



Characterisation of single wind turbine wakes with static and scanning WINTWEX-W LiDAR data



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Content



- + Measurement Campaign (WINTWEX-W)
- + Data Quality & Availability
- + First Results of Windcube profiles
- + Outlook

WINTWEX-W

+ LiDARs

+ WindCube v1



+ WindCube v2



+ WindCube 100S



+ ZephIR DM



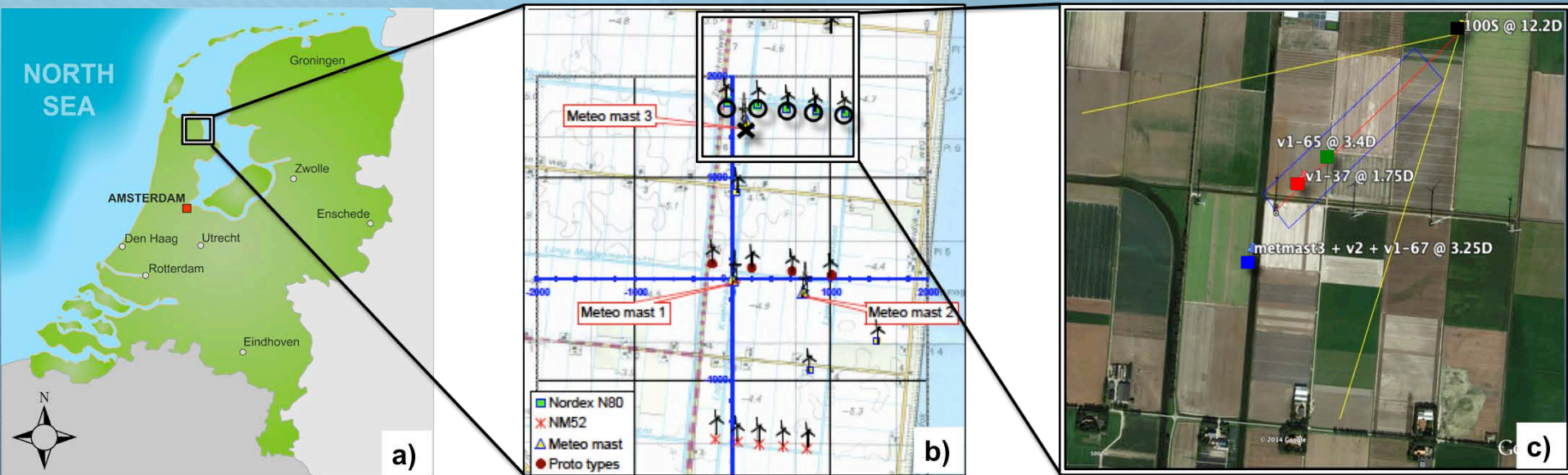
+ Wind Iris



+ SUMO



WINTWEX-W

