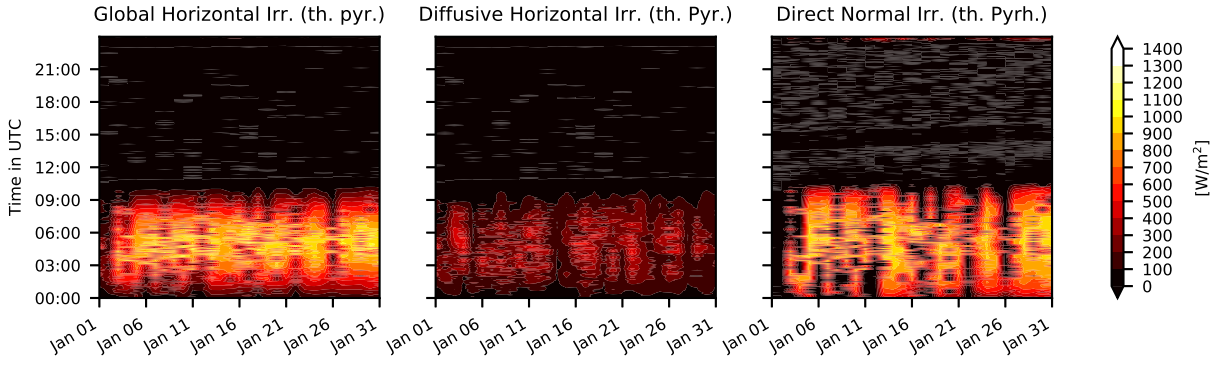


Figure 2: Daily irradiance measurements illustrated side-by-side

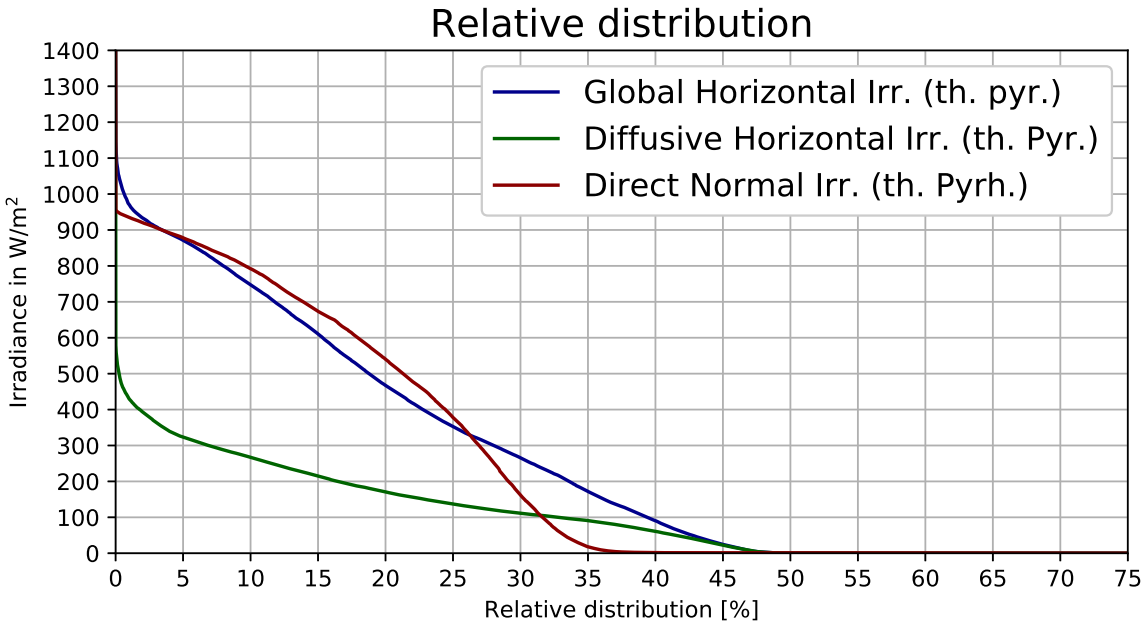


Figure 3: Distribution of irradiance measurements

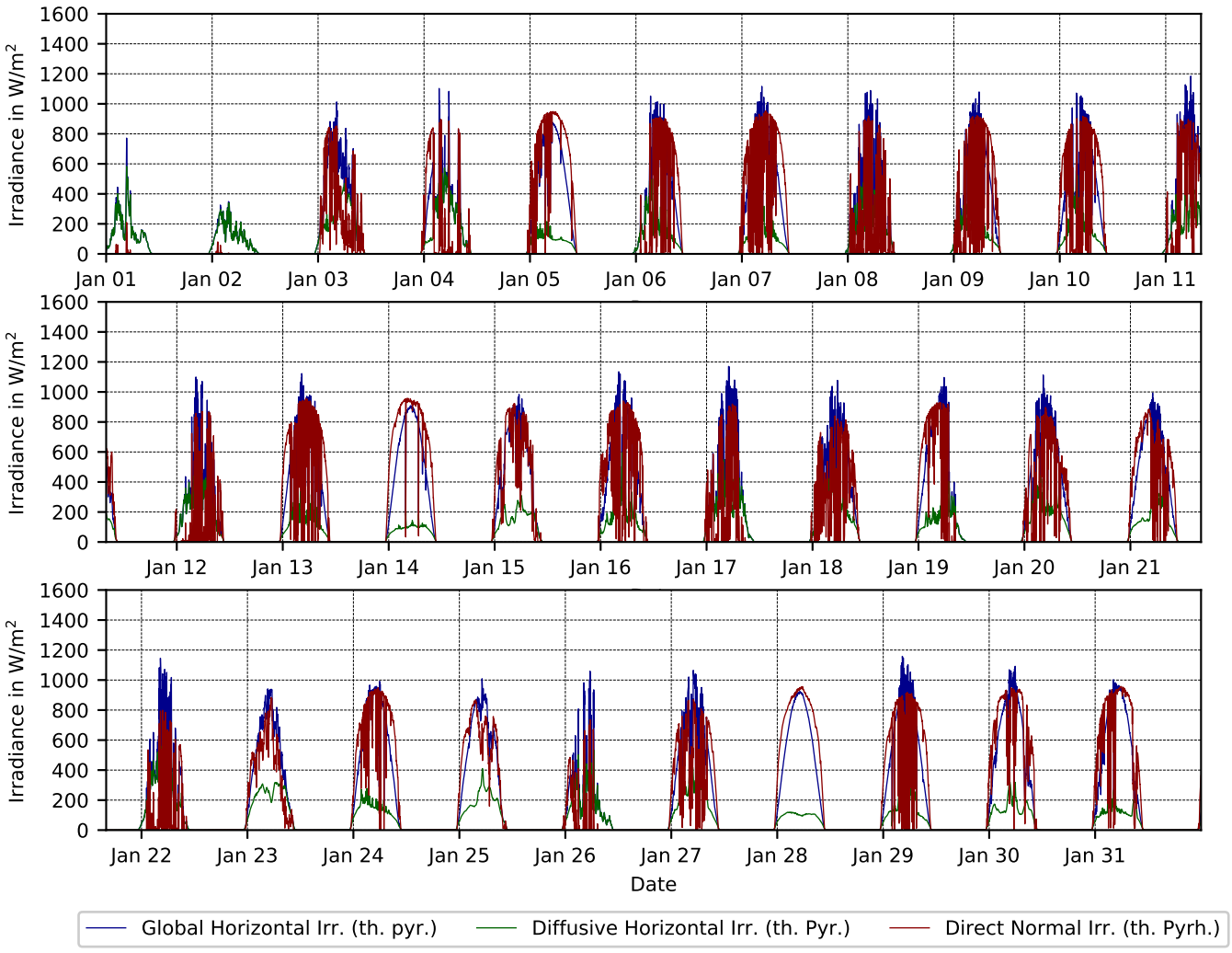


Figure 4: Time series of daily irradiance cycles

Data Quality Assessment

Assessing the quality of the data on a regular basis is crucial for measurements following high standards. At Suntrace we believe in transparency towards customers when it comes to data quality. Besides the quality flags in the data files, detailed information on the data quality is available through figure 5, where all relevant parameters are listed along with the results of quality tests.

