SafeWind

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Deliverable Dc-2.2

"Results of the measurement campaign in flat terrain - An overview of the collected data"

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Abstract: The data collected in the flat terrain campaigns are presented in an overview form. An assessment of the measured data will be reported in the second series of this deliverable.

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PL: *Project leader* **WPL:** *Work package leader* **TL:** *Task leader*

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Contents

1. Introduction

The purpose of this document is to give a brief overview of the measurements made in flat terrain in the framework of the Task 2.2 of the SafeWind project. It is the intention that these data will form the basis of the power curve and extreme wind analyses to be performed in subsequent work tasks. It is also hoped that the data can be employed in a broader sense in the SafeWind project.

In a subsequent version of Dc-2.2 Deliverable (Dc-2.2 assessment), the quality if the data will be assessed and the results of the flat terrain campaign will be presented.

2. Overview and adaptations of the campaign plan

Although the initial intention as defined in the technical annex, was to perform one long, uninterrupted measurement campaign, this has not been practically possible due to both logistical and commercial constraints. At the start of the SafeWind project, the poor state of maturity resulted in many and frequent lidar failures. Indeed the instrument available at Risø DTU, the Windcube WLS-07, has the serial number 02 – it is only the second example of a production Windcube. More contemporary versions of this system have incorporated a large number of improvements and the reliability is much improved. Even so, the commercial pressure on the use of such machines is very great, with a commercial rental value approaching 10k€/month.

In fact our early Windcube proved surprisingly reliable, at least in its first year of operation. An alternative strategy was therefore adopted in which the SafeWind lidar dataset consists of an initial period of 7 months of earlier lidar measurements (comprising 3 separate periods) plus some 4 months of new data. The latter period has the dual purpose of extending the flat terrain dataset and providing a flat terrain inter-comparison between the 3 instruments (Windcube lidar, ZephiR lidar and Scintec sodar) that will subsequently be deployed at the complex Alaiz site.

Most of the earlier data (periods 1 and 2) were gathered in work related to the FP6 UpWind project. This demonstrated the synergy and continuation between the UpWind and SafeWind projects. The resources saved on re-using old data have been diverted to performing a flat terrain inter-comparison of all three of the remote sensing instruments to be used in the complex campaign. This was not originally planned either but greatly strengthens the scientific value of the complex terrain campaign since generic instrument differences should already be identified.

3. Site description

All the data were collected at the Danish National Test Station for Large Wind Turbines, located at Høvsøre in Western Jutland, Denmark, about 30 km west-northwest of Holstebro.
The facility comprises a line of five test stands for MW-class wind turbines, oriented north-south parallel to the coast (slightly, about 3 deg, tilted to the east), and each stand has its dedicated upstream measuring mast for performance tests to the west. At the southern end of the turbine line in the position a sixth wind turbine might have occupied, is a 116m tall meteorological mast.

Figure 1 Lidar test site. The row of wind turbines at the Høvsøre test site with the tall meteorological mast in the front.

3.1 Terrain description

The test site at Høvsøre is a flat site, mainly consisting of grasslands, with maximum height variations less than 5 m. To the south is a lagoon, at the closest point 900 m from the met. mast, and about 1.8 km to the west the North Sea, separated from the land by a strip of sand dunes about 10 m high – see Figure 2-3. The land behind the dike lies about 1-5 m above sea level. The most homogeneous fetch is represented by the easterly directions with mostly open farmland.

Figure 2 Høvsøre test site seen from the coastline in the west.

4. The Windcube lidar

Unless otherwise indicated, the data have been collected using a Leosphere WLS-7 (Windcube) lidar, unit number 02.

The Windcube, shown in Figure 4, is a pulsed lidar with a fixed focus. It has a 30 degree prism to deflect the beam from the vertical but the prism does not rotate continuously. Instead, the prism holds still whilst the lidar sends a stream of pulses (5000-10000) in a given direction, recording the backscatter in a number of range gates (fixed time delays) triggered by the end of each pulse. Having sent the required number of pulses, the prism rotates to the next azimuth angle to be scanned, each separated by 90 degrees. A full rotation takes about 6 seconds.

During the rotation and before the next stream of pulses can be sent, the recorded data are processed. For each range gate, the time series from each pulse are Fourier transformed to power spectra which are block-averaged. A maximum likelihood estimator is then applied to obtain the frequency shift, the broadening of the spectra and the signal to noise ratio. For above threshold signals, the radial speed is directly proportional to the frequency shift. At each direction step, the Windcube combines the four most recent radial speeds at each height in order to obtain the horizontal and vertical speed and wind direction. For below threshold signal strength, the Windcube will report no horizontal wind speed for this and (at least) the next 3 time steps. This causes a fall in the 'availability' as given in the tables below.

Figure 3 A Windcube lidar on test at Høvsøre Test Station.

5. The data series

For each period, the location and instrument details are presented together with a table of the available measurement heights, showing the time-stamps for the first and the last 10 minute periods. For each period a time series of wind speed (blue) and wind direction (red) is plotted.

An overview of the data periods is given in the following table:

Period	Start date	End date	Days	Purpose	Project
1	2007-12-12	2008-02-25	74	Mast comparison	UpWind
2	2008-02-25	2008-07-16	138	Power curve tests	UpWind
3	2010-02-02	2010-05-20	97	Mast comparison	SafeWind
4	2010-05-21	2010-09-24	122	Instrument inter-comparison	SafeWind

5.1 Period 1

Location: 56°26'25.51"N, 8° 9'3.02"E (116m met mast)
Instrument: Windcube WLS-7-02

Heights, data periods and availability:

Height	Count(Name)	Avg(Available)	min(Name)	Max(Name)
40	10693	99.84964	200712121700	200802250910
60	10693	99.08634	200712121700	200802250910
80	10693	98.78024	200712121700	200802250910
100	10693	97.88331	200712121700	200802250910
116	10693	96.65042	200712121700	200802250910
130	10693	95.34797	200712121700	200802250910
160	10435	90.28374	200712122200	200802231900
200	10435	77.62792	200712122200	200802231900
250	9134	64.86672	200712220820	200802231900
300	9134	50.60702	200712220820	200802231900

