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Elaboration on 24 months data disclosure for HKN

Introduction

Fugro has been contracted by The Netherlands Enterprise Agency (RVO.nl) to supply meteorological and oceanographic measurement data at the Hollandse Kust (noord) (HKN) Wind Farm Zone (WFZ) by deploying two Seawatch Wind LiDAR Buoys (SWLB) at the site. The aim of the measurement campaign was to provide two sets of continuous meteorological and oceanographic (metocean) data including wind profiles with excellent quality and high availability over a period of 2 years. Details of the extent of the HKN Wind Farm Zone are given in Figure 1. It is expected that the data will allow stakeholders to carry out more accurate calculations of the annual energy yield and improve/validate metocean models that have been made as input for the overall wind farm design.

Two Seawatch Wind Lidar buoys were deployed at the Hollandse Kust (noord) locations HKNA and HKNB, measurements started on April 10, 2018 00:00 hours and lasted for 24 months. HKN is located 26 km from the Dutch Coast, and Station HKNB was approximately 600 m south of HKNA. The initial positions are shown on the map in Figure 1. The water depths relative to Mean Sea Level (MSL) are around 24 m at these locations, based on data from a detailed bathymetric survey by Fugro commissioned by RVO.nl. As the buoys are free to float around the mooring point within a radius of about 110 m, the actual water depth at the actual position of the buoy at any time would vary by approximately ±0.1 m.
During the measurement campaign at HKN buoys have been relocated in the area, due to deployment at wrong location and due to geophysical survey performed during deployment by TenneT. Buoy were located within 2,500 m of the original position and variation of conditions over this distance is judged as insignificant. The 24-months data report as well as the processed data files are giving the exact locations of deployment of buoys HKNA and HKNB.

Monthly data reports and files

During the measurements campaign the data was reported on a monthly basis by factual data reports of Fugro, processed data files per month and a data validation report by Deltares. In these reports information on instrumentation, serial numbers, and post-processing can be found in more detail. The monthly reports and data files can be found on https://offshorewind.rvo.nl.

Publication of measurements for 24 months

In a summary report Fugro has reported the full measurements over 24 months in a report, processed data files for wind, hydraulic (waves, currents and water level) and meteorological data (Temperature, Pressure and humidity) over the full 24 months period and as raw data files (separate files per deployment). In the report the explanation of the processed and raw data files is included.

In the period April 10, 2017 to April 10, 2019 5 changes of buoy for HKNA and 4 change of buoy at HKNB (one was a change of LiDAR mounted on WS158) have occurred. Period of buoy operations are given in Table 1.

Table 1.1: *Hollandse Kust (noord) LiDAR buoy locations and measurement intervals. Spherical coordinates are given in ETRS89 and the cartesian coordinates in UTM 31N.*

Deployment Number	Buoy	LiDAR unit	Interval (UTC)		Nominal Positions		
			First measurement	Last measurement	Easting (m)	Northing (m)	DM
Station HKNA							
1	WS149	Z428	2017-04-10 00:00	2017-06-10 14:00	583949	5838365	52°41.3217' 4°14.5212'
3	WS155	Z505	2017-06-11 11:00	2017-09-07 00:00	583949	5838365	52°41.3217' 4°14.5212'
4	WS156	Z501	2017-09-07 12:10	2018-01-26 00:00	584043	5838345	52°41.3100' 4°14.6043'
6	WS158	Z513	2018-01-26 17:50	2018-06-08 13:30	583952	5838366	52°41.3220' 4°14.5260'
7	WS140	Z417	2018-06-08 13:40	2018-10-13 11:50	586354	5838212	52°41.2140' 4°16.6560'
11	WS156	Z501	2018-10-13 12:00	2019-02-25 15:50	583943	5838265	52°41.2680' 4°14.5140'
13	WS156	Z501	2019-03-01 13:00	2019-04-10 23:50	583943	5838265	52°41.2680' 4°14.5140'
Station HKNB							
2	WS170	Z585	2017-04-10 00:00	2017-12-02 00:00	583952	5837767	52°40.9992' 4°14.5147'
5	WS140	Z417	2017-12-02 09:20	2018-04-09 09:40	583958	5837731	52°40.9797' 4°14.5195'
8	WS170	Z585	2018-05-15 15:00	2018-07-17 10:40	583954	5837773	52°41.0040' 4°14.5140'
9	WS170	Z585	2018-07-17 13:30	2018-10-13 13:00	583954	5838773	52°41.5440' 4°14.5320'
10	WS170	Z585	2018-10-16 10:00	2018-11-25 08:00	583954	5838773	52°41.5440' 4°14.5320'
12	WS158	Z417	2018-11-25 08:10	2019-02-27 10:00	583907	5838773	52°41.5421' 4°14.4903'
12b	WS158	Z417	2019-02-27 14:30	2019-03-21 11:50	583957	5838577	52°41.4360' 4°14.5320'
14	WS158	Z513	2019-03-24 12:20	2019-04-10 23:50	583957	5838577	52°41.4360' 4°14.5320'

