Preliminary comparative ZephIR Lidar results to cup anemometer measurements

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Contents of the presentation

- Experiences with ZephiR lidar I 2006
- ZephIR Lidar comparisons to the met mast measurements
- The planned measurement campaigns within the “UPWIND” and the “Improved Performance Methods” projects.

ZephiR experiences in 2006

- 2 ZephiR lidars (unit 8 and unit 2)

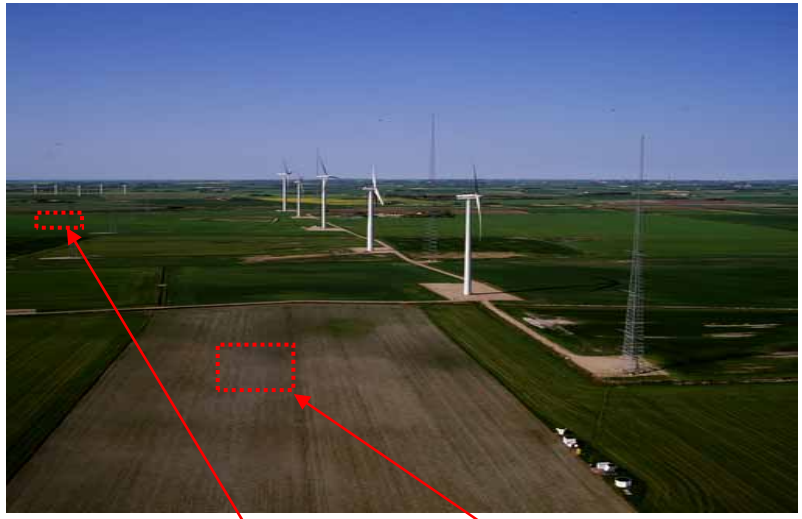
- Comparative measurements at Risø and Høvsøre
- Offshore measurements at Horns Rev

- Much “childhood sickness”
- Problems often arising after shipment
- Software ok for typical “developer” applications
- Software poorly suited to research and on-line measurements

The Høvsøre Test Station and the experimental setup (1)

- Measurement sector: 240°-300°
- The measurements started primo December. They will continue for at least one year (ZephIR unit 8).
- The ZephIR unit 2 will be deployed next to unit no. 8 on Tuesday 23-01-07.
- One ceilometer will be permanently deployed within two weeks.