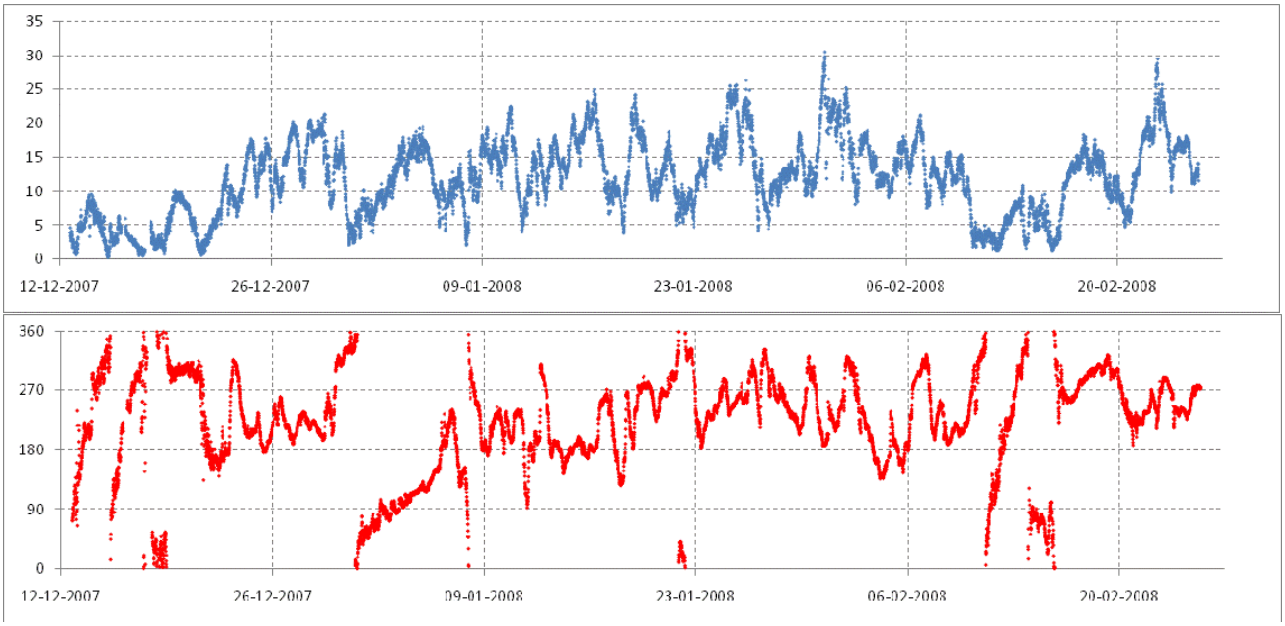


Figure 4 Time series of wind speed at 100m (blue) and wind direction (red) for Period 1.

5.2 Period 2

Location: 56°26'56.23"N, 8° 8'50.28"E (half way between stand2 and stand 3 masts)
Instrument: Windcube WLS-7-02

Heights, data periods and availability:

Height	Count(Name)	Avg(Available)	min(Name)	Max(Name)
40	19897	99.75748	200802251440	200807160930
42	967	99.80394	200807091630	200807160930
50	12017	99.52773	200802251440	200807091700
60	19898	99.01717	200802251440	200807160930
70	12016	99.15714	200802251440	200805211500
80	19898	99.12899	200802251440	200807160930
90	12016	99.22796	200802251440	200805211500
100	19898	98.37912	200802251440	200807160930
110	12016	97.55342	200802251440	200805211500
120	19898	96.39679	200802251440	200807160930
130	12052	94.56763	200802251440	200806121350
140	19898	92.10251	200802251440	200807160930
150	12016	87.48746	200802251440	200805211500
160	19898	80.71838	200802251440	200807160930
200	19898	56.61632	200802251440	200807160930
250	12052	40.27814	200802251440	200806121350
300	19898	24.97763	200802251440	200807160930

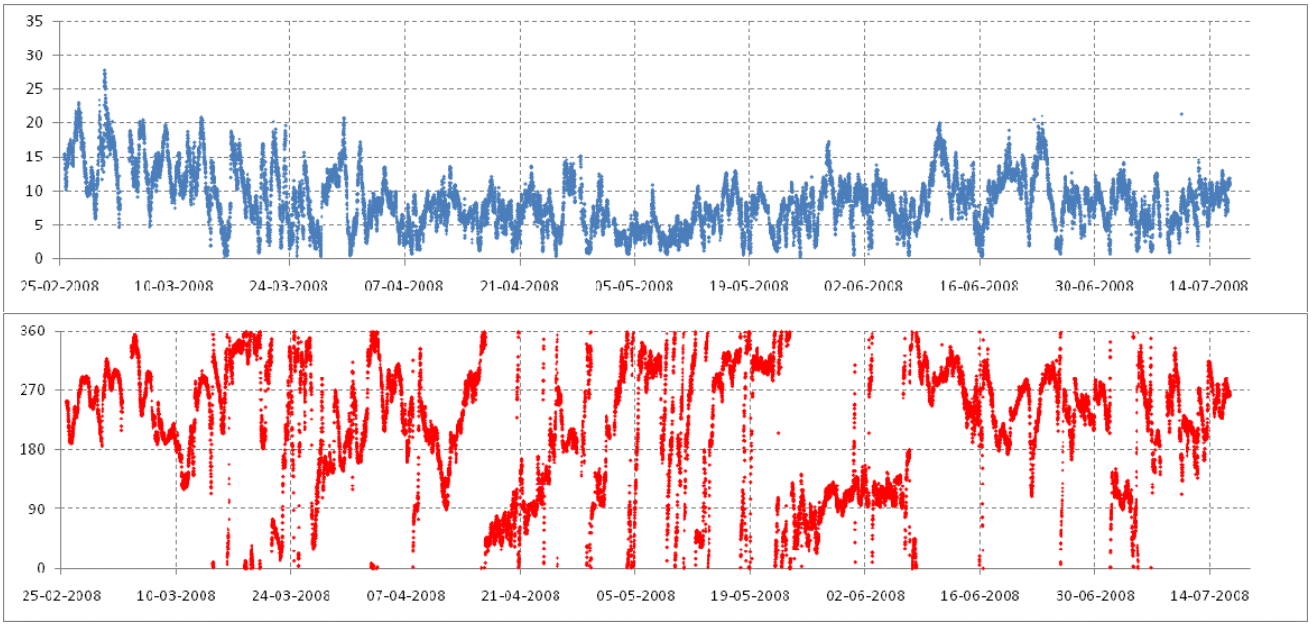


Figure 5 Time series of wind speed at 100m (blue) and wind direction (red) for Period 2.

5.3 Period 3

Location: 56°26'25.51"N, 8° 9'3.02"E (116m met mast)
Instrument: Windcube WLS-7-02

Heights, data periods and availability:

Height	10 mins	Availability	min(Name)	Max(Name)
40	13975	99.07651	201002020750	201005202350
60	13975	98.80054	201002020750	201005202350
80	13975	98.56525	201002020750	201005202350
100	13975	98.25073	201002020750	201005202350
116	13975	97.60857	201002020750	201005202350
130	13975	96.35682	201002020750	201005202350
160	13975	92.25889	201002020750	201005202350
200	13975	85.1495	201002020750	201005202350
250	13975	71.08944	201002020750	201005202350
300	13975	54.66423	201002020750	201005202350

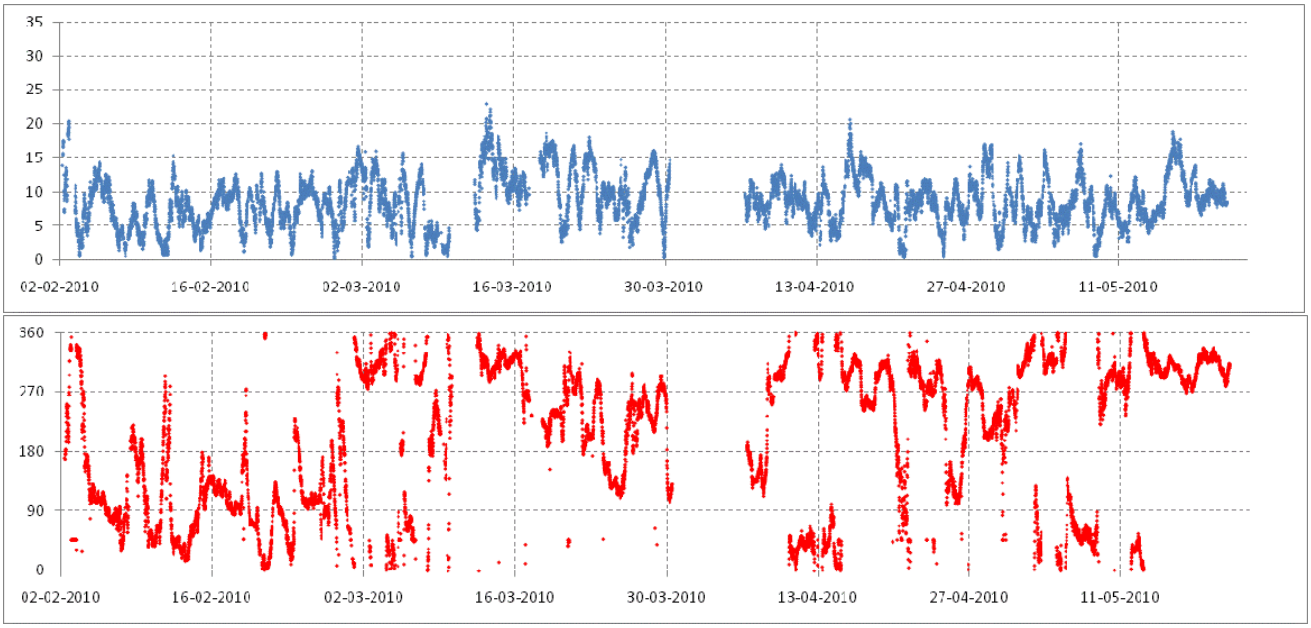


Figure 6 Time series of wind speed at 100m (blue) and wind direction (red) for Period 3.