Table 1: Buoy identification and deployment periods for HKNA and HKNB.

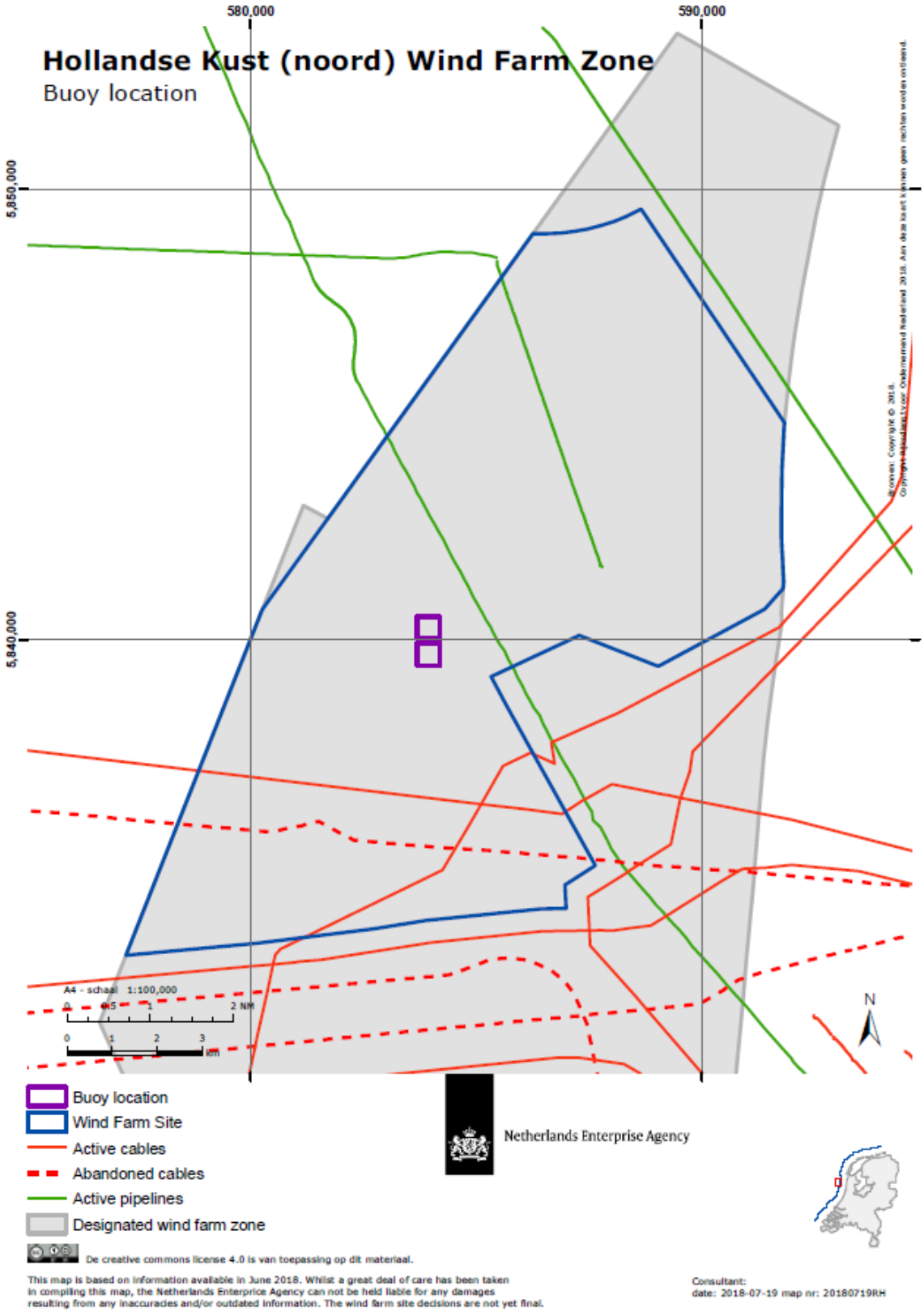

Figure 1: Lay-out and buoy location for HKN WFZ

Raw data verification

The raw data is checked by Navigant and RHDHV on coverage of the reported valid measurement periods per buoy and found to be compliant hereto. It is noted that the processed 24-month dataset and raw data sets are downloaded from the buoys after recovering. The monthly datasets published contain mostly satellite transmitted data from the buoys. Due to transmission problems additional records may be found in the processed 24-months data sets and the raw data sets of the LiDAR and wave sense buoy motions.
The raw data files generated by the Zephir LiDAR are published as generated by the buoy. As the buoy was sometimes operational when recovered to shore, also data collection during the transit to shore can be included. Table 2 presents the period of measurements which are Quality checked by Fugro and Deltares and for which the data can be considered. Data outside the deployment periods should be disregarded.