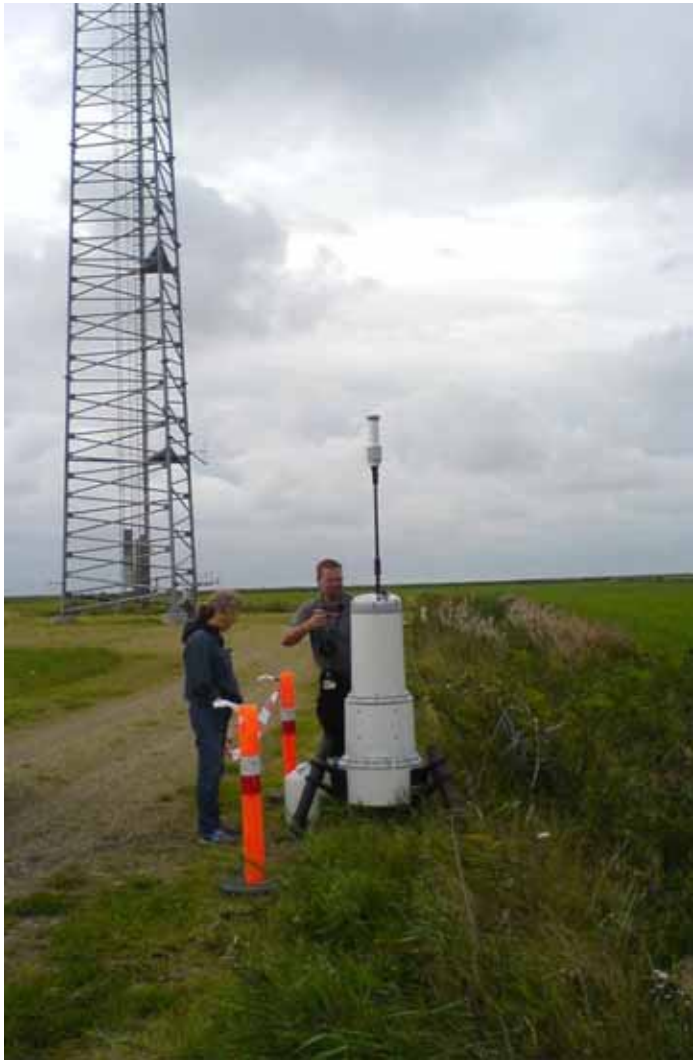
ZephIR unit 8



Test pad 1, available

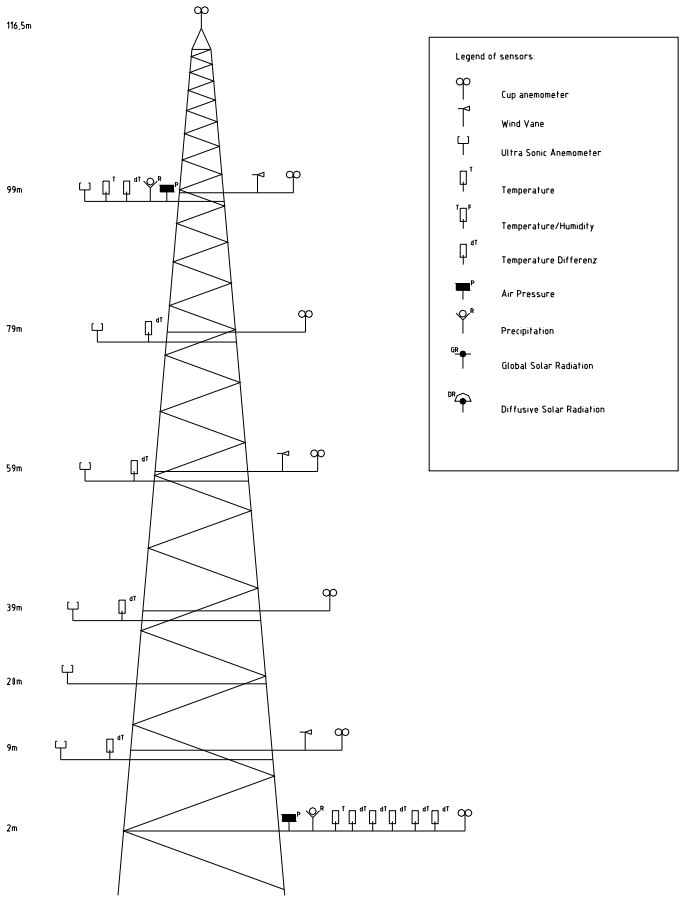
Test pad 2, available soon

The Høvsøre Test Station and the experimental setup (2)



The Høvsøre Test Station and the experimental setup (3)

The instrumentation of the met mast

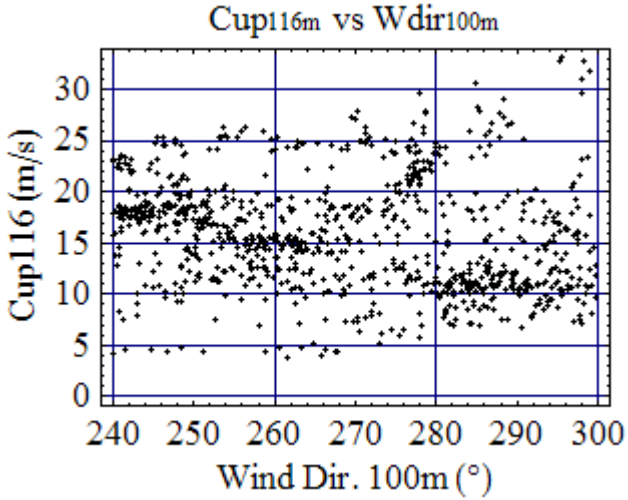


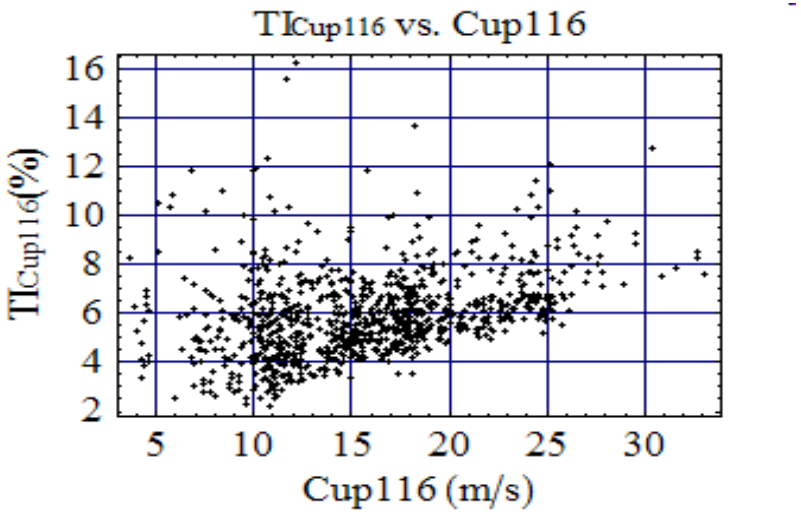
Sensor	Position
Cup anemometer	116.5m
Cup anemometer, wind vane, sonic anemometer, temperature, differential temperature, relative humidity, air pressure	100m
Cup anemometer, sonic anemometer, differential temperature	80m
Cup anemometer, sonic anemometer, differential temperature, wind vane	60m
Cup anemometer, sonic anemometer, differential temperature	40m
Sonic anemometer	20m
Cup anemometer, sonic anemometer, differential temperature, wind vane	10m
Cup anemometer, temperature, differential temperature, relative humidity, air pressure, rain	2m