5.4 Period 4 (Intercomparison – Windcube)

Location: 56°26'50.37"N, 8° 8'38.23"E (Mast 3B)
Instrument: Windcube WLS-7-02

Heights, data periods and availability:

Height	Count(Name)	Avg(Available)	min(Name)	Max(Name)
50	17563	98.09605	201005211050	201009240050
70	17563	97.49909	201005211050	201009240050
90	17563	97.05348	201005211050	201009240050
100	17563	96.75819	201005211050	201009240050
116	17563	96.02827	201005211050	201009240050
130	17563	95.13312	201005211050	201009240050
160	17563	91.74037	201005211050	201009240050
200	17563	83.64077	201005211050	201009240050
250	17563	67.41212	201005211050	201009240050
300	17563	51.07944	201005211050	201009240050

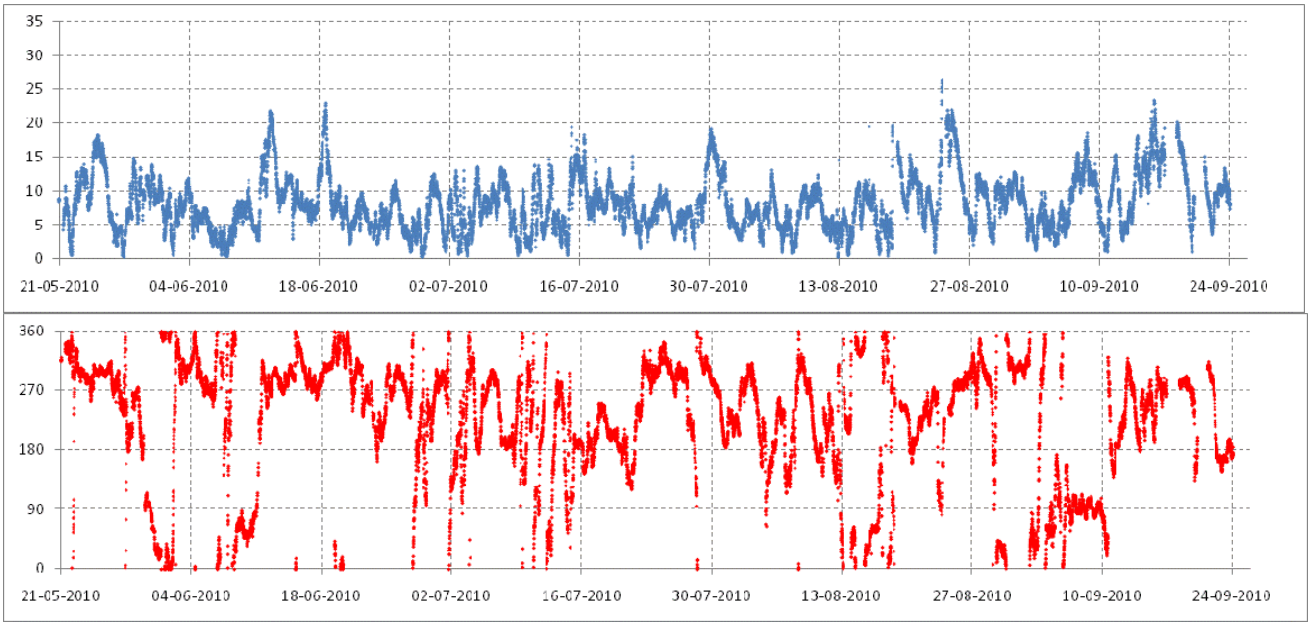


Figure 7 Time series of wind speed at 100m (blue) and wind direction (red) for Period 4 (Windcube lidar).

5.5 Period 4 (Intercomparison – ZephiR)

Location: 56°26'50.37"N, 8° 8'38.23"E (Mast 3B)
Instrument: ZephiR unit 104

Heights and data periods

height	min(name)	max(Name)	Count(Name)
49	201008101200	201009240650	5642
69	201008101200	201009240650	5642
89	201008101200	201009240650	5642
114	201008101200	201009240650	5642
158	201008101200	201009240650	5642

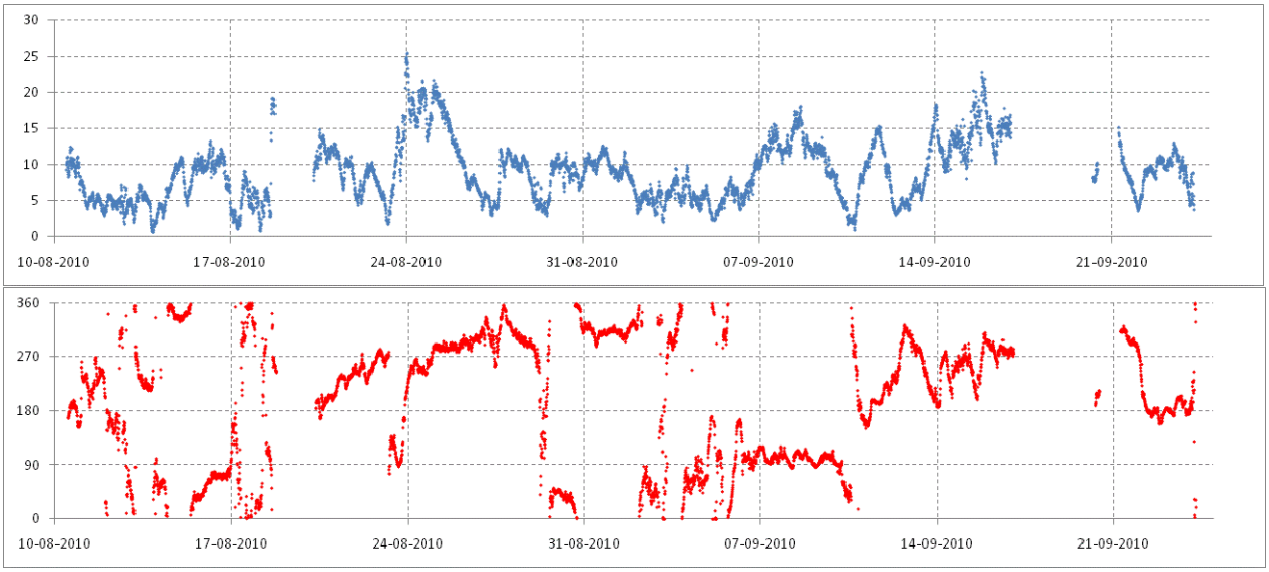


Figure 8 Time series of wind speed at 114m (blue) and wind direction (red) for Period 4 (ZephIR lidar).

