

MEMO

Confidential

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Subject: Market questions regarding floating LiDAR data for HKZ WRA2
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CC:

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Introduction

Ecofys WTTS has prepared a combined wind resource assessment for the Hollandse Kust (zuid) Wind Farm Zone, for RVO.nl*. One of the primary data sources for the second wind resource assessment (WRA2) is a pair of floating LiDARs, named HKZA and HKZB. RVO.nl has received two questions from interested parties regarding the data from those buoys. Ecofys WTTS addresses those questions in this memo.

* Ecofys WTTS, Hollandse Kust (zuid) Wind Farm Zone – Combined Wind Resource Assessment, for RVO.nl, 18 September 2017, Available online: <http://offshorewind.rvo.nl/file/view/53815952/report-combined-wind-resource-assessment-wra-1-and-wra-2-hollandse-kust-zuid-wfz-ecofys>

Question 1

1. The concurrent mean wind speed (i.e. when measurements for both locations HKZA and HKZB are valid) differ by 0.1 m/s. Is there any explanation, given the small distance between the 2 positions?

Answer 1

The dataset used for this report from the two LiDAR buoys includes recorded concurrent wind speeds over a 12-month period (05/06/2016 to 04/06/2017). The mean wind speeds recorded at 100 m over that period differ by 0.1 m/s in the raw data, as shown in Table 1.

However, the difference is primarily due to differences in the data availability for each LiDAR buoy. The HKZA buoy has a lower availability than HKZB. After quality control (described in detail in the report*), and considering only timesteps with concurrent measurements of both buoys, the mean wind speeds at 100 m differ by only 0.01 m/s, as shown in Table 1. This level of accuracy is well within measurement uncertainties.

Table 1 – Mean wind speed at 100 m for HKZA and HKZB

	HKZA	HKZB
Mean wind speed at 100 m 05/06/2016 to 05/06/2017 Raw	8.70	8.60
Mean wind speed at 100 m 05/06/2016 to 05/06/2017 Filtered Both LiDARs measuring simultaneously	8.64	8.63

A scatter plot of concurrent wind speed measurements at 100 m, shown in Figure 1, confirms that the measurements are closely correlated without evident bias (the slope of the best fit line is 0.994).

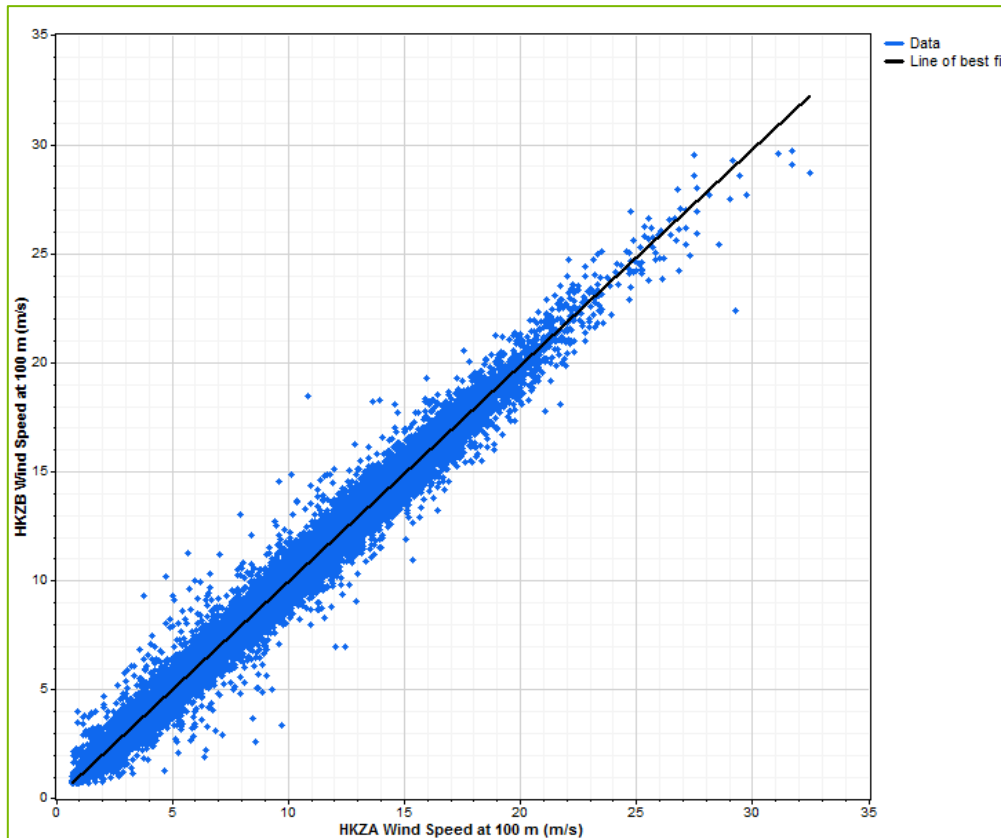


Figure 1 – Scatter plot of concurrent wind speed measurements at HKZA and HKZB at 100 m ($y=0.994x$ $R^2=0.99$)

Question 2

2. There seems to be a consistent difference of $\sim 5^\circ$ in the wind direction measurements of HKZA and HKZB. Is there any explanation, given the small distance between the 2 positions?