The lidar ZephIR measured parameters

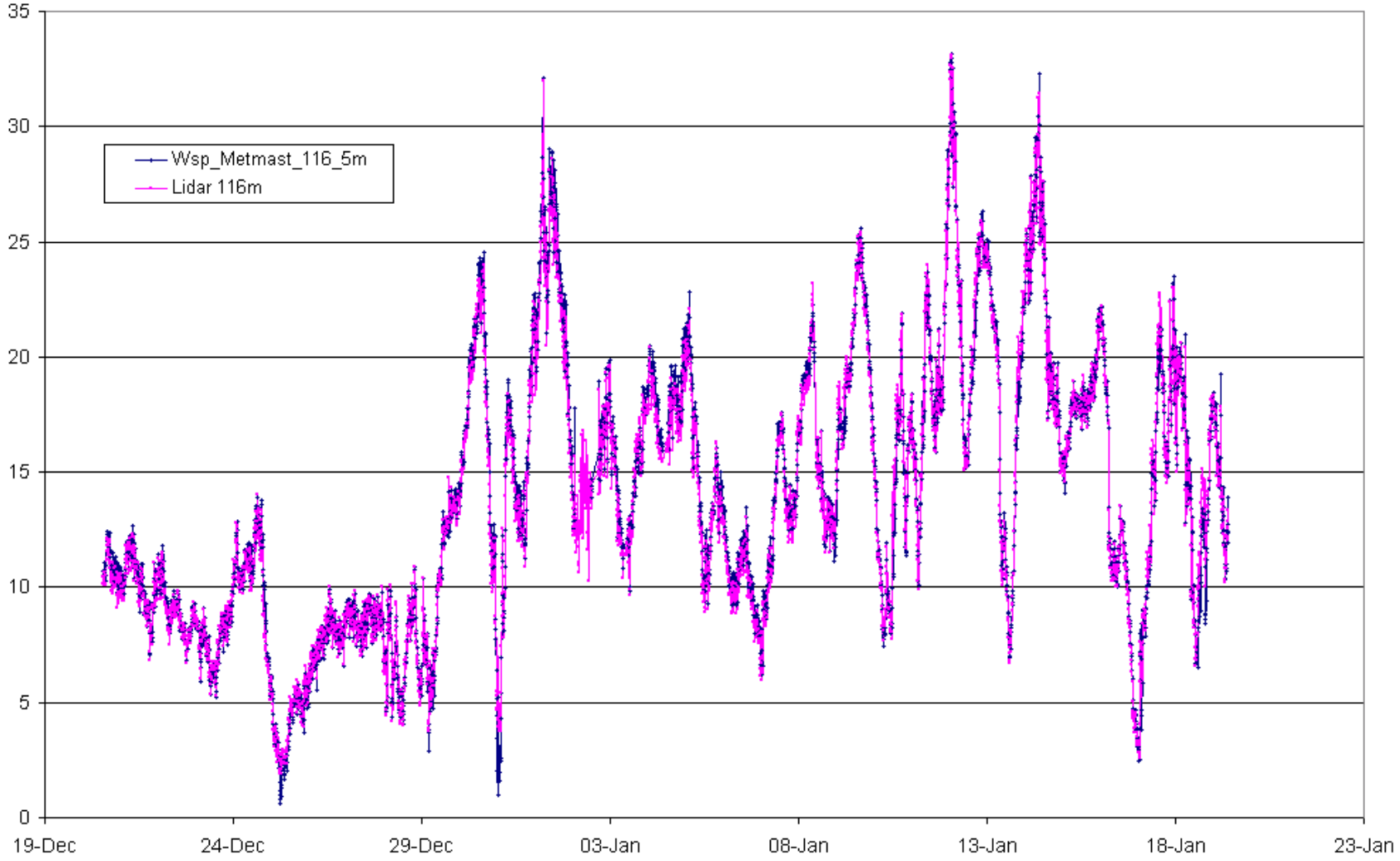
- Measuring heights 300,116,100,80,40m
- Data collected – 3sec ZephiR results and 50Hz raw spectra
- Derived 10 minute means and standard deviations of:
  U, W, dir
- Re-calculation using own algorithms from 50Hz spectra.
- Mast cup (10Hz) and sonic data (20Hz) saved .

