norcowe

Norwegian Centre for Offshore Wind Energy

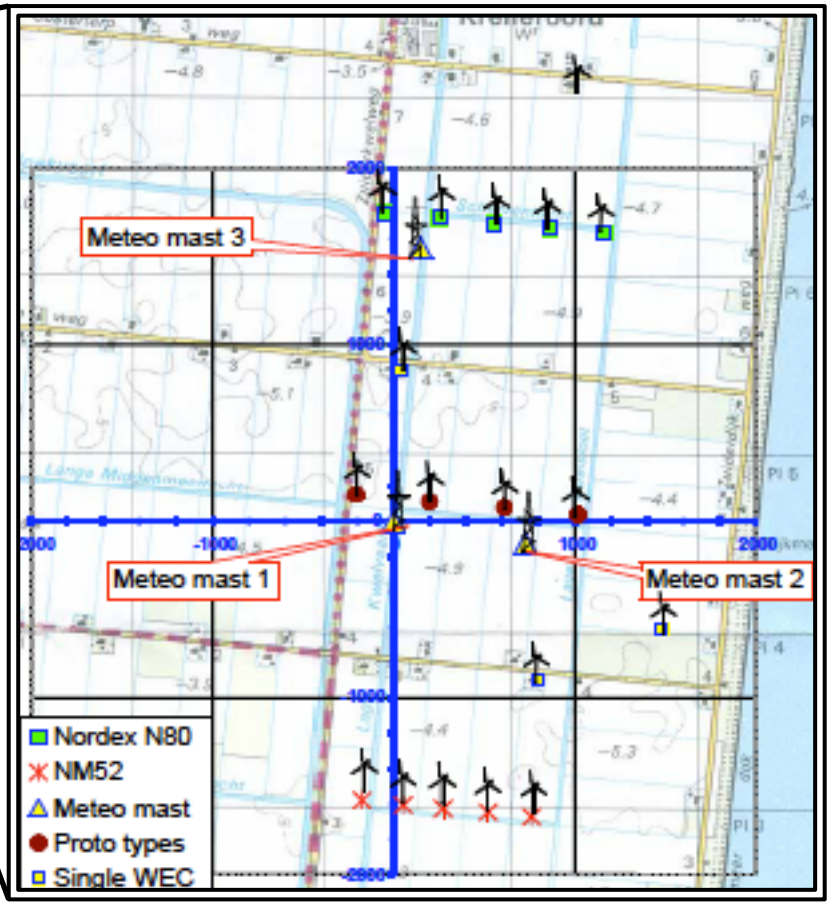
cmr

ECN

WINTWEX-W

Wind Turbine Wake Experiment - Wieringermeer

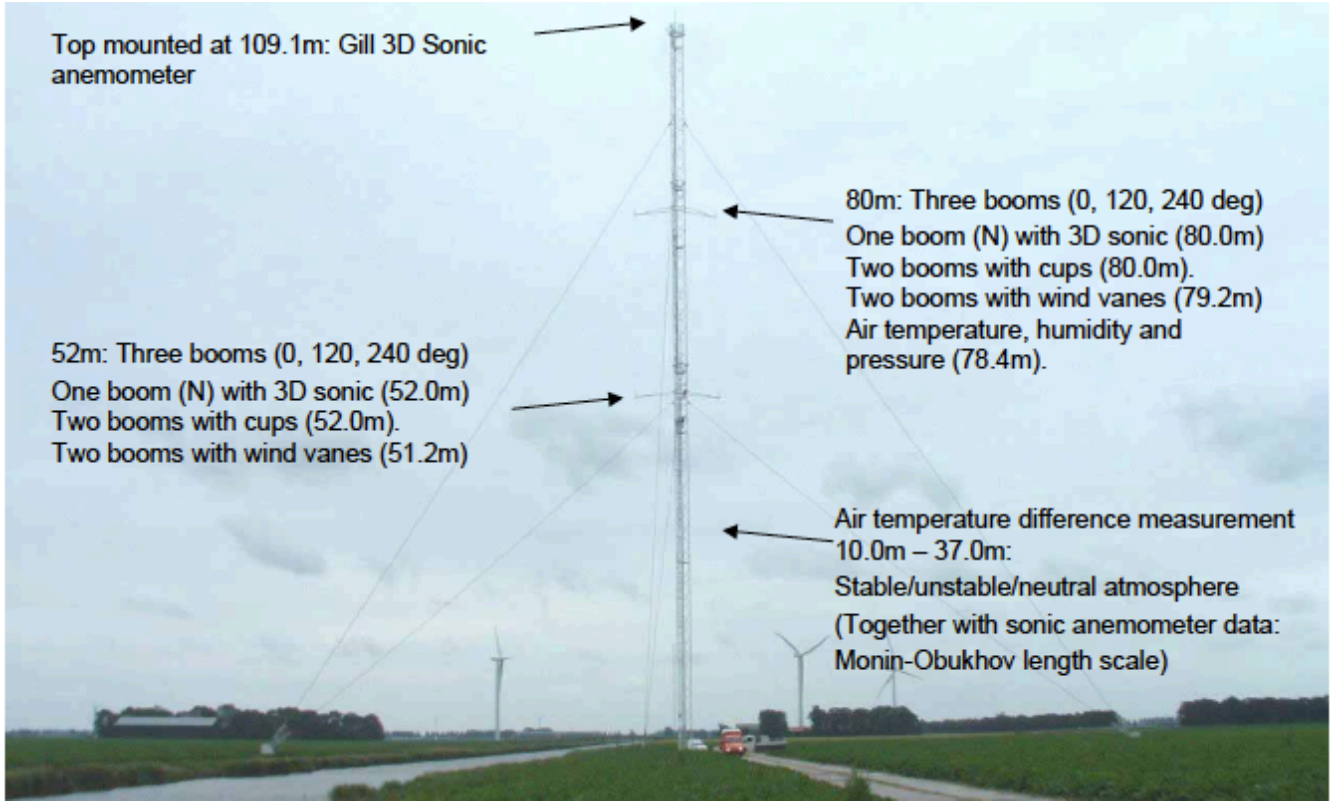
ECN test site Wieringermeer