Answer 2

Ecofys WTTS confirms that the two wind direction measurements (HKZA and HKZB, at 100 m) can differ by about 5 degrees, as indicated in some sample intervals shown in Figure 2. However, the difference is not sufficiently regular to be considered as a static bias, nor is there any evidence of changing behaviour with time, as can be seen in the sample time series. A scatter plot of the wind directions, in Figure 3, indicates excellent agreement between the two measurement sources. The differences observed between the two buoys are within the measurement uncertainty of the direction sensors, and may reflect actual differences between the two locations at each timestep. The fit has a slope near unity, but deviates slightly from 1.0 due to the 5 degrees shift (the source of ‘clouds’ of data points in the upper left and lower right corners). The temporal differences are not seen in the average wind roses, which are nearly identical between HKZA and HKZB, at 100 m, as seen in Figure 4.

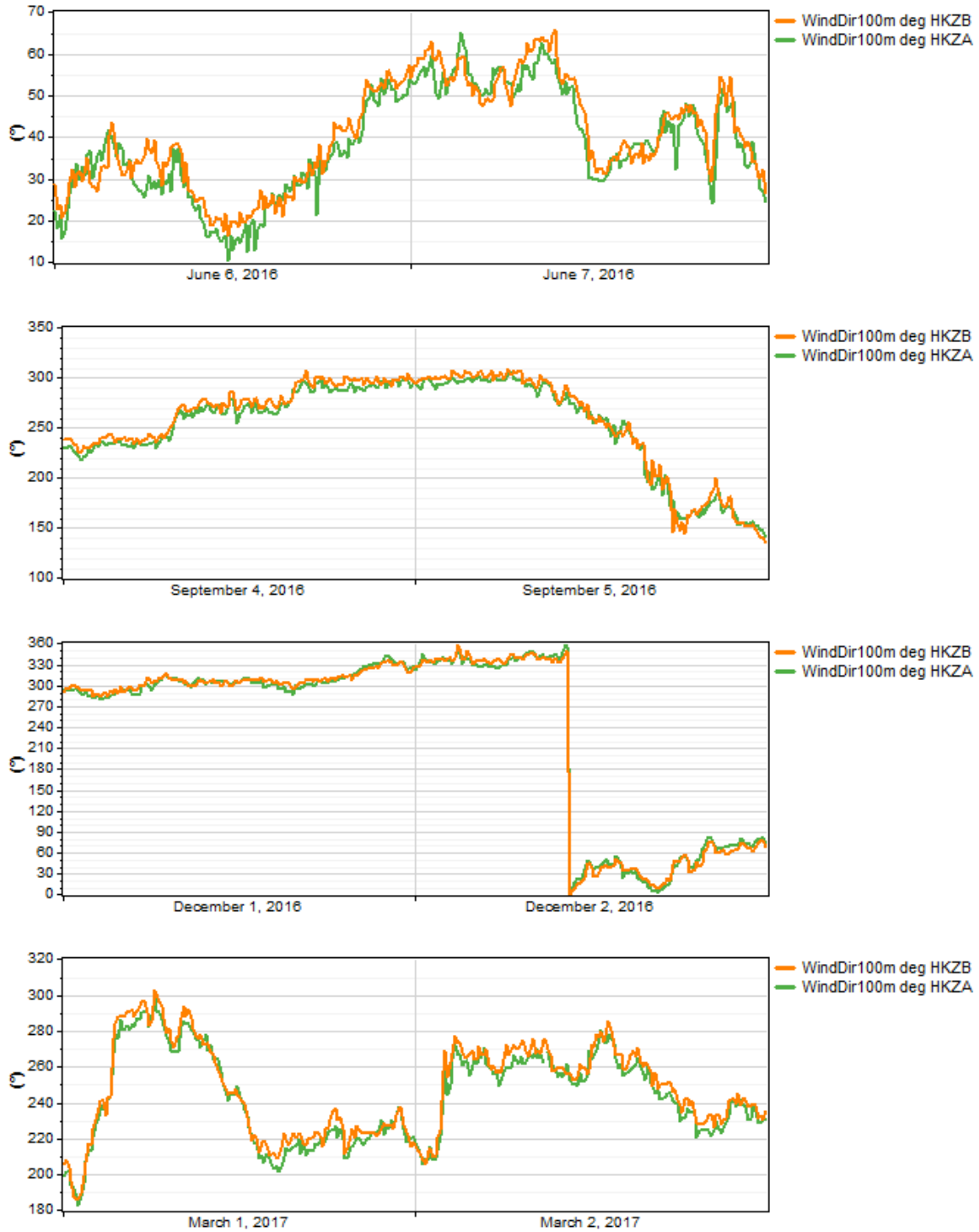


Figure 2 – Time series of wind direction measurements for HKZA and HKZB at 100 m, for intervals during the measurement period
(note different y axis scales)