Cup anemometer measurements

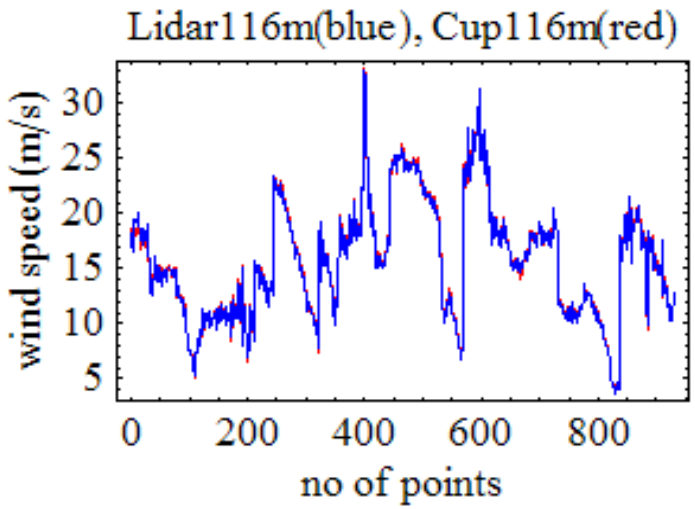


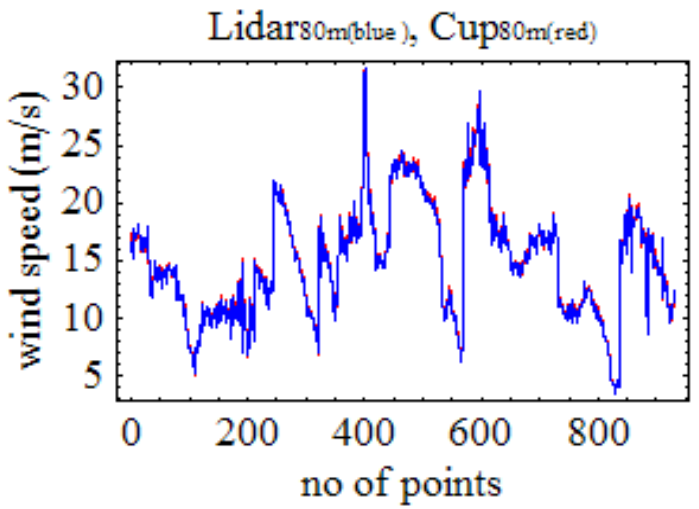


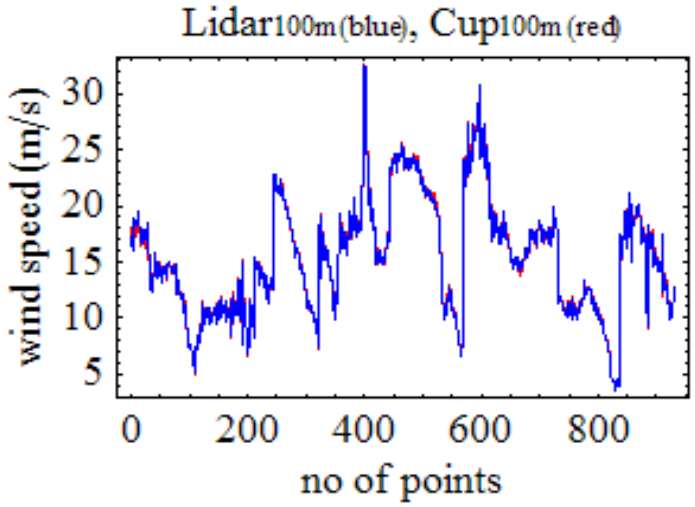
Lidar and cup at 100m vs time, all data (unfiltered)

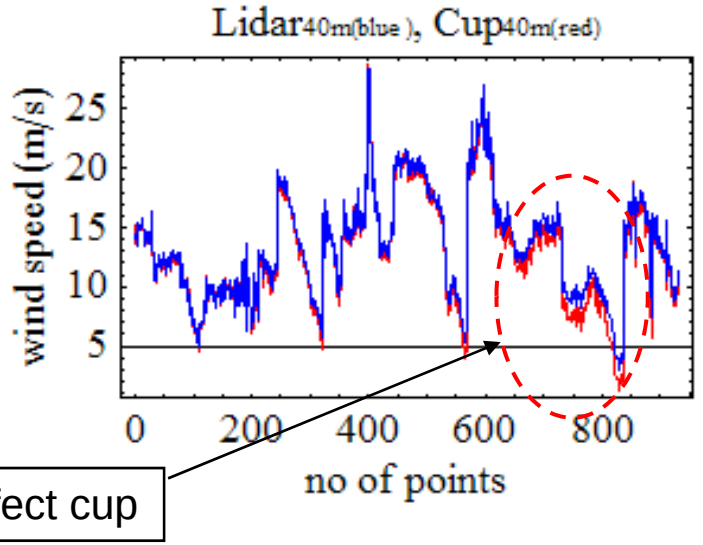


Lidar-cup hor. wind speed measurements (dry weather data)