- Available data from
  - 5 Nordex research turbines
    - 80 m hub & rotor diameter
  - 6 upstream met masts

ECN test site Wieringermeer

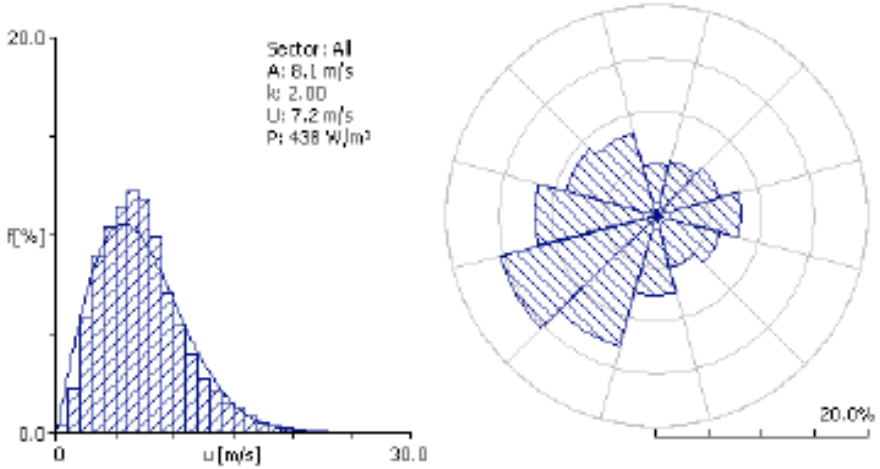
- Met mast 3
  - 3 sonic anemometers at 52 m, 80 m and 109 m