5.6 Period 4 (Intercomparison – Scintec Sodar)

Location: 56°26'50.37"N, 8° 8'38.23"E (Mast 3B)
Instrument: Scintec sodar

Heights and data periods.
The count of 10 minute periods includes only valid values where a speed could be recovered.

height	min(Name)	max(Name)	Count(Name)
20	201008301800	201009140920	1516
25	201008301800	201009140920	1969
30	201008301800	201009140920	1990
35	201008301800	201009140920	1988
40	201008301800	201009140920	1988
45	201008301800	201009140920	1984
50	201008301800	201009140920	1983
55	201008301800	201009140920	1982
60	201008301800	201009140920	1970
65	201008301800	201009140920	1949
70	201008301800	201009140920	1934
75	201008301800	201009140920	1935
80	201008301800	201009140920	1932
85	201008301800	201009140920	1906
90	201008301800	201009140920	1875
95	201008301800	201009140920	1849
100	201008301800	201009140910	1841
105	201008301800	201009140920	1830
110	201008301810	201009140920	1809
115	201008301810	201009140920	1803
120	201008301810	201009140920	1791
125	201008301810	201009140920	1793
130	201008301810	201009140920	1771
135	201008301810	201009140910	1735
140	201008301810	201009140900	1701
145	201008301810	201009140900	1678
150	201008301810	201009140900	1647

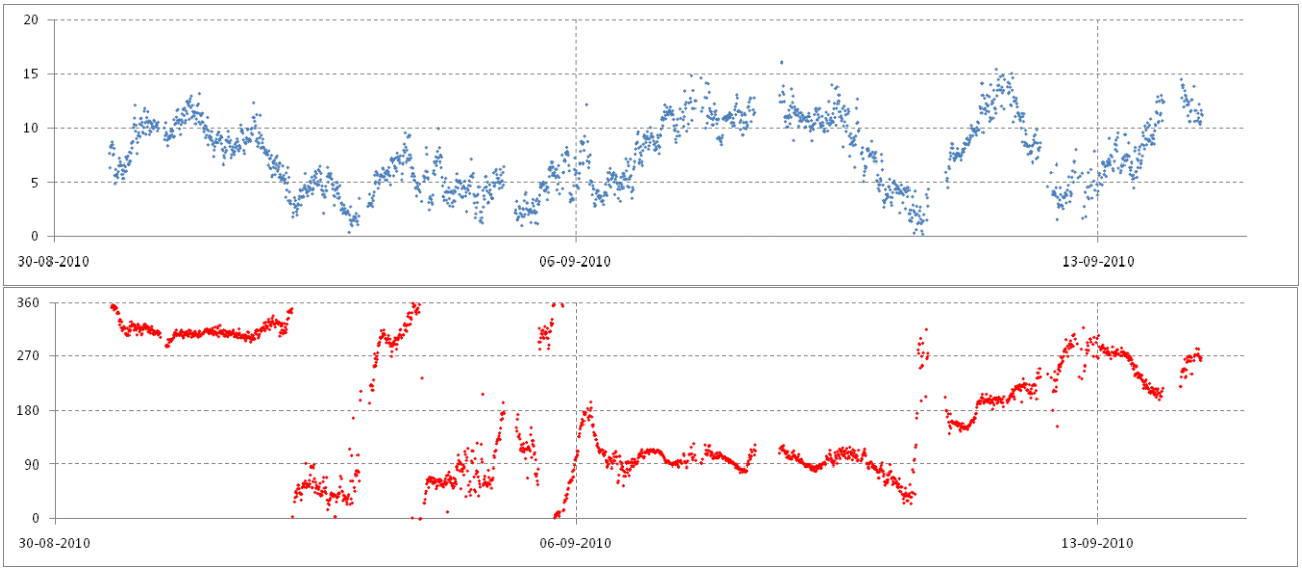


Figure 9 Time series of wind speed at 100m (blue) and wind direction (red) for Period 4 (Scintec sodar).

6. Accessing the data

Data are available from a MySQL database server at address: veadata-01.risoe.dk. Data for the first three periods are contained in database *safewind_hovsore_lidar*. Data for the final period, the flat terrain inter-comparison are located in database *safewind_hovsore_campaign*. Access is restricted by user and password which are allocated on application to the author of this report. Documentation of the table structures and examples of typical queries are given in Appendix A of this report.

7. Conclusion

The database contains over 62000 ten min mean values of wind speed from the Windcube lidar at 100m (plus a similar number for a large range of other heights). This represents more than one year data, although not continuous as originally intended. As time passes, lidars become more reliable and more numerous and long-term data sets will become more common. There are already several examples (e.g. from the EU NorseWind campaign and the Risø DTU Østerild measurements), both onshore and offshore that could be relevant within the context of SafeWind.

Acknowledgements

The author would like to thank the technician team at Høvsøre, Bjarne Sønderskov and Anders Vestergaard for their vital contributions to the lidar measurements.

Appendix A – Table structure and example queries

I Database safewind_hovsore_campaign

This database contains data from Windcube, ZephiR lidars and Scintec sodar for the period of the flat-terrain inter-comparison at Høvsøre.

Database structure

DATA SOURCE	KIND OF DATA	TABLE NAME	INFORMATION
mast	10 min stat.	mast3b_means	10 min. averages
		mast3b_stdvs	10 min standard deviation
		mast3b_maxs	10 min maximum
		mast3b_mins	10 min minimum
	Time series	mast3b_fast	20Hz data
Windcube	10 min stat.	windcube_unit2_rundef	common to all ranges
		windcube_unit2_10min	data values (including averages, standard deviations, maximums, minimums)
	Time series	windcube_unit2_fast	data values
ZephIR	10 min stat	zephir_unit104_10min	data values
		zephir_unit104_rundef	common to all ranges
		zephir_unit104_10min_ch	
	Time series	zephir_unit104_3sec	data values
Scintec sodar	10 min stat.	scintex_stat	data values
		scintex_rundef	common to all ranges

Tables description

For each table, every parameter is described with its name in the table, its type (character, integer, floating number, …), its unit and a short description. Each table counts one or two key parameters. A key parameter (or a pair of key parameters, when two key parameters are needed) has a unique value and therefore enables us to distinguish one row from the others.

Mast data

mast3b_means, mast3b_stdvs, mast3b_maxs, mast3b_mins				
KEY	COLUMN NAME	DATATYPE	DEFINITION	UNIT
*	Name	char(12)	beginning of the 10 min period YYYYMMDDhhmm (Y= year; M=month; D=day; h=hour (from 0 to 23); m=minute)	
	Wsp_91m_3B	float	wind speed measured by top mounted Risø cup at 91m on mast 3B	m/s
	Wsp_89m_3B	float	wind speed measured by boom mounted Risø cup at 89m on mast 3B (boom pointing south)	m/s
	Wsp_71m_3B	float	wind speed measured by boom mounted Risø cup at 71m on mast 3B (boom pointing south)	m/s
	Wsp_51m_3B	float	wind speed measured by boom mounted Risø cup at 51m on mast 3B (boom pointing south)	m/s
	Wsp_31m_3B	float	wind speed measured by boom mounted Risø cup at 31m on mast 3B (boom pointing south)	m/s
	Wsp_71m_N_3B	float	wind speed measured by boom mounted Thies cup at 71m on mast 3B (boom pointing north)	m/s
	Wsp_51m_N_3B	float	wind speed measured by boom mounted Thies cup at 51m on mast 3B (boom pointing north)	m/s
	Wind_dir_89m_3B	float	wind direction measured by vane at 89m on mast 3B	deg.
	Tabs_89m_3B	float	absolute temperature at 89m on mast 3B	°C
	Rain_3B	float	Precipitation detection at stand 3B (>4.1: dry; <4.1: some rain, more as value approaches 0)	Yes/No
	pressure_89m_3B	float	Atmospheric pressure at stand 3B	kBar
	RH_3m_3B	float	Relative humidity at 3m (Vaisala sensor)	%
	Vaisala_Temps_3m	float	Absolute temperature (measured by the Vaisala humidity sensor) at 3m	°C