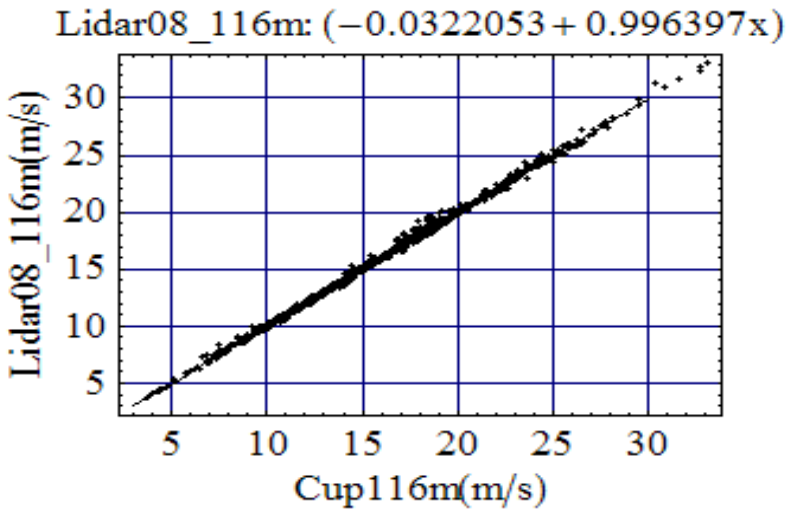


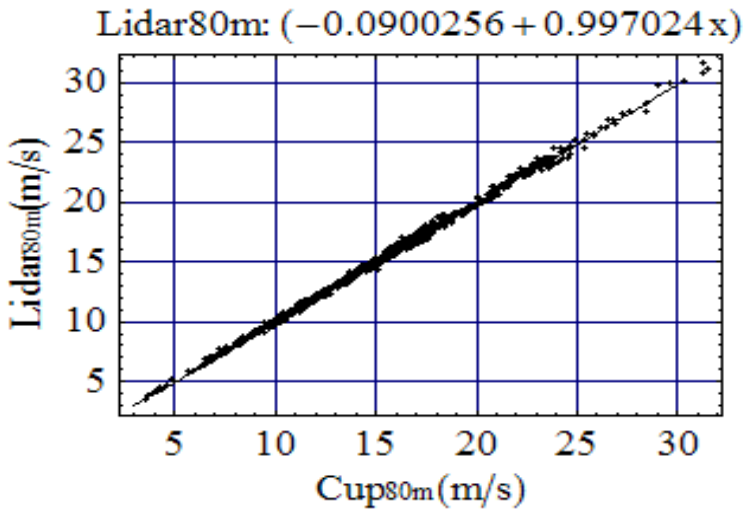


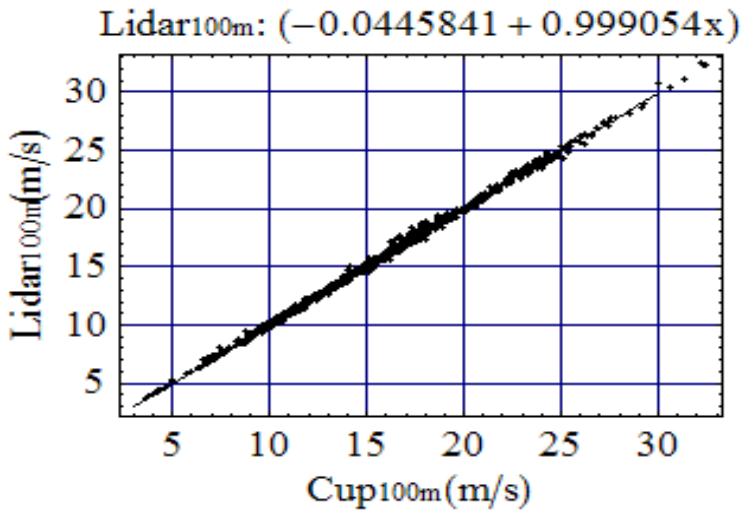




Lidar-cup slope (dry weather data)

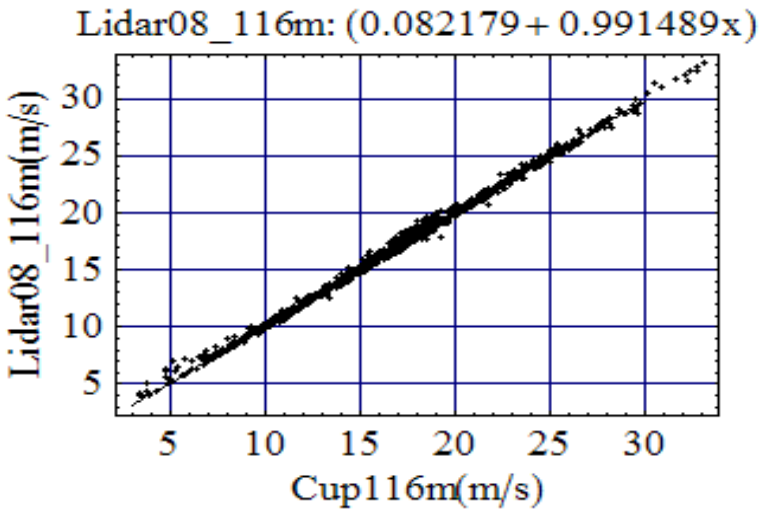


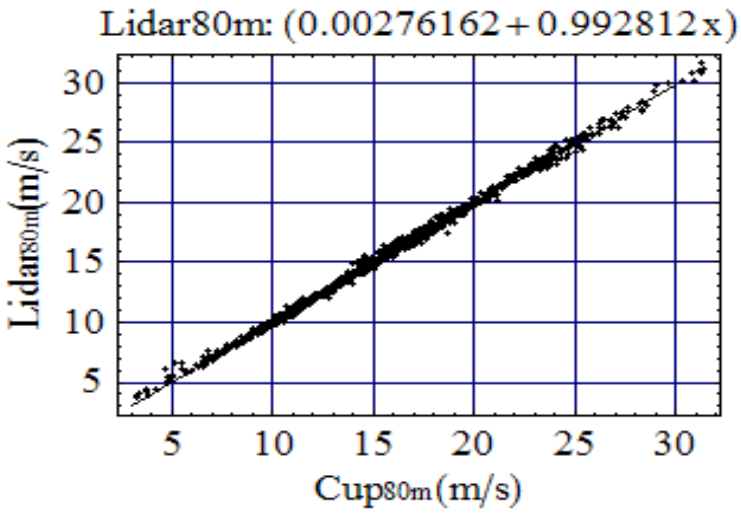


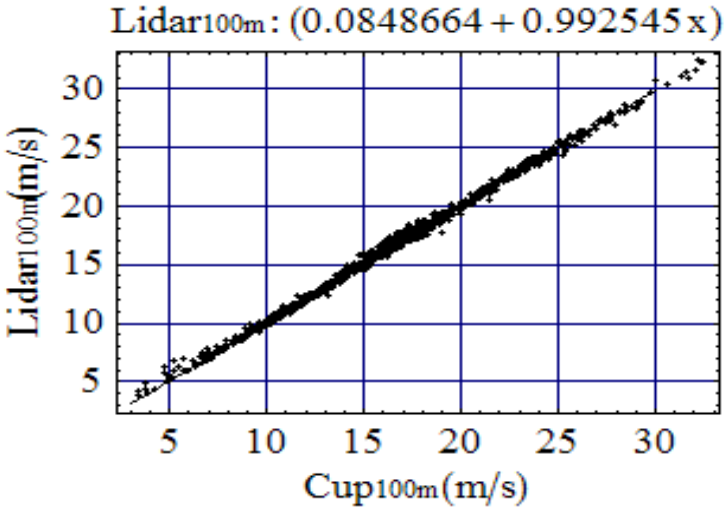


- Slope very close to unity.
- High degree of correlation.