If radiation measurements are performed by thermopile-based instruments, it is often observed that negative values are recorded during the night as they emit more radiation (infra-red) than they receive, as they are generally warmer than the effective environmental temperature. Those values are mostly in the range of –1 to –4 W/m^2 and are set to 0 W/m^2 as this slightly influences the results without representing effects one could obverse in f.e. photovoltaic power plants. These values are adequately marked as "corrected" in the figure and are not a sign of bad data quality.

Cleaning of the devices measuring irradiance is essential. Based on the type of instrument it is defined how often they should be cleaned. In the lower part of figure 5 it is shown how much of the time the instrument were in a sufficiently cleaned state based on the service button used by the station keeper to record cleaning events. It is important to note that this does not cover natural cleaning events like rain. Sufficiently strong rain events can also – if rain is not polluted – clean the instruments. Therefore, it is recommended to take a combined look at the service button pushes and rain events when investigating the cleanliness of the devices during the month.

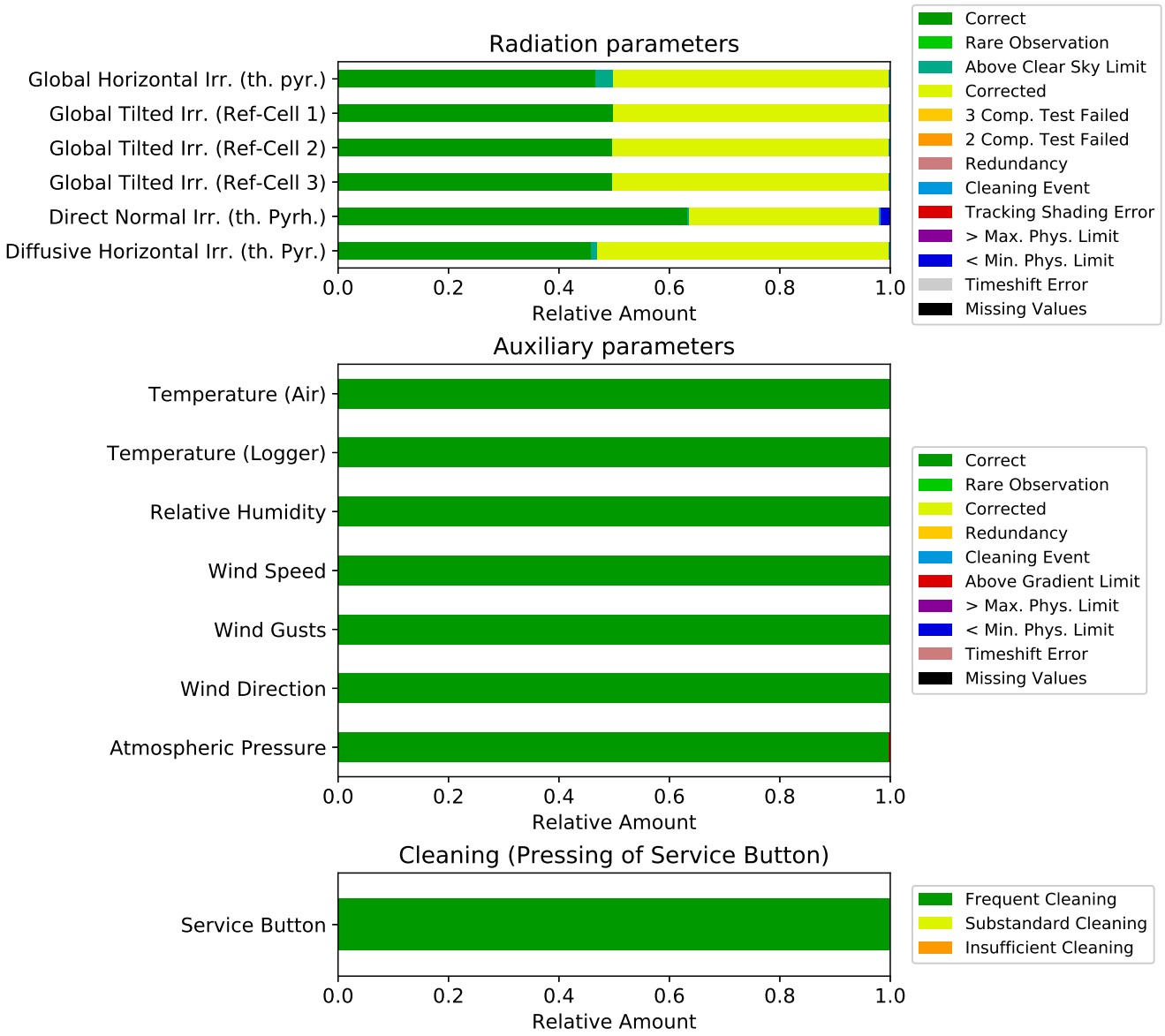


Figure 5: Quality check tests of radiation and auxilliary parameters along with the cleaning status during the month. Some more information about how to interpret the illustration is stated in the paragraph above.

Auxilliary Measurements

Auxilliary measurements like temperature and humidity (see figure 6) are not just important for solar power yield estimates, but also for analysing solar measurements, especially when issues occur. Also natural processes like the formation of dew is relevant for solar power plants and can not be identified with certainty without knowledge of atmospheric conditions.