Deployment	Station	Buoy		Deployment period		Processed data files		Raw data files			
			LiDAR	Start date UTC	End date UTC	Start date UTC	End date UTC	Content	Filename	Start date UTC (in file)	End date UTC (in file)
#1	HKNA	WS149		10/4/2017 0:00	10/6/2017 14:00	10/4/2017 0:00	10/6/2017 14:00	Wavesens Raw Motion	1_chpr_WS149.csv	10/4/2017 0:00	10/6/2017 14:00
			Z428			10/4/2017 0:00	27/05/2017 15:30	Zephir Z428 Raw 1 Hz	1_Z428.zip	10/4/2017 0:00	27/05/2017 15:30
#3	HKNA	WS155		11/6/2017 11:00	7/9/2017 0:00	11/6/2017 12:10	28/08/2017 20:50	Wavesens Raw Motion	2_chpr_WS155.csv	11/6/2017 12:10	28/08/2017 20:30
			Z505			11/6/2017 12:10	28/08/2017 19:30	Zephir Z505 Raw 1 Hz	2_Z505.zip	11/6/2017 12:00	29/08/2017 00:51
#4	HKNA	WS156		7/9/2018 12:10	26/01/2018 00:00	7/9/2017 12:10	26/01/2018 00:00	Wavesens Raw Motion	3_chpr_WS156.csv	7/9/2017 12:10	26/01/2018 00:00
			Z501			7/9/2017 12:10	16/1/2018 17:10	Zephir Z501 Raw 1 Hz	3_Z501.zip	7/9/2017 12:00	16/01/2018 4:58
#6	HKNA	WS158		26/01/2018 17:50	8/6/2018 13:30	26/01/2018 18:10	8/6/2018 13:20	Wavesens Raw Motion	6_chpr_WS158.csv	26/01/2018 18:10	8/6/2018 13:20
			Z513			26/01/2018 18:10	28/05/2018 07:30	Zephir Z513 Raw 1 Hz	6_Z513.zip	26/01/2018 00:00	8/6/2018 23:59
#7	HKNA	WS140		8/6/2018 13:40	13/10/2018 11:50	8/6/2018 13:40	13/10/2018 11:50	Wavesens Raw Motion	7_chpr_WS140.csv	8/6/2018 13:20	13/10/2018 11:50
			Z417			8/6/2018 13:40	13/10/2018 11:50	Zephir Z417 Raw 1 Hz	7_Z417.zip	8/6/2018 0:00	13/10/2018 13:47
#11	HKNA	WS156		13/10/2018 12:00	25/02/2019 15:50	13/10/2018 12:00	25/02/2019 15:50	Wavesens Raw Motion	11_chpr_WS156.csv	13/10/2018 11:50	25/02/2019 15:50
			Z501			13/10/2018 12:00	25/02/2019 15:50	Zephir Z501 Raw 1 Hz	11_Z501.zip	13/10/2018 00:00	25/02/2019 16:40
#13	HKNA	WS156		1/3/2019 13:00	10/4/2019 23:50	1/3/2019 13:00	10/4/2019 23:50	Wavesens Raw Motion	13_chpr_WS156.csv	1/3/2019 13:00	10/4/2019 23:50
			Z501			1/3/2019 13:00	10/4/2019 23:50	Zephir file was corrupted, no raw wind data			
#2	HKNB	WS170		10/4/2017 0:00	2/12/2017 0:00	10/4/2017 0:00	2/12/2017 0:00	Wavesens Raw Motion	2_chpr_WS170.csv	4/10/2017 0:00	2/12/2017 9:10