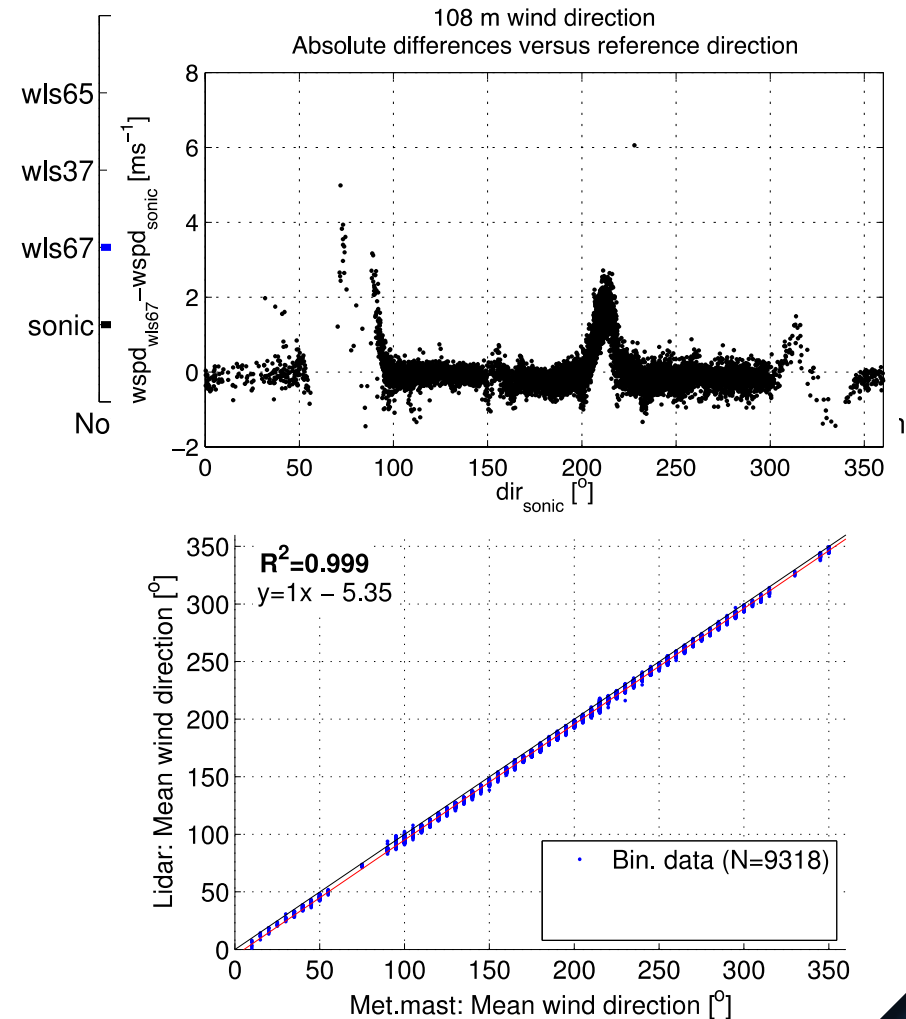


- 5 Nordex research turbines
80 m hub & rotor diameter (D)
- x 6 upstream met masts

- Wls67 upstream at 3.25D
- Wls37 downstream at 1.75D
- Wls65 downstream at 3.4D
- Wls100s downstr. at 12.2D

DATA Q & A

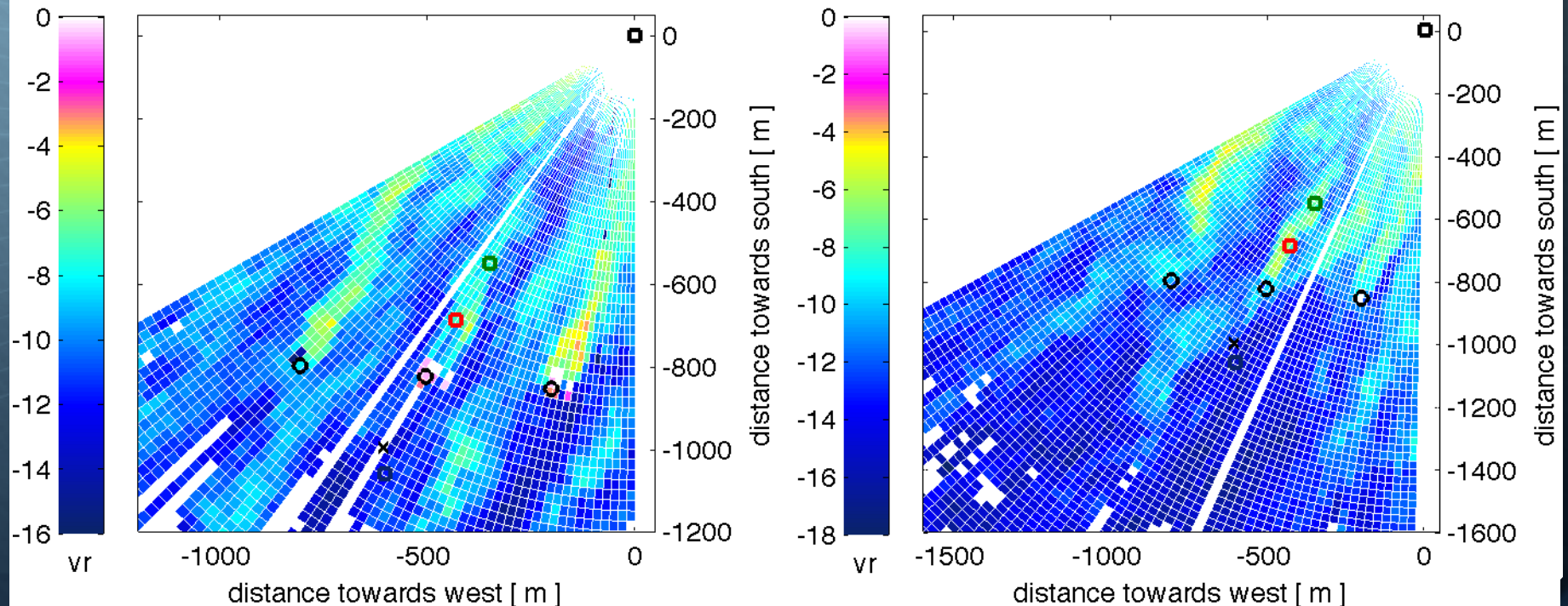
- + High data avail. during operation
 - + Gaps due to relocation & farm work
- + Good LiDAR quality
 - + Wind speed correlation altered by wakes
(not yet wind direction filtered)