mast3b_fast				
KEY	COLUMN NAME	DATATYPE	DEFINITION	UNIT
*	name	char(12)	beginning of the 10 min period YYYYMMDDhhmm (Y= year; M=month; D=day; h=hour (from 0 to 23); m=minute)	
*	scan_id	smallint(5)	sample index (from 1 to 12000 for each name)	
	Wsp_91m_3B	smallint(5)	wind speed measured by top mounted Risø cup at 91m on mast 3B	cm/s
	Wsp_89m_3B	smallint(5)	wind speed measured by boom mounted Risø cup at 89m on mast 3B (boom pointing south)	cm/s
	Wsp_71m_3B	smallint(5)	wind speed measured by boom mounted Risø cup at 71m on mast 3B (boom pointing south)	cm/s
	Wsp_51m_3B	smallint(5)	wind speed measured by boom mounted Risø cup at 51m on mast 3B (boom pointing south)	cm/s
	Wsp_31m_3B	smallint(5)	wind speed measured by boom mounted Risø cup at 31m on mast 3B (boom pointing south)	cm/s
	Wsp_71m_N_3B	smallint(5)	wind speed measured by boom mounted Thies cup at 71m on mast 3B (boom pointing north)	cm/s
	Wsp_51m_N_3B	smallint(5)	wind speed measured by boom mounted Thies cup at 51m on mast 3B (boom pointing north)	cm/s

Windcube data

windcube_unit2_10min				
KEY	COLUMN NAME	DATATYPE	DEFINITION	UNIT
*	name	char(12)	beginning of the 10 min period YYYYMMDDhhmm (Y= year; M=month; D=day; h=hour (from 0 to 23); m=minute)	
*	Height	smallint(5)	vertical height at which the lidar measures	m
	Available	float	ratio between number of retrieved horizontal speeds* and total number of scans	[%]
	U	float	10 min mean horizontal wind speed	m/s
	Dir	float	10 min mean wind direction	deg
	U_stdv	float	10 min standard deviation of the horizontal wind speed	m/s
	U_min	float	10 min minimum of the horizontal wind speed	m/s
	U_max	float	10 min maximum of the horizontal wind speed	m/s
	Dir_stdv	float	10 min standard deviation of the wind direction	deg.
	W	float	10 min average of the vertical wind speed	m/s
	W_stdv	float	10 min standard deviation of the vertical wind speed	m/s
	W_min	float	10 min minimum of the vertical wind speed	m/s
	W_max	float	10 min maximum of the vertical wind speed	m/s
	CNR	float	10 min mean CNR	[-]
	CNR_stdv	float	10 min standard deviation of the CNR	[-]
	CNR_max	float	10 min maximum CNR	[-]
	CNR_min	float	10 min minimum CNR	[-]
	Vdismean	float	Mean spectral broadening	m/s
	Vdisstd	float	Standard deviation of the spectral broadening	m/s
	Vdismin	float	10 min minimum of the spectral broadening	m/s
	Vdismax	float	10 min maximum of the spectral broadening	m/s

* The retrieval of the (“instantaneous”) horizontal speed requires 4 consecutive radial speed measurements (in the 4 different directions) with a CNR>-21 each.

Windcube_unit2_rundef				
KEY	COLUMN NAME	DATATYPE	DEFINITION	UNIT
*	Name	char(12)	beginning of the 10 min period YYYYMMDDhhmm (Y= year; M=month; D=day; h=hour (from 0 to 23); m=minute)	
	Start_dt	datetime	Time of the first measurements in the given 10 minute period	
	Tot_scans	smallint(5)	total number of scans	[-]
	CNR_0	float	average CNR at all heights for line-of-sight 0 over 10min	[-]
	CNR_90	float	average CNR at all heights for line-of-sight 90 over 10min	[-]
	CNR_180	float	average CNR at all heights for line-of-sight 180 over 10min	[-]
	CNR_270	float	average CNR at all heights for line-of-sight 270 over 10min	[-]

windcube_unit2_fast				
KEY	COLUMN NAME	DATATYPE	DEFINITION	UNIT
*	Date_Time	datetime	Time stamp YYYY-MM-DD hh:mm:ss (Y= year; M=month; D=day; h=hour (from 0 to 23); m=minute,s:second)	
*	Height	smallint(5)	horizontal range at which the lidar measures	m
	Name	char(12)	beginning of the 10 min period YYYYMMDDhhmm (Y= year; M=month; D=day; h=hour (from 0 to 23); m=minute)	
	Azimuth	smallint(5)	Azimuth beam position (0, 90 180 or 270).	
	CNR	float	Carrier to Noise Ratio	[-]
	Vrad	float	Radial wind speed (i.e. projection of the total wind speed vector in the line-of-sight, given by “Azimuth”)	m/s
	Vdis	float	Spectral broadening	m/s
	U	float	Horizonatl wind speed (derived from the four last consecutive radial speed measurements)	m/s
	Dir	float	Wind direction (derived from the four last consecutive radial speed measurements)	deg
	W	float	Vertical wind speed (derived from the four last consecutive radial speed measurements)	

Zephir data

zephir_unit104_10min				
KEY	COLUMN NAME	DATATYPE	DEFINITION	UNIT
*	Name	char(12)	beginning of the 10 min period YYYYMMDDhhmm (Y= year; M=month; D=day; h=hour (from 0 to 23); m=minute)	
*	Height	smallint(5)	vertical height at which the lidar measures	m
	Scans_in_Average	smallint(5)	Number of 3second scan used in the 10 minute average. *	
	Points_in_fit	float	Averaged number of points in fit in 10 minutes	[-]
	Hor_Vel	float	10 min mean horizontal wind speed	m/s
	Ver_Vel	float	10 min mean vertical wind speed	m/s
	Turb	float	10 minute average of “turb” parameter	
	Wind_Dir	float	10 min mean wind dirrection	deg
	U_stdv	float	10 min standard deviation of the horizontal wind speed	m/s
	U_min	float	10 min minimum of the horizontal wind speed	m/s
	U_max	float	10 min maximum of the horizontal wind speed	m/s
	W_stdv	float	10 min standard deviation of the vertical wind speed	m/s
	W_min	float	10 min minimum of the vertical wind speed	m/s
	W_max	float	10 min maximum of the vertical wind speed	m/s
	Dir_stdv	float	10 min standard deviation of the wind direction	deg.
	Scaling	float	10 min average scaling	[-]
	ACS	float	10 min average of ACS	

* The 3 second scan resulting in two few radial speed measurements to obtain a reliable fit (e.g. number of points in fit below 15) are discarded.