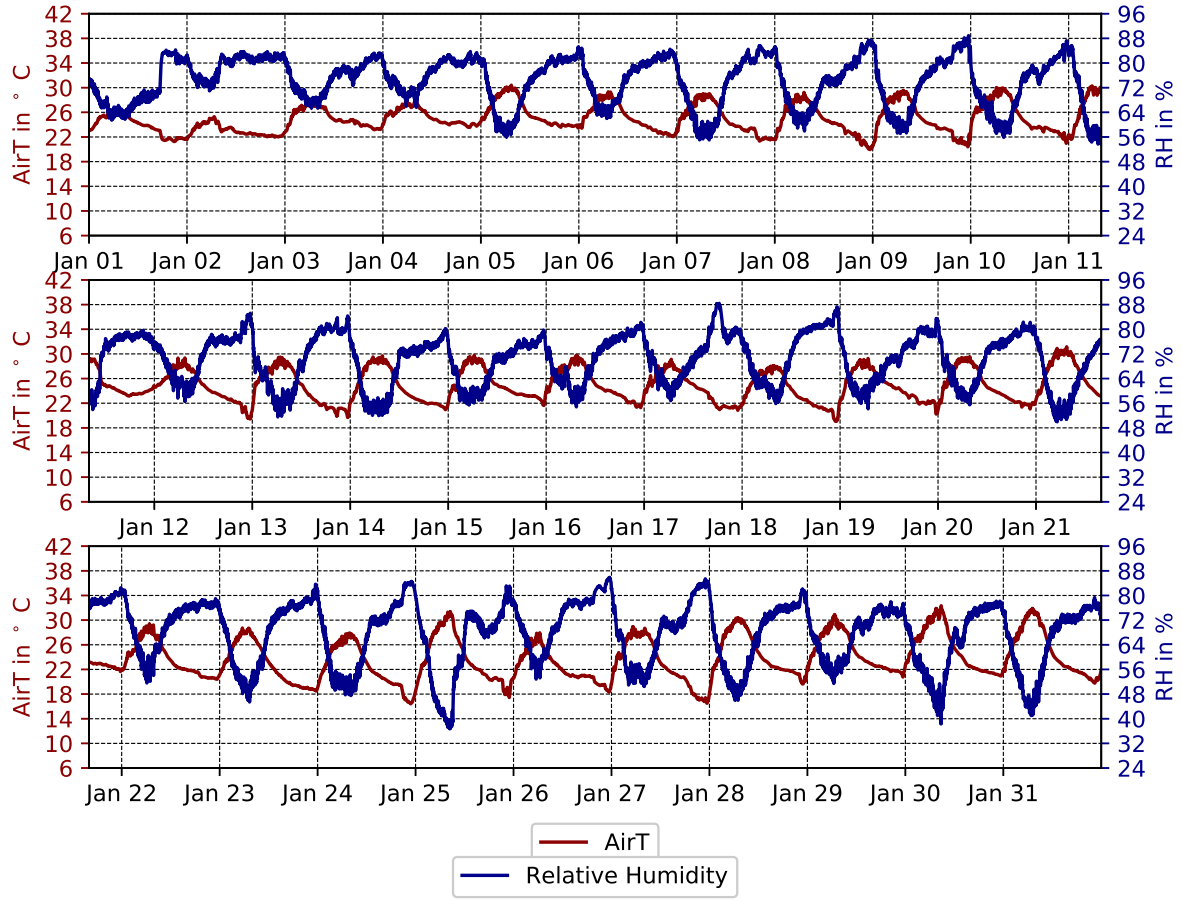


Figure 6: Temperature and Humidity

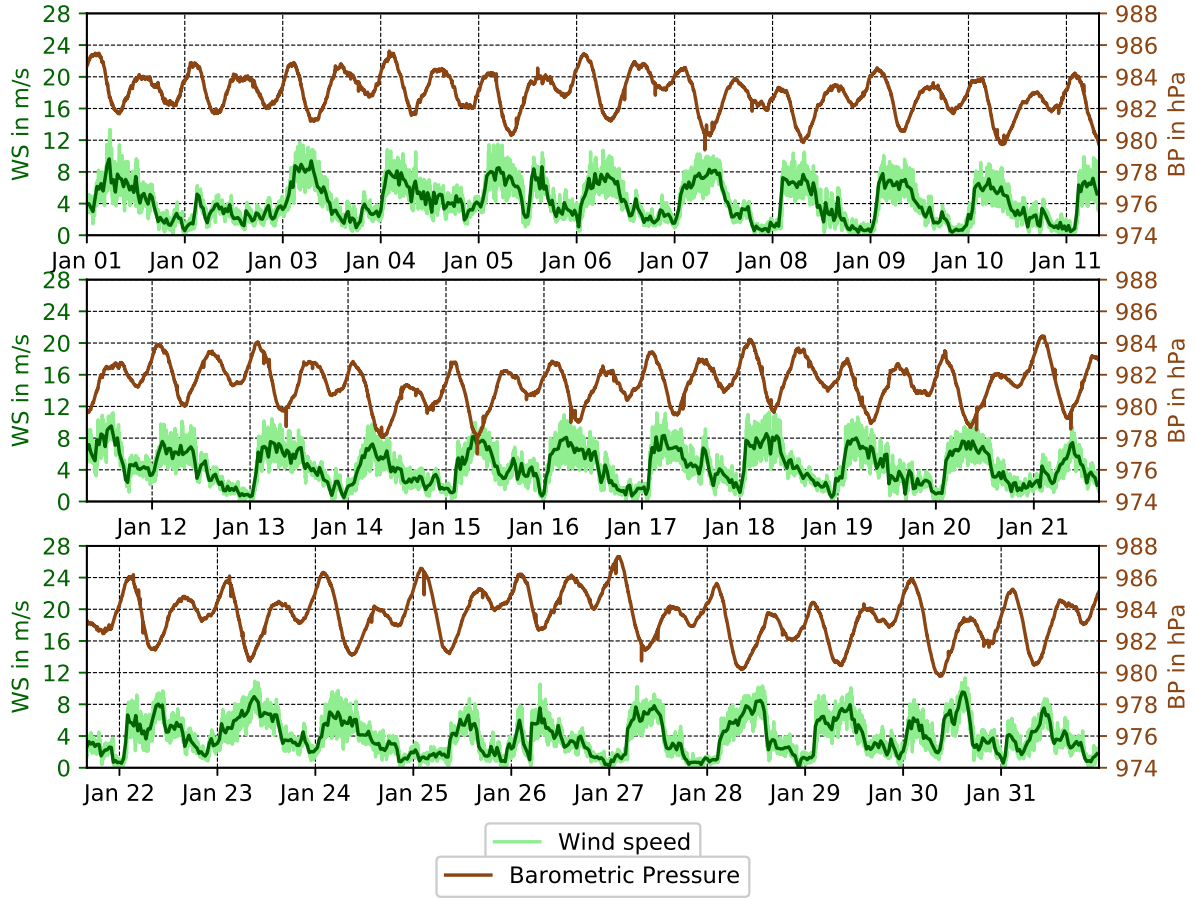