First Results

10 sec PPI on 01.11.2013 at 4° and 7° elevation angle

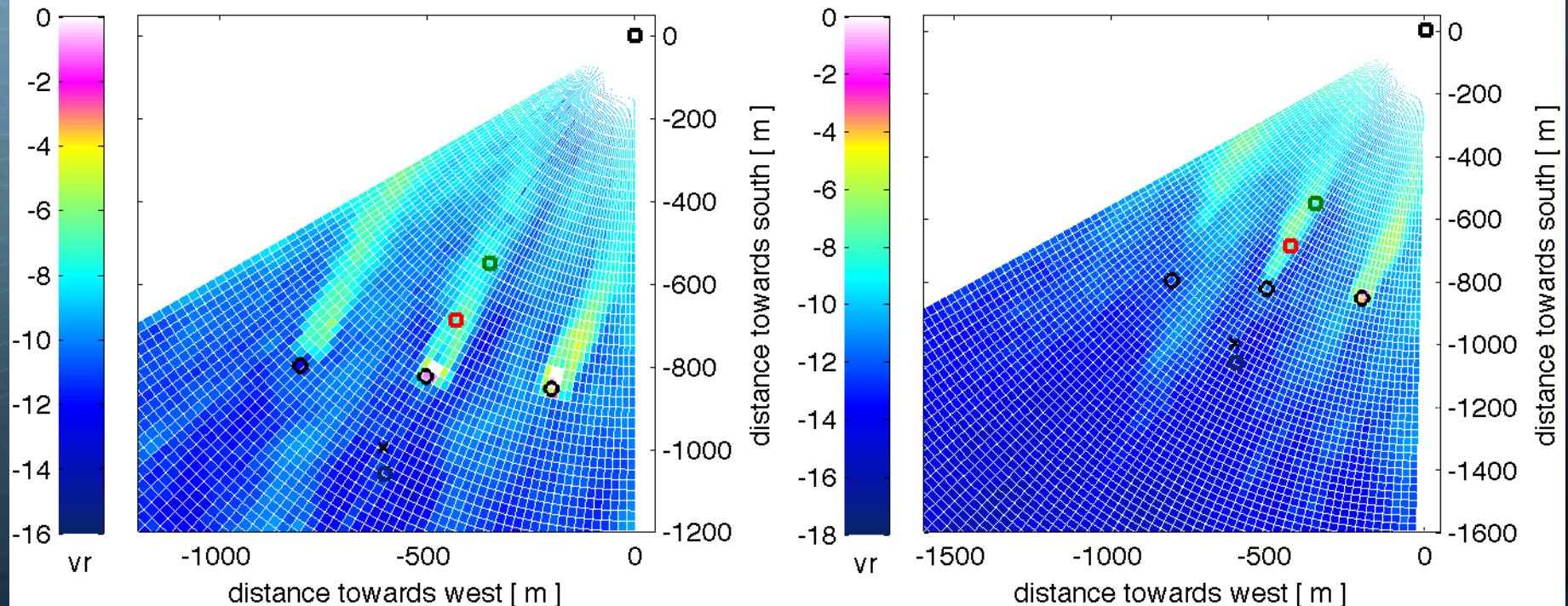
+ Upstream wake effects & meandering