Lidar-cup slope (ALL weather data, wsp>3m/s, 20% rain points)

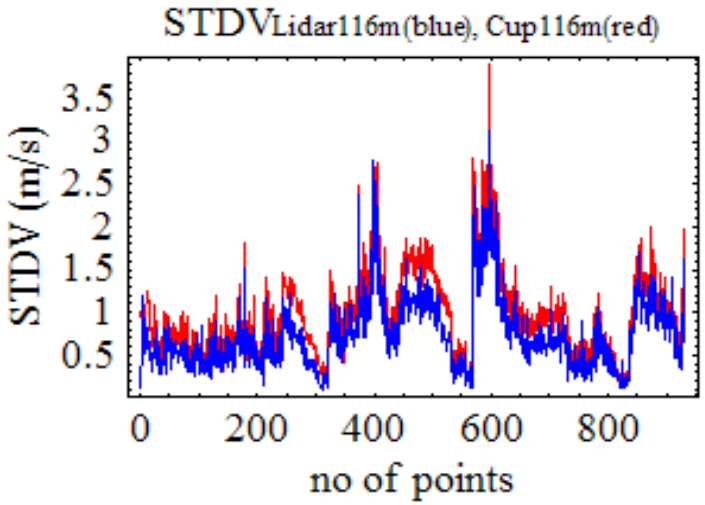


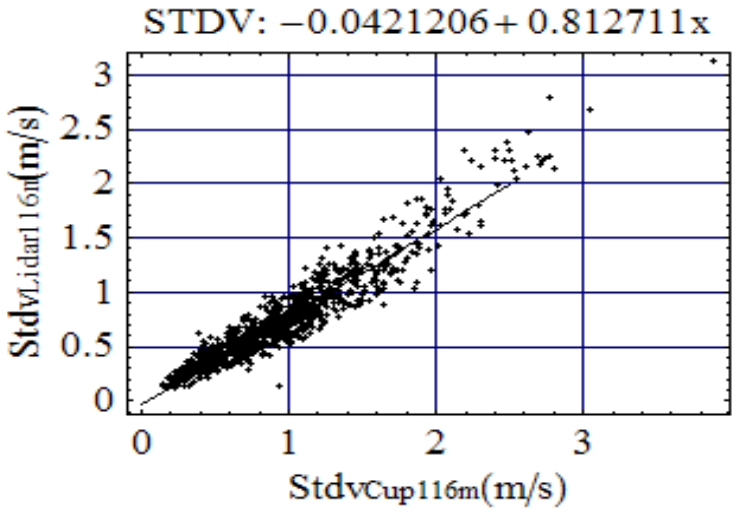


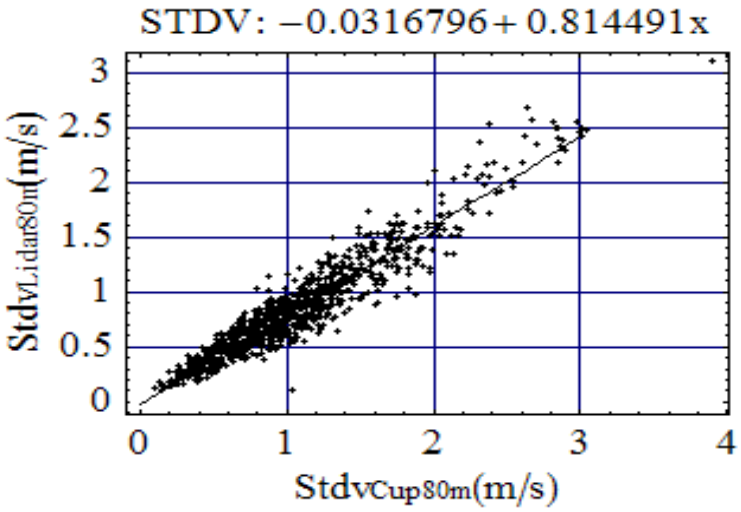


- Rain influences the relation lidar-cup.
- However it is difficult to evaluate the influence of rain on each instrument as both are influenced.
- Increased scatter.
- More work is needed.