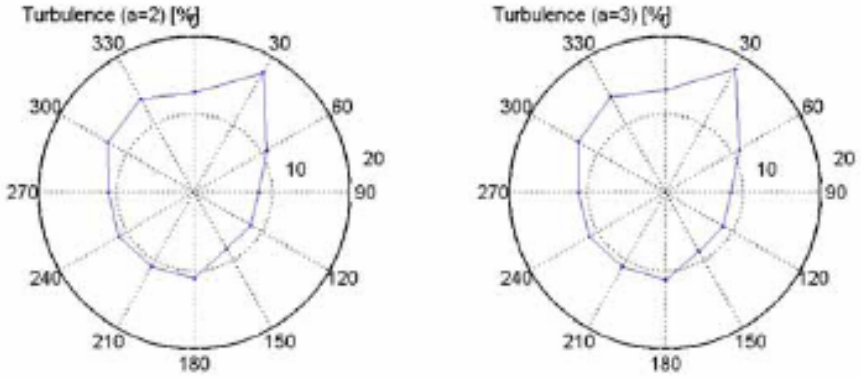
ECN test site Wieringermeer

- Analysis of 2 years met mast data (met mast 1&3)
  - Main wind direction at 71,6 m: SW
  - Most frequent wind speed at 71,6 m: 7 m/s
  - Maximum turbulence intensity at 80 m: NE

MM1: H=71.6 m, June 2003-May 2005

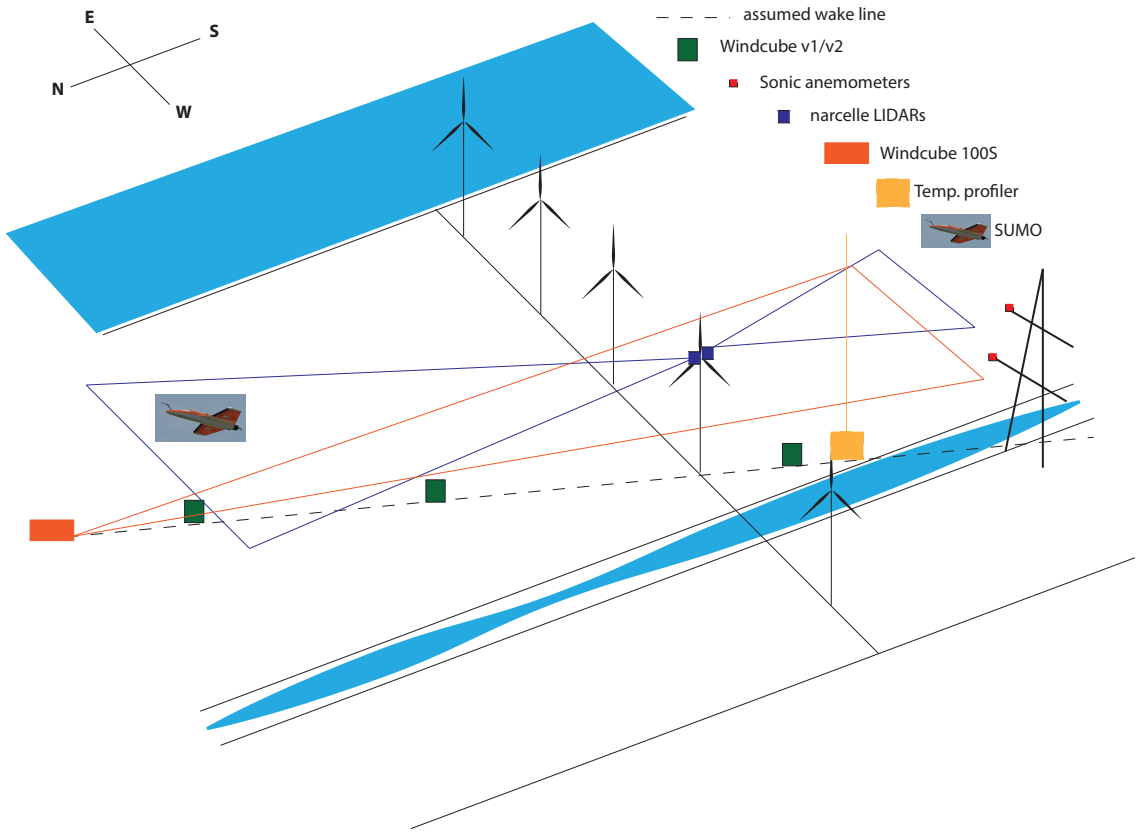


MM 3:H=80m, Turb. Int. according to IEC 61400-1



Campaign setup

- Additional measurement equipment aligned in the main wind direction (210°)
  - 1x Windcube 100s
  - 3x Windcube v1
  - 1x Windcube v2
  - 1x Zephir DM
  - 1x SUMO