zephir_unit104_3sec				
KEY	COLUMN NAME	DATATYPE	DEFINITION	UNIT
*	Idx	integer		[-]
	Date_Time	Datetime	Time stamp YYYY-MM-DD hh:mm:ss (Y= year; M=month; D=day;	[-]

			h=hour (from 0 to 23); m=minute,s:second)	
	Name	char(12)	beginning of the 10 min period YYYYMMDDhhmm (Y= year; M=month; D=day; h=hour (from 0 to 23); m=minute)	[-]
	Reference	integer	Increments by one every time it changes height (assigned by the Zephir)	[-]
	Height	smallint(5)	vertical height at which the lidar measures	m
	Points_in_fit	float	Number of points (i.e. radial speeds at various azimuth position) used to make a fit to the rectified cosine function and retrieve the function parameters.	[-]
	Hor_Vel	float	horizontal wind speed	m/s
	Ver_Vel	float	vertical wind speed	m/s
	Turb	float	Standard deviation of the points around the fitted function/ Residual error of the fit function	m/s
	Wind_Dir	float	wind direction	deg
	Vane	float	Direction measured by the Zephir complementary wind vane	Deg
	Statu_hex	char(8)	Status code delivered by the Zephir	[-]
	Raining	char(1)	True if it detects rain, False if not.	[-]
	Wiping	char(1)	True if wiping, False if not.	[-]
	Focusing	char(1)	True is moving the focusing	[-]
	Spare2	char(1)	XXXXXXXXXXXXXXXXXXX	X
	CC	char(1)	True if the cloud correction algorithm is on, False if it is off	[-]
	Cloud_measure	char(1)	True when it measures at the heights used in the cloud correction algorithm (38m and 800m). These measurements are not cloud corrected.	[-]
	Scaling	float	3 second average of the ratio between 255 and the maximum backscatter intensity in the thresholded spectrum	[-]
	ACS	float	Level of correction for cloud defined as a number between 0 and 1 (0: not correction at all)	[-]

zephir_unit104_rundef				
KEY	COLUMN NAME	DATATYPE	DEFINITION	UNIT
*	Name	char(12)	beginning of the 10 min period YYYYMMDDhhmm (Y= year; M=month; D=day; h=hour (from 0 to 23); m=minute)	
	Start_dt	datetime	Time of the first measurements in the given 10 minute period	
	Spd	float	Wind speed measured by the ZephIR complementary mast	
	Vane	float	Wind direction measured by the ZephIR complementary mast	°
	Temp	float	Air absolute temperature measured by the ZephIR complementary mast	°C
	Pressure	float	Atmospheric pressure measured by the ZephIR complementary mast	kBar
	Humidity	float	Atmospheric relative humidity measured by the ZephIR complementary mast	%
	Rain	float	10 min average of the rain detection by the ZephIR complementary mast defined as a number between 0 and 1 (0: no rain at all, 1: rain all the time during the 10 min)	[-]
	Battery	float	Battery voltage	V
	CC	char(1)	True if the cloud correction algorithm is on, False if it is off	[-]
	O_pod_Temp	float	Optical pod internal temperature	°C
	E_pod_Temp	float	Electronic pod internal temperature	°C
	B_pod_Temp	float	Battery pod internal temperature	°C

Scintex Sodar data

scintex_stats				
KEY	COLUMN NAME	DATATYPE	DEFINITION	UNIT
*	Name	char(12)	beginning of the 10 min period yyyymmddHHMM (y= year; m=month; d=day; H=hour (from 0 to 23); M=minute)	
*	Height	smallint	vertical height at which the sodar measures	m
	speed	float	10 min mean horizontal wind	m/s

			speed	
	Dir	float	10 min mean horizontal direction	°
	U	float	10 min average of the eastern* component of the wind vector	m/s
	V	float	10 min average of the nothern* component of the wind vector	m/s
	W	float	10 min average of the vertical wind speed	m/s
	sigW	float	10 min standard deviation of the vertical wind speed	m/s
	Bck	integer	Total intensity of the reflected signal (range corrected)	
	error	smallint(5)	error code for wind measurement	
	sigU	float	10 min standard deviation of U	m/s
	sigV	float	10 min standard deviation of V	m/s
	errU	smallint(5)	error code for U component**	
	errV	smallint(5)	error code for V component**	
	errW	smallint(5)	error code for W component**	
	confU	smallint(5)	Confidence class for U component***	
	confV	smallint(5)	Confidence class for V component***	
	confW	smallint(5)	Confidence class for W component***	

* in the sodar antenna coordinate system, i.e. depends on the antenna orientation.
** The error c ode can take the following values:
1 : invalid horizontal wind result: quality check not passed
2 : invalid vertical wind result: quality check not passed
256: ground clutter contamination of horizontal wind detected and removed
257: ground clutter contamination and invalid horizontal wind
258: ground clutter contamination and invalid vertical wind
259: ground clutter contamination and invalid horizontal and vertical wind
Note: The variables errU, errV, errW can only take the value 256 (contamination of the given component with a ground echo, but handled by the software).
*** The confidence class can take the values :
4: very high confidence
3: high confidence
2: medium confidence
1: low confidence
0: error
Values 0 and 1 should come with invalidation.

scintex_rundef				
KEY	COLUMN NAME	DATATYPE	DEFINITION	UNIT
*	Name	char(12)	beginning of the 10 min period yyyymmddHHMM (y= year; m=month; d=day; H=hour (from 0 to 23); M=minute)	
	start_dt	Datetime	Time stamp of the beginning of the 10 minute period YYYY-MM-DD hh:mm:ss (Y= year; M=month; D=day; h=hour (from 0 to 23); m=minute,s:second)	
	stop_dt	Datetime	Time stamp of the end of the 10 minute period YYYY-MM-DD hh:mm:ss (Y= year; M=month; D=day; h=hour (from 0 to 23); m=minute,s:second)	
	duration	Float	number of seconds between start_dt and stop_dt	s

II Database safewind_hovsore_lidar

This database contains only Windcube lidar data. The table structure is exactly as defined in the *safewind_hovsore_campaign* database. The data for period 2 is in a separate table series windcube_site2_unit2_10min since this data is measured at a different location. A compilation of hourly mean values (speed and direction) has been made in table windcube_hour. This table includes data from periods 1, 2 and 3 (ignoring the small difference in location).

Examples of MySQL queries:

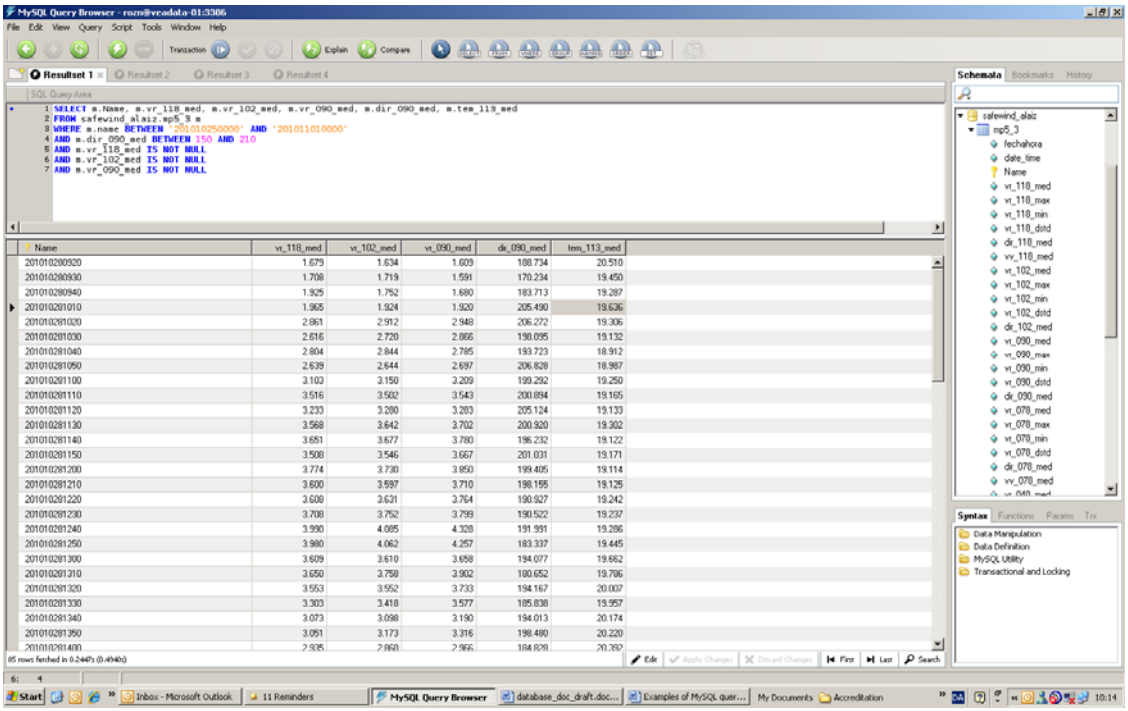
This database is implemented as a MySQL server to which any user can access (provided a user name and password) through a MySQL query browser.