First Results

10 min mean PPI on 01.11.2013 at 4° and 7° elevation angle

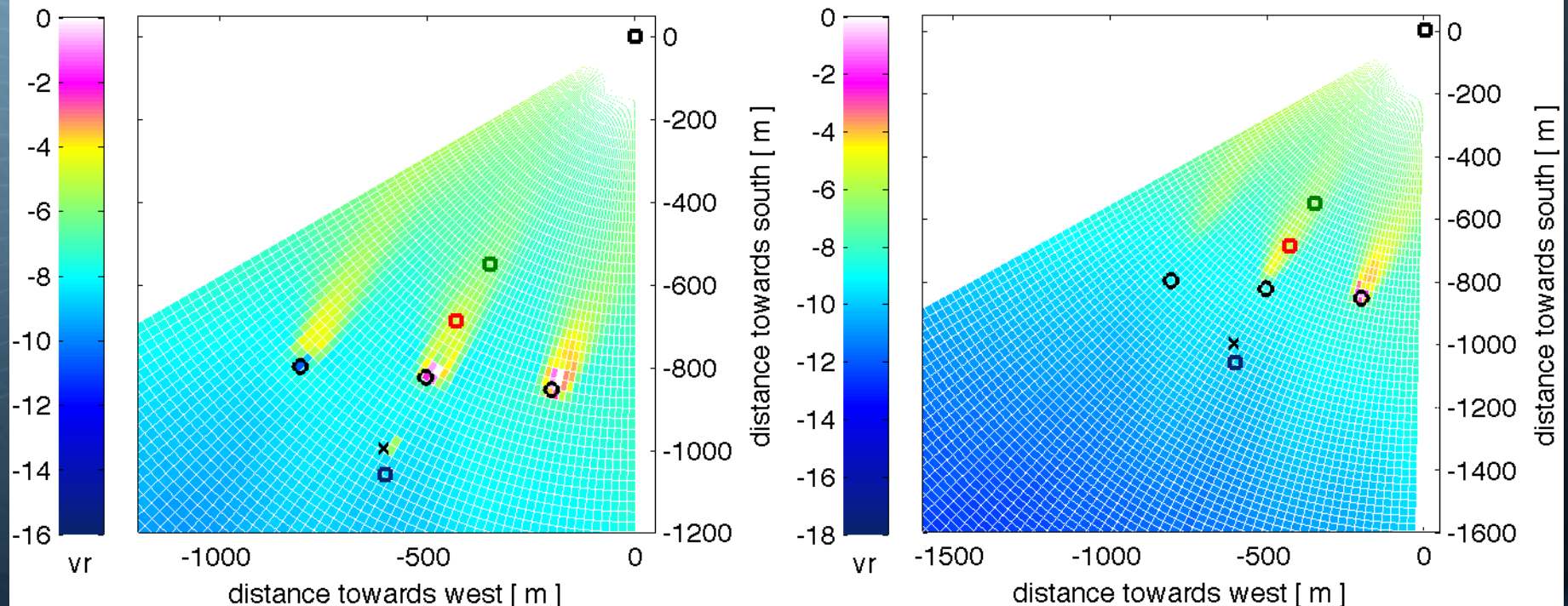
+ Wake deficit of 6m/s extends beyond 10D