Figure 7: Atmospheric Pressure and Wind Speed; dark green line illustrates 15 minutes mean wind speed.

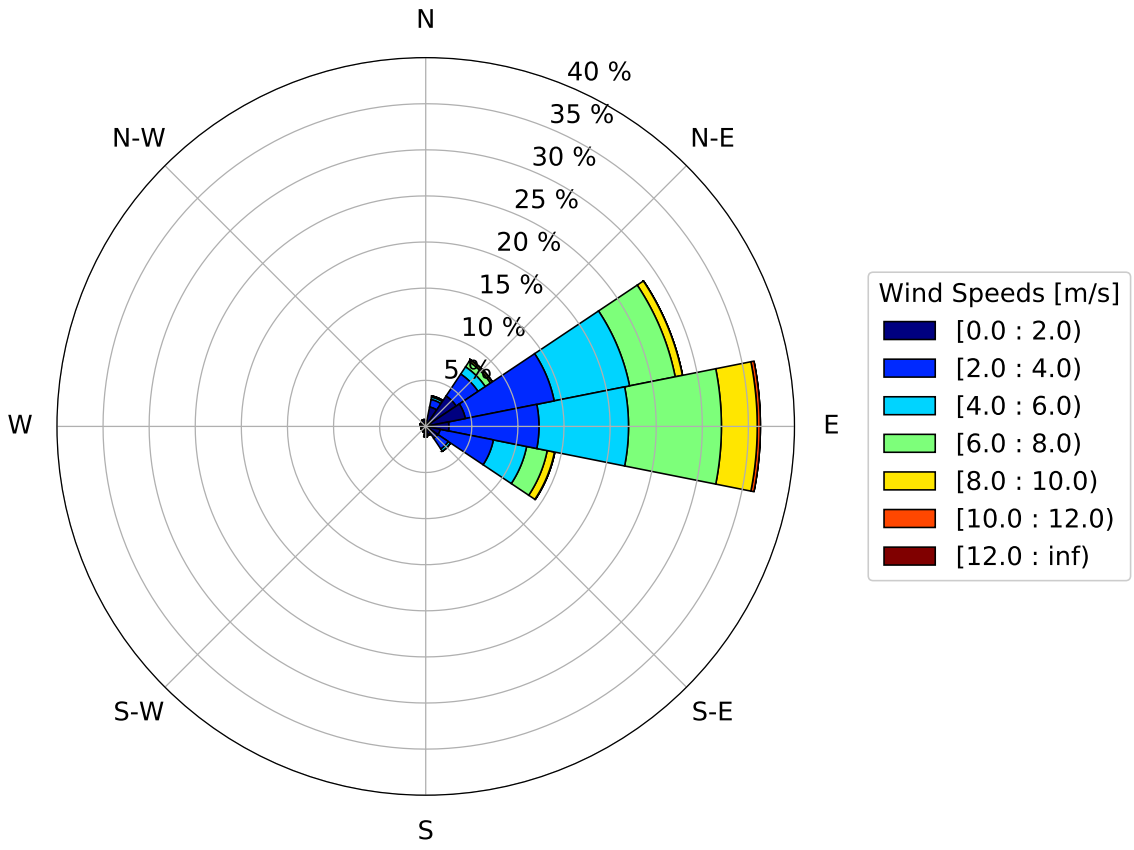


Figure 8: Wind Rose: Relative frequency of wind directions with related observed wind speeds.