Here are a few examples of MySQL queries:

1) To get the mean wind speed at various heights (118m, 102m, 90m), the wind direction at 90m and the temperature at 113m from the met mast between the 25/10/2010 00:00 and the 31/10/2010 24:00 when the wind direction is within the sector: 150°-210°:

```
SELECT m.Name, m.vr_118_med, m.vr_102_med, m.vr_090_med, m.dir_090_med,
m.tem_113_med
FROM safewind_alaiz.mp5_3 m
WHERE m.name BETWEEN '201010250000' AND '201011010000'
AND m.dir_090_med BETWEEN 150 AND 210
AND m.vr_118_med IS NOT NULL
AND m.vr_102_med IS NOT NULL
AND m.vr_090_med IS NOT NULL
```

- "IS NOT NULL" returns only parameters with numeric values.
- The number and the order of parameters, tables and conditions does not matter, what matters is the structure:
  SELECT [parameter names] FROM [table names] WHERE [conditions]

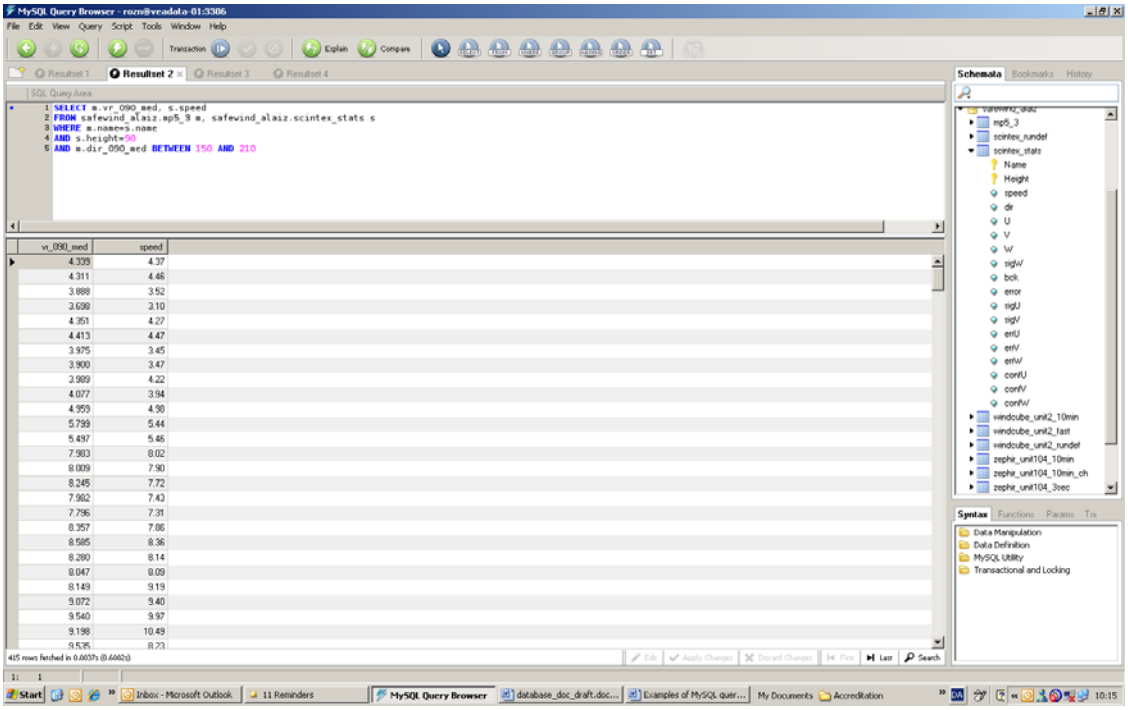


2) To get the simultaneous (10 minute mean) wind speed from the cup anemometer at 90m and that from the sodar at the height 90m:

```
SELECT m.vr_090_med, s.speed
FROM safewind_alaiz.mp5_3 m, safewind_alaiz.scintex_stats s
WHERE m.name=s.name
AND s.height=90
AND m.dir_090_med BETWEEN 150 AND 210
```

- m is an alias for the table safewind_alaiz.mp5_3, and s for the safewind_alaiz.scintex_stats table; this enables us to distinguish between parameters having the same name in the different tables (e.g. to distinguish between m.name and s.name).

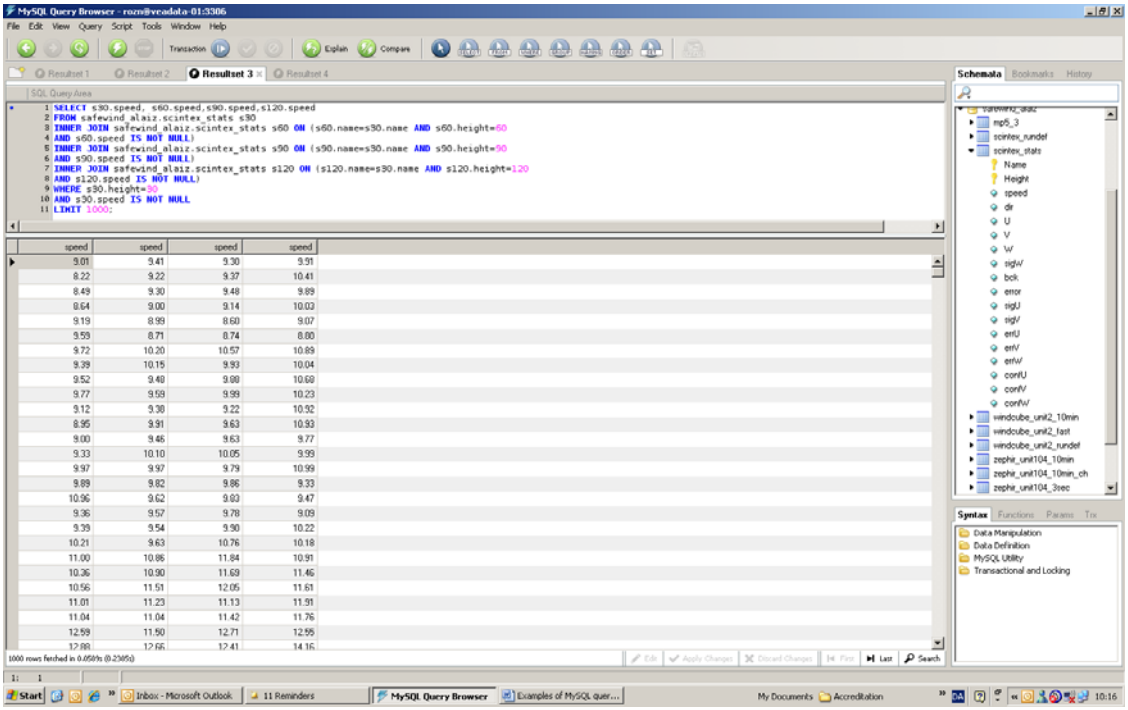
→ In order to get simultaneous data, we make a join on the names of each table, i.e. one row corresponds to one name.