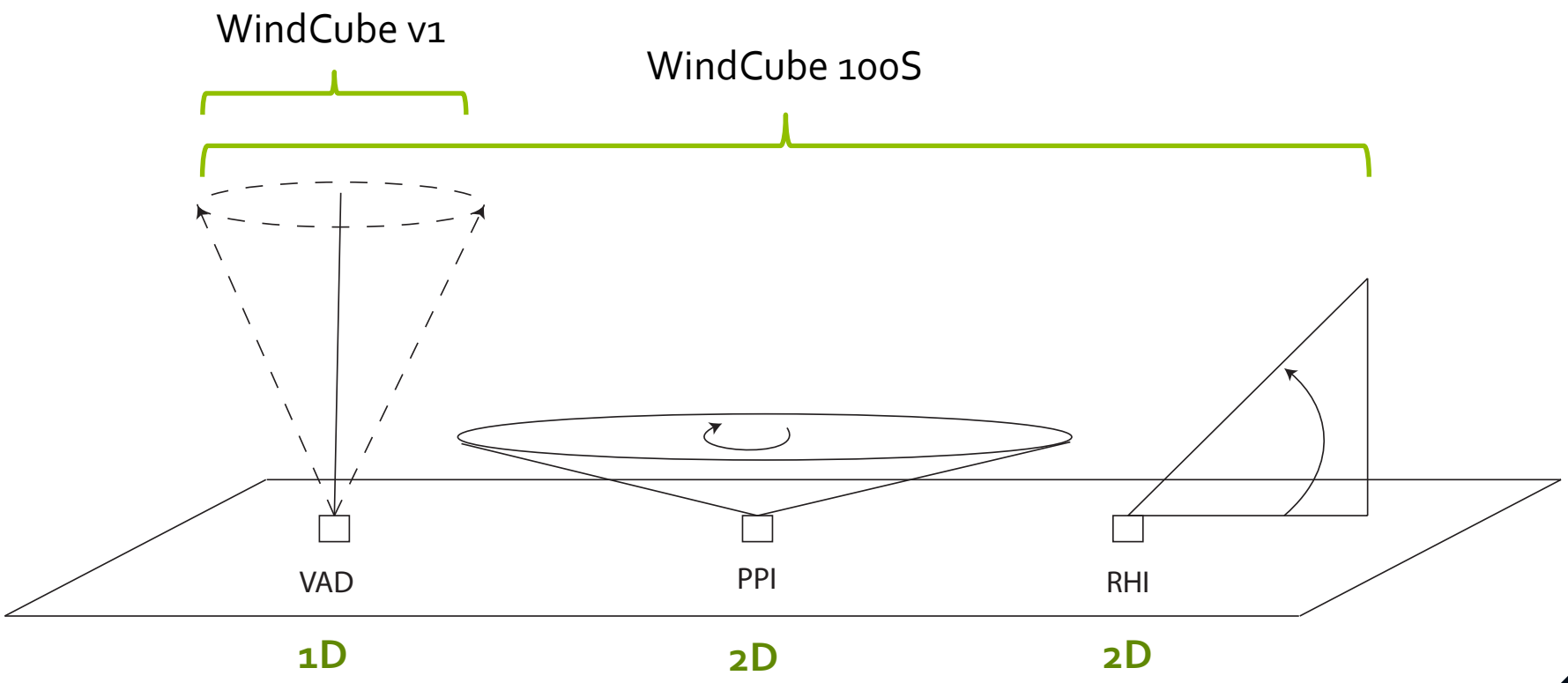
Campaign setup

- WindCube v1

Performances	
Range	40 – 200 m
Probe length	20 m
Data sampling rate	4s
Scanning cone angle	30°

Campaign setup

- Measurement Methods



Campaign setup

- WindCube 100S

Performances	
Range	100 – 3500 m
Probe length	50 m
Data sampling rate	1s / deg
Azimuth angle	0˚ - 360˚
Elevation angle	-10˚ - 190˚