			Z585			10/4/2017 0:00	2/12/2017 0:00	Zephir Z585 Raw 1 Hz	2_Z585.zip	4/10/2017 0:00	2/12/2017 13:35
#5	HKNB	WS140		2/12/2017 9:20	9/4/2018 9:40	2/12/2017 9:40	9/4/2018 9:40	Wavesens Raw Motion	5_chpr_WS140.csv	12/2/2017 9:40	9/4/2018 9:40
			Z417			2/12/2017 9:40	9/4/2018 9:40	Zephir Z417 Raw 1 Hz	5_Z417.zip	12/2/2017 0:00	9/4/2018 15:25
#8	HKNB	WS170		15/05/2018 15:00	17/07/2018 10:40	15/05/2018 15:00	17/07/2018 10:40	Wavesens Raw Motion	8_chpr_WS170.csv	15/05/2018 15:10	17/07/2018 10:50
			Z585			15/05/2018 15:00	17/07/2018 10:40	Zephir Z585 Raw 1 Hz	8_Z585.zip	15/05/2018 00:00	17/07/2018 10:50
#9	HKNB	WS170		17/07/2018 13:30	13/10/2018 13:00	17/07/2018 13:30	13/10/2018 13:00	Wavesens Raw Motion	9_chpr_WS170.csv	17/07/2018 13:30	13/10/2018 13:00
			Z585			17/07/2018 14:10	13/10/2018 13:00	Zephir Z585 Raw 1 Hz	9_Z585.zip	17/07/2018 00:00	13/10/2018 13:50
#10	HKNB	WS170		16/10/2018 10:00	25/11/2018 08:00	16/10/2018 10:00	25/11/2018 08:00	Wavesens Raw Motion	10_chpr_WS170.csv	16/10/2018 10:00	25/11/2018 08:00
			Z585			16/10/2018 10:00	22/11/2018 5:10	Zephir Z585 Raw 1 Hz	10_Z585.zip	16/10/2018 00:00	25/11/2018 23:59
#12	HKNB	WS158		25/11/2018 08:10	27/02/2019 10:00	25/11/2018 08:10	21/02/2019 08:00	Wavesens Raw Motion	12_chpr_WS158.csv	25/11/2018 10:00	21/02/2019 07:50
			Z417			25/11/2018 8:10	21/02/2019 08:20	Zephir Z417 Raw 1 Hz	12_Z417.zip	25/11/2018 08:10	21/02/2019 08:40
	HKNB	WS158		27/02/2019 14:30	21/03/2019 11:50	27/02/2019 15:00	12/3/2019 4:50	Wavesens Raw Motion	12_chpr_WS158.csv	27/02/2019 12:20	12/3/2019 4:40
			Z417			27/02/2019 15:00	12/3/2019 4:50	Zephir Z417 Raw 1 Hz	12_Z417.zip	27/02/2019 11:55	12/3/2019 9:00
#14	HKNB	WS158		24/03/2019 12:20	10/4/2019 23:50	24/03/2019 12:20	10/4/2019 23:50	Wavesens Raw Motion	14_chrp_WS158	24/03/2019 12:20	10/4/2019 23:50
			Z513			24/03/2019 13:00	10/4/2019 23:50	Zephir Z513 Raw 1 Hz	14_Z513.zip	24/03/2018 12:20	10/4/2019 23:59

Table 2: Quality checked measurement periods for wavesense and LiDAR recordings