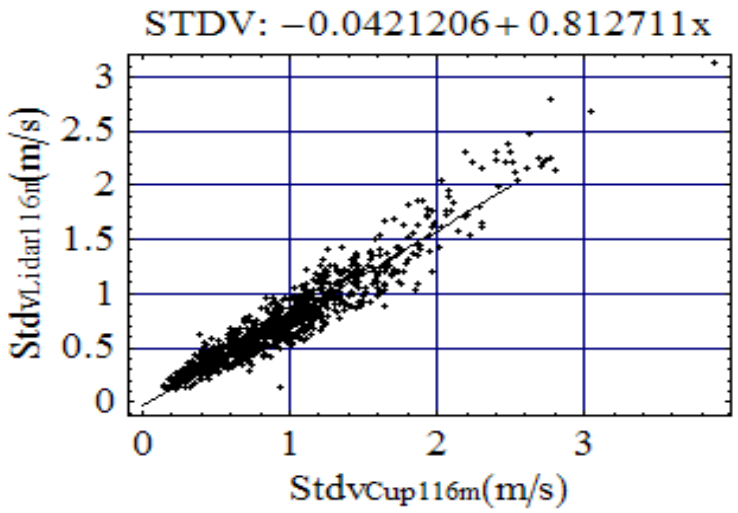
Lidar-cup STDV (dry weather data)

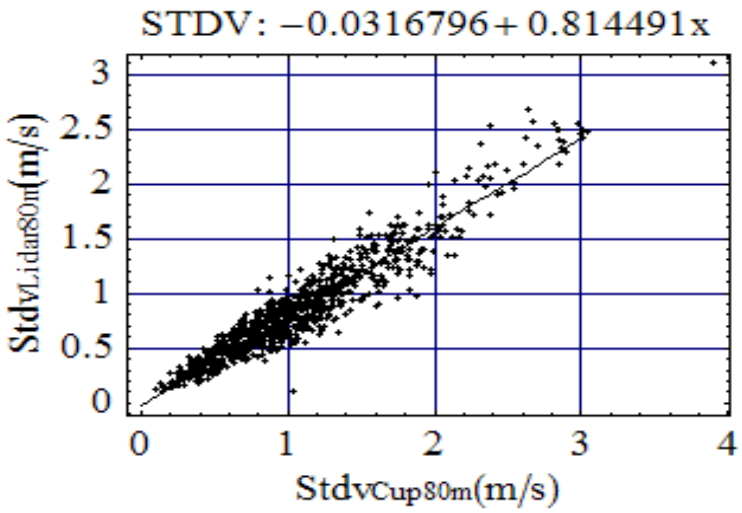


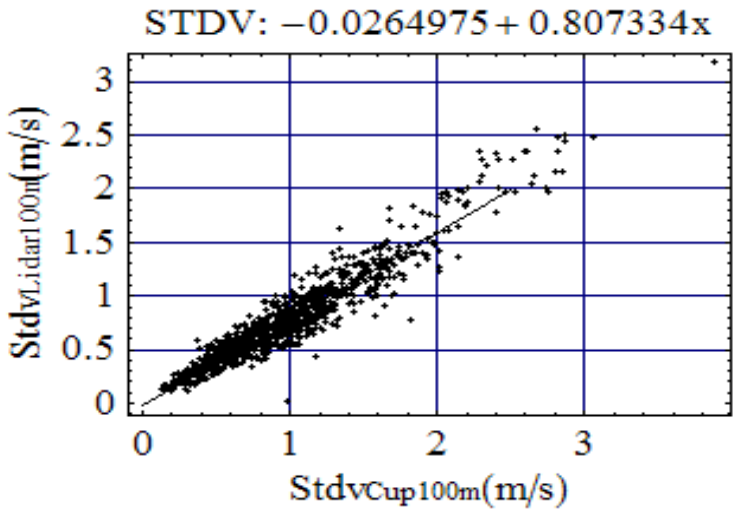


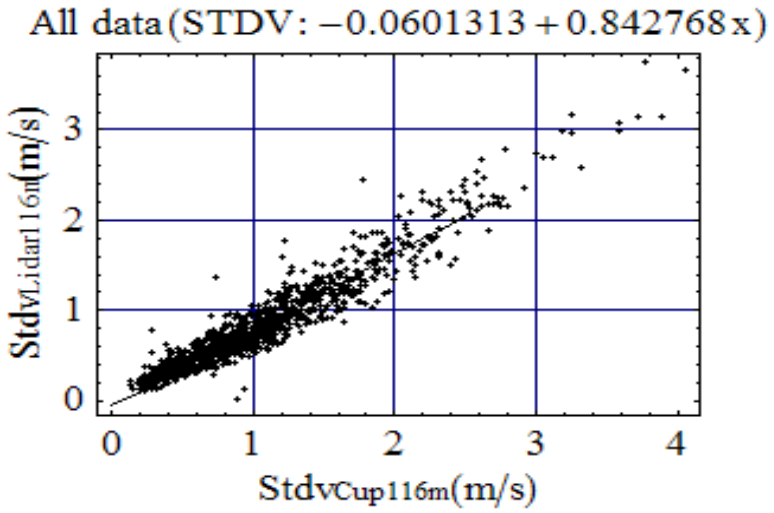


Lidar-cup STDV slope (dry weather data)