3) To get the (10 min. mean) wind speed measured by the sodar at various ranges simultaneously:

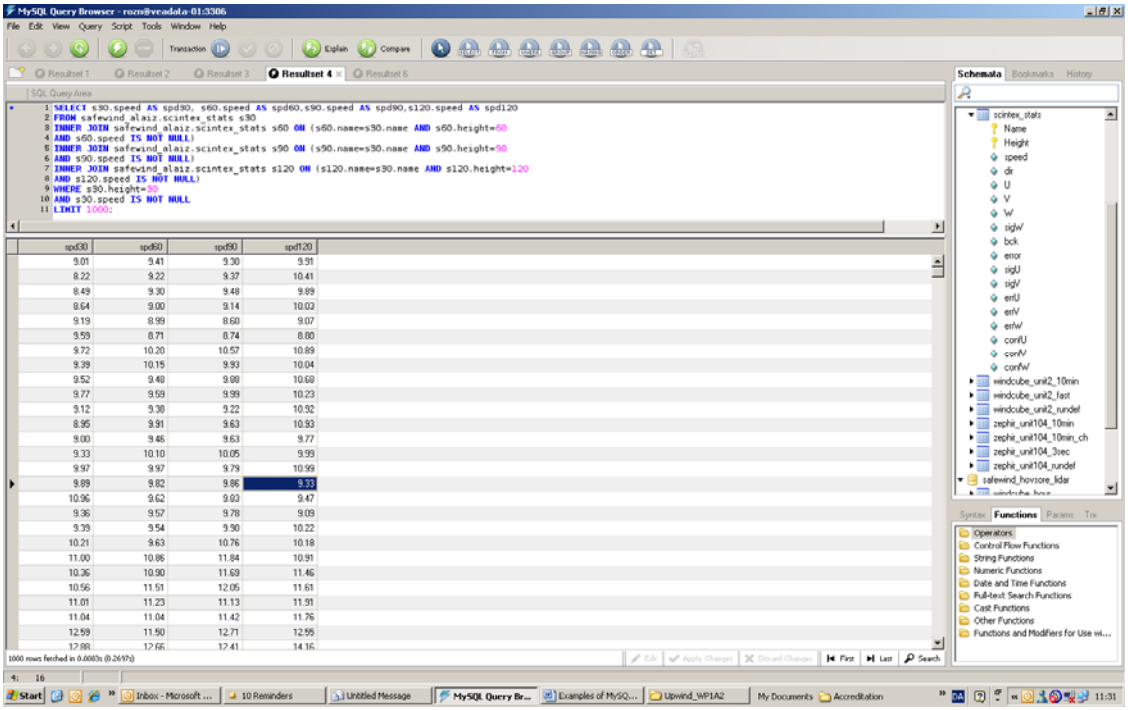
```
SELECT s30.speed, s60.speed,s90.speed,s120.speed
FROM safewind_alaiz.scintex_stats s30
INNER JOIN safewind_alaiz.scintex_stats s60 ON (s60.name=s30.name AND s60.height=60 AND s60.speed IS NOT NULL)
INNER JOIN safewind_alaiz.scintex_stats s90 ON (s90.name=s30.name AND s90.height=90 AND s90.speed IS NOT NULL)
INNER JOIN safewind_alaiz.scintex_stats s120 ON (s120.name=s30.name AND s120.height=120 AND s120.speed IS NOT NULL)
WHERE s30.height=30
AND s30.speed IS NOT NULL
LIMIT 1000;
```

- Here a subset of the table is defined by selecting all the data having the same range (each subset of data is given an alias), and a join is made on the subset's alias
- "LIMIT 1000" limits the number of output rows to 1000



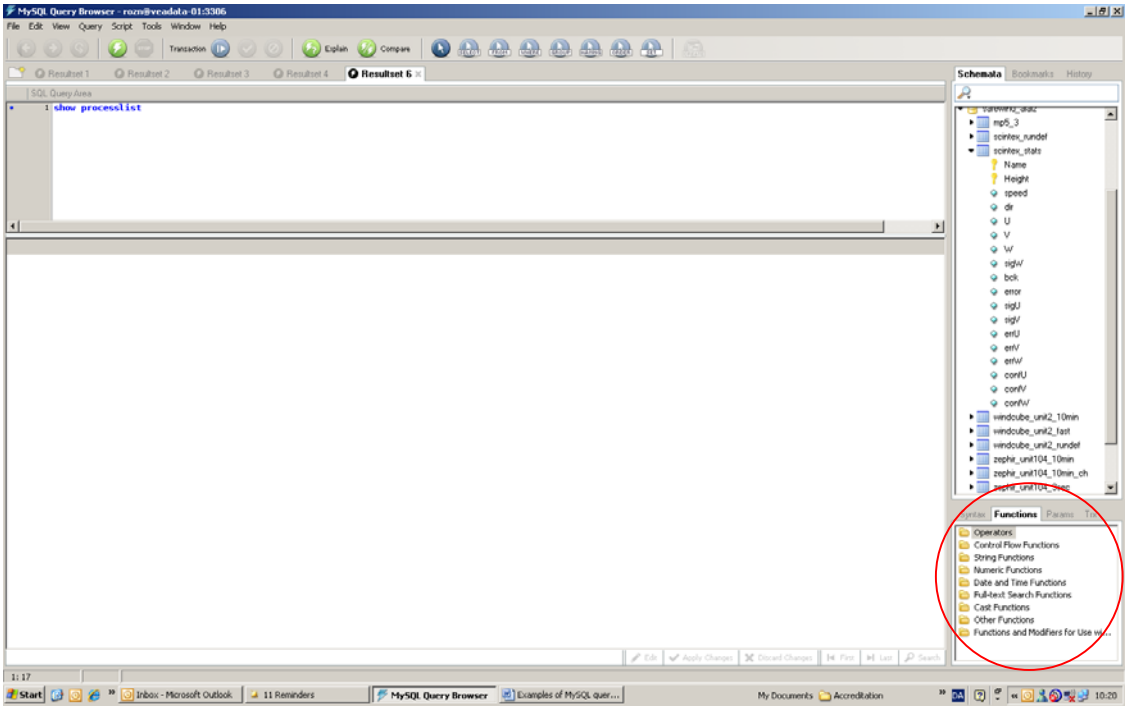
Small tip: use "AS" to give explicit names to the columns:

```
SELECT s30.speed AS spd30, s60.speed AS spd60,s90.speed AS spd90,s120.speed AS spd120
FROM safewind_alaiz.scintex_stats s30
INNER JOIN safewind_alaiz.scintex_stats s60 ON (s60.name=s30.name AND s60.height=60 AND s60.speed IS NOT NULL)
INNER JOIN safewind_alaiz.scintex_stats s90 ON (s90.name=s30.name AND s90.height=90 AND s90.speed IS NOT NULL)
INNER JOIN safewind_alaiz.scintex_stats s120 ON (s120.name=s30.name AND s120.height=120 AND s120.speed IS NOT NULL)
WHERE s30.height=30
AND s30.speed IS NOT NULL
LIMIT 1000;
```



4) Tips for beginners:

Useful information can be found about the functions that can be used in a MySQL query in the square on the bottom left corner of the browser.



If ever the join between tables is forgotten or not well defined, the output dataset can be very large (several times the size of the entire database) and the query browser may not return any response for a long time. Shutting down the query browser does not stop the query to run. If such a wrong query is not stopped, it might get the database stuck.
→ In order to avoid this, may be a good idea to use “LIMIT” to limit the number of outputs when trying out a new query.
→ If ever it gets stuck, the query must be “killed”.
To do so:
1- find the query id by running
“show processlist”
2- kill the query, by running:
“kill” followed by the id of the query you want to kill.

Note: in these examples, the key words were written in upper case to be emphasized, but the MySQL brower is actually not upper/lower case sensitive.