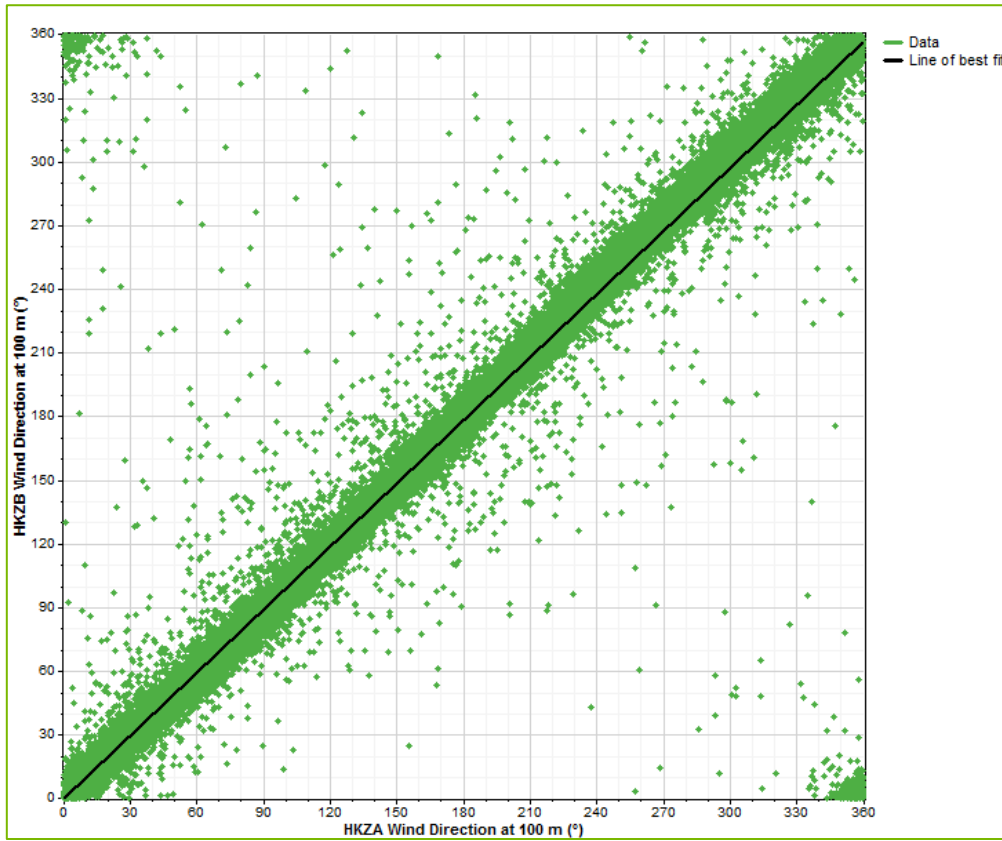


Figure 3 – Scatter plot of concurrent wind direction measurements at HKZA and HKZB at 100 m ($y=0.991x$)

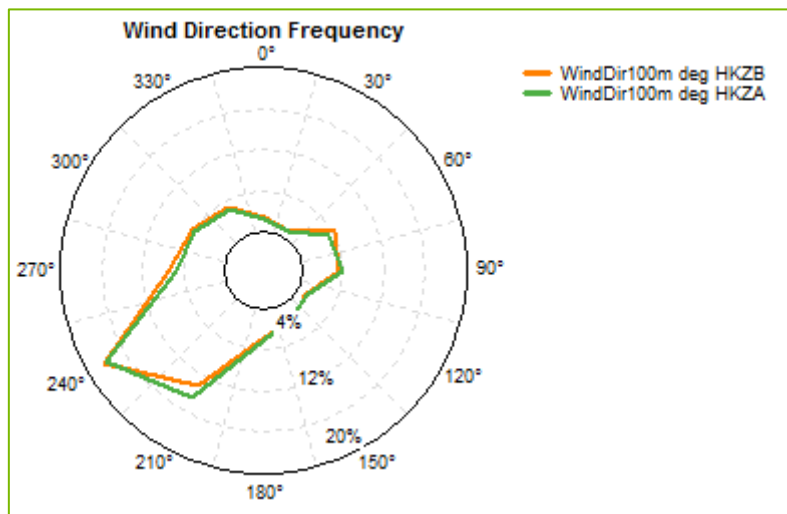


Figure 4 – Wind roses for concurrent wind direction measurements at HKZA and HKZB at 100 m