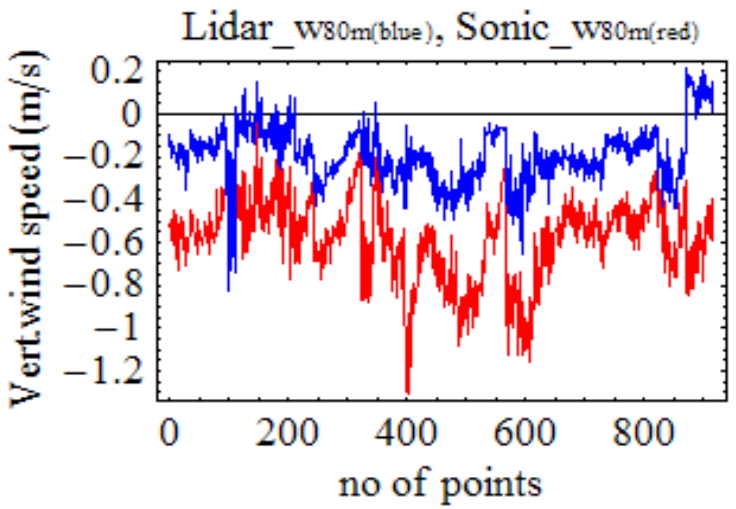


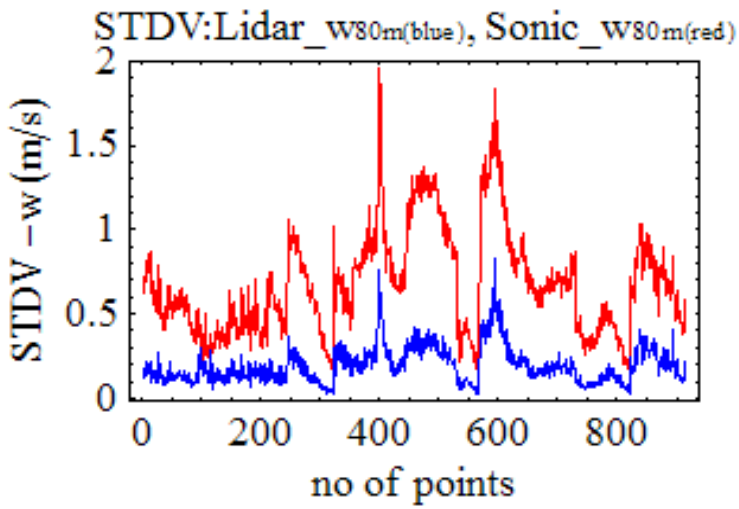


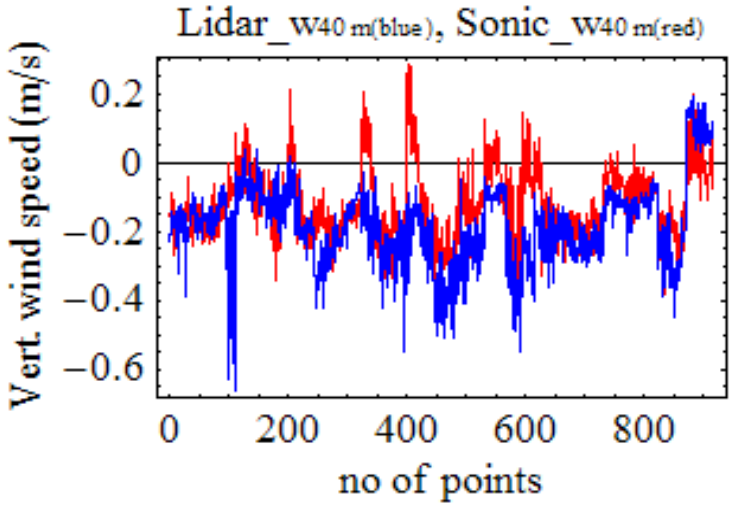


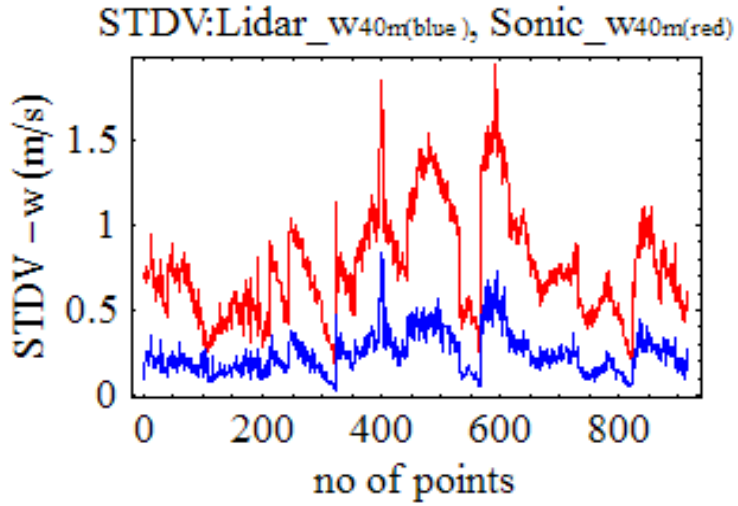


Lidar-sonic vertical wind speed (dry weather data)









Future plans

- Commissioning of remote sensing test sites (now)

- Long term ZephiR evaluation (1 year)
- Side-by-side ZephiR evaluation (3 months)

- Power curve measurements 1 (hub cup replacement)
- Power curve measurements 2 (vertical wind profile over rotor)
- Power curve measurements 3 (wind over whole rotor)

- Test of other lidar concepts

- Introduction of lidar to standards

Conclusions

- Zephir very promising
- Teething problems being solved
- Høvsøre remote sensing test facility now in operation