First Results

1 day mean PPI on 01.11.2013 at 4° and 7° elevation angle

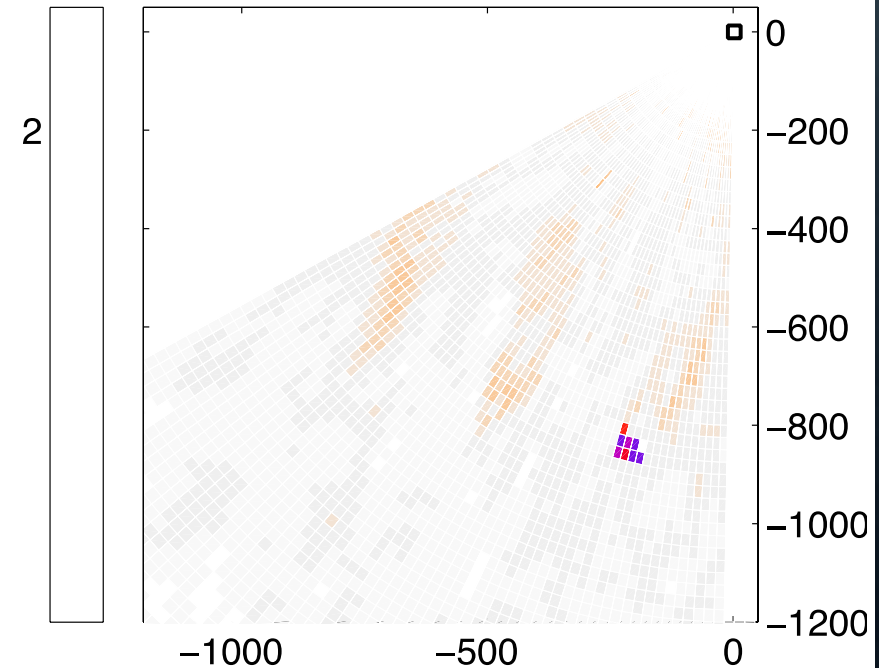
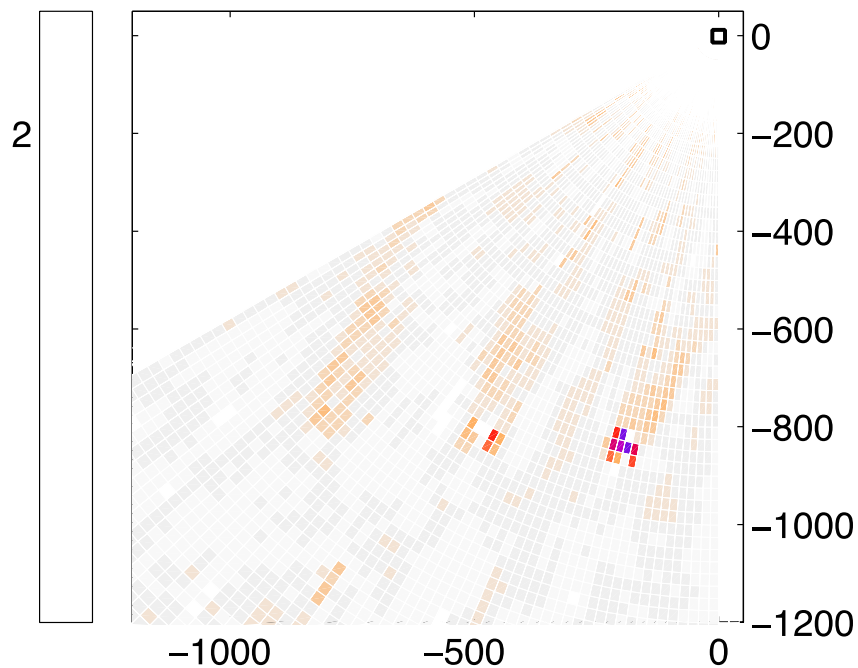
+ On the daily average wake deficit reduces to 4 m/s at hub height cross section



First Results

TI of 10 min mean PPI on 01.11.2013 at 4° and 7° elevation angle

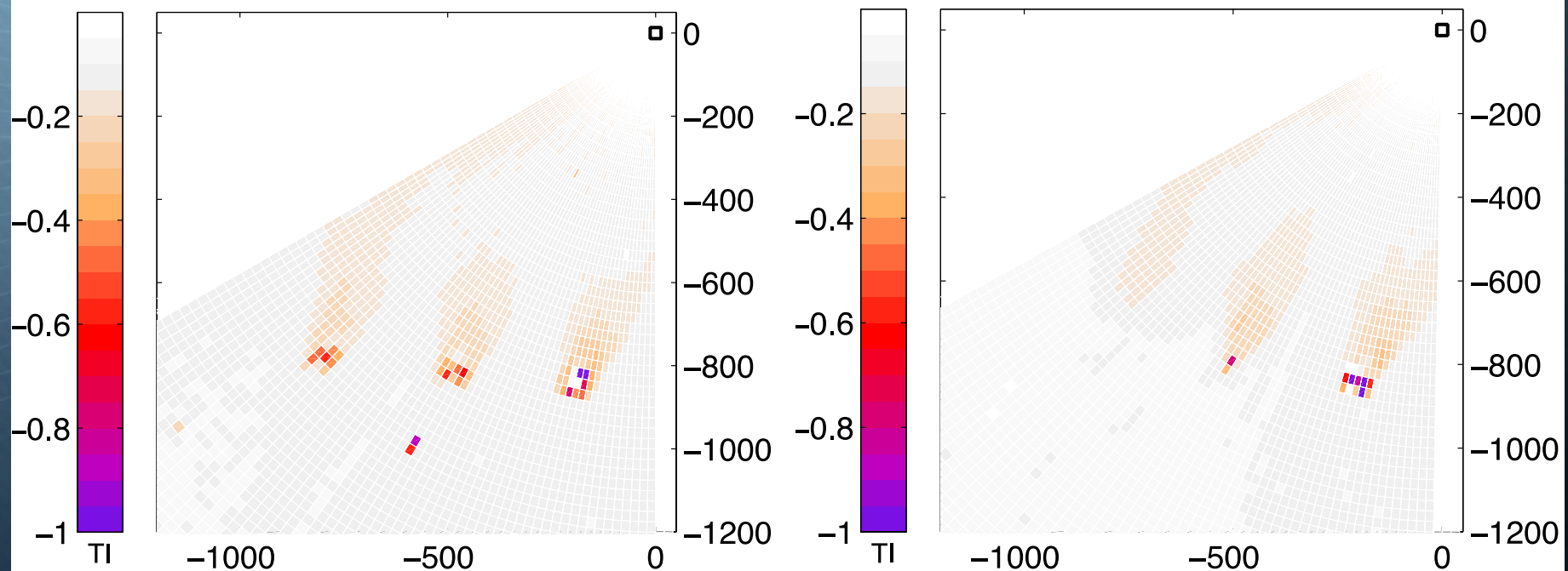
- + TI of radial wind speed varies between 0.1 and 0.3 and pops up beyond 10D



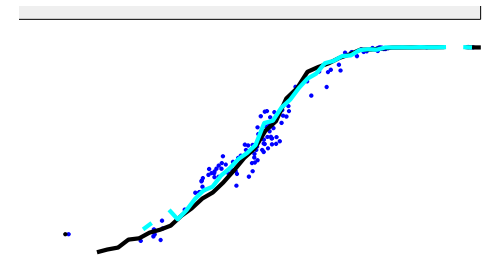
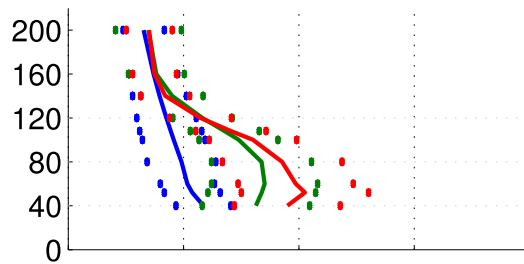
First Results

TI of 1 day mean PPI on 01.11.2013 at 4° and 7° elevation angle

- + Rather distinct TI areas of 0.2 and 0.3
- + Wake picture of turbine nr 5 influenced by roll of instrument



First Results



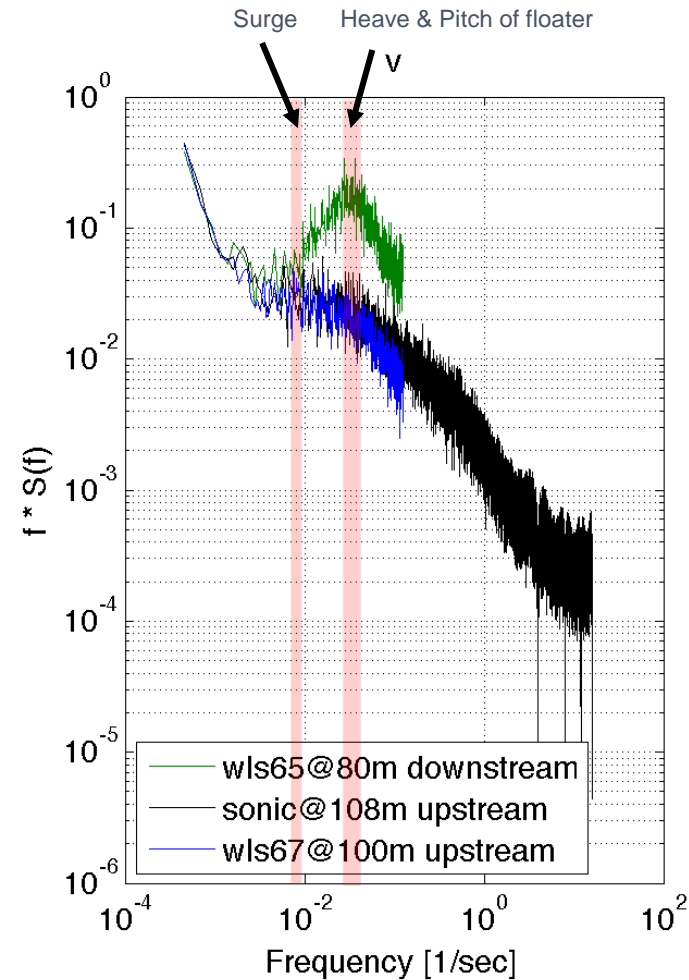
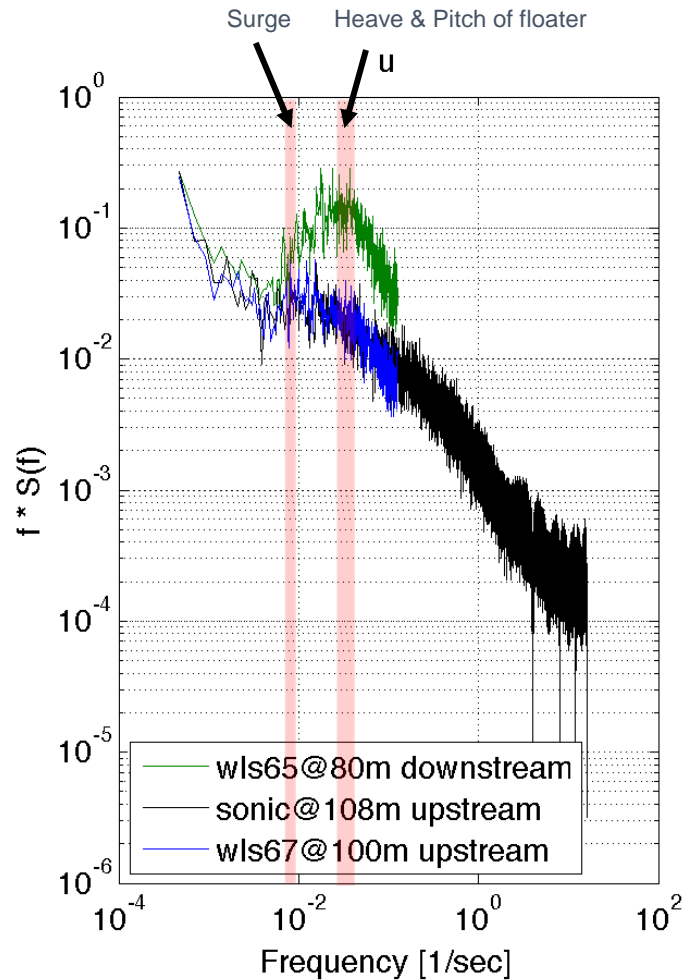
Summary

- + Good quality dataset
- + Proof of concept (able to catch wakes with 100s and v1s)
- + Velocity deficit extends beyond 10 D and mixes on average with ambient air
- + Wakes are strongest during stable conditions leading to less energy production

Outlook

- + Test UCAR/NREL wake characterization
- + Wake field analysis
 - + Divergence
 - + Single value analysis
- + Spectral analysis
- + ...

Outlook





Thank you ☺