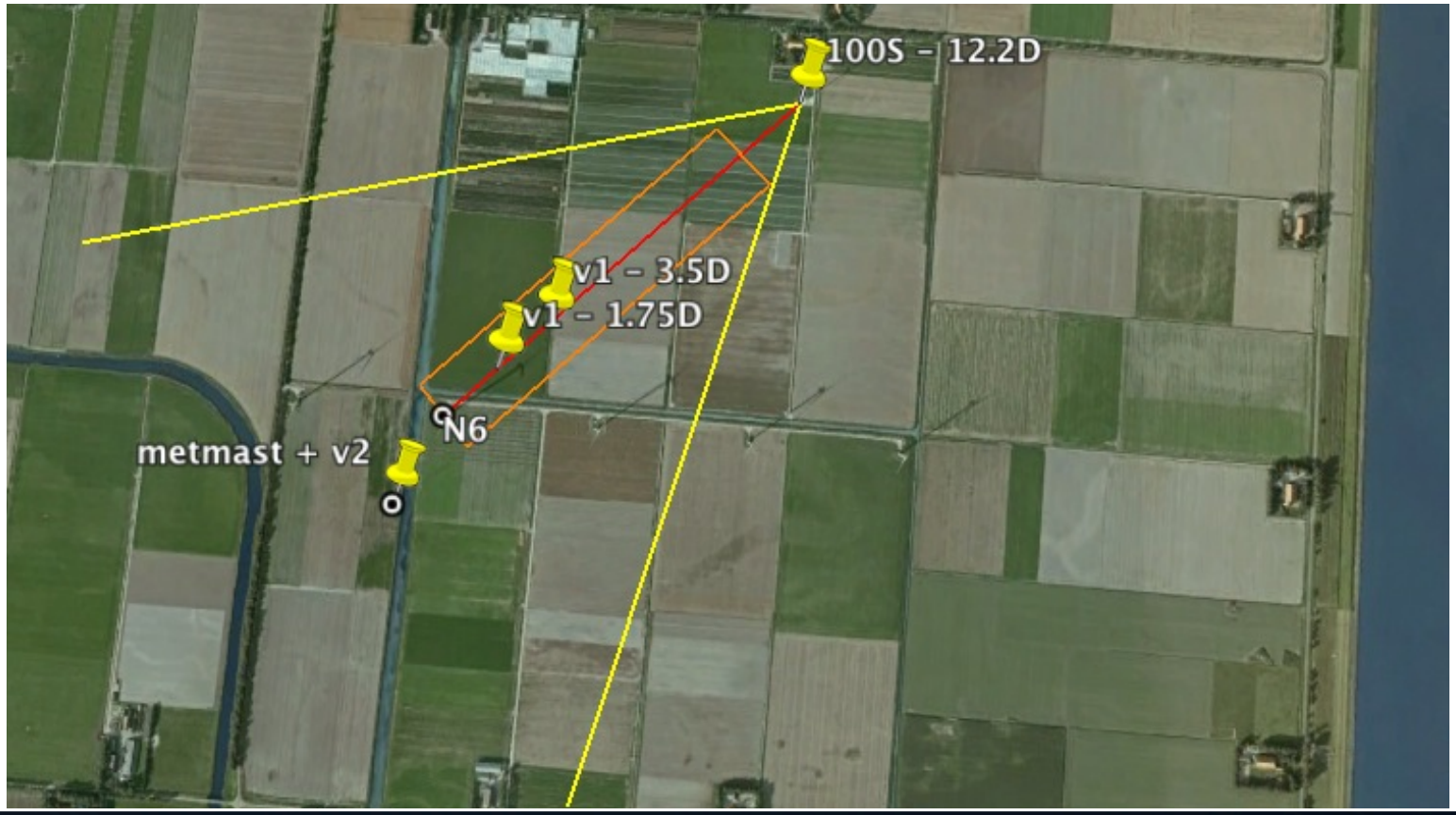
Campaign Setup

- Rotor diameter (D): 80 m
- Distance: 973 m (12.2 D)
- Area of interest: 2D x 10D

Type	Azimuth	Elevation	Speed	Duration
PPI	198° - 258°	2.4°	6°/sec	10 sec
PPI	258° - 198°	4.7°	6°/sec	10 sec
PPI	198° - 258°	7.1°	6°/sec	10 sec
RHI	228°	60° - 0°	6°/sec	10 sec
RHI	228°	0° - 60°	6°/sec	10 sec
RHI	228°	60° - 0°	6°/sec	10 sec
Sampling rate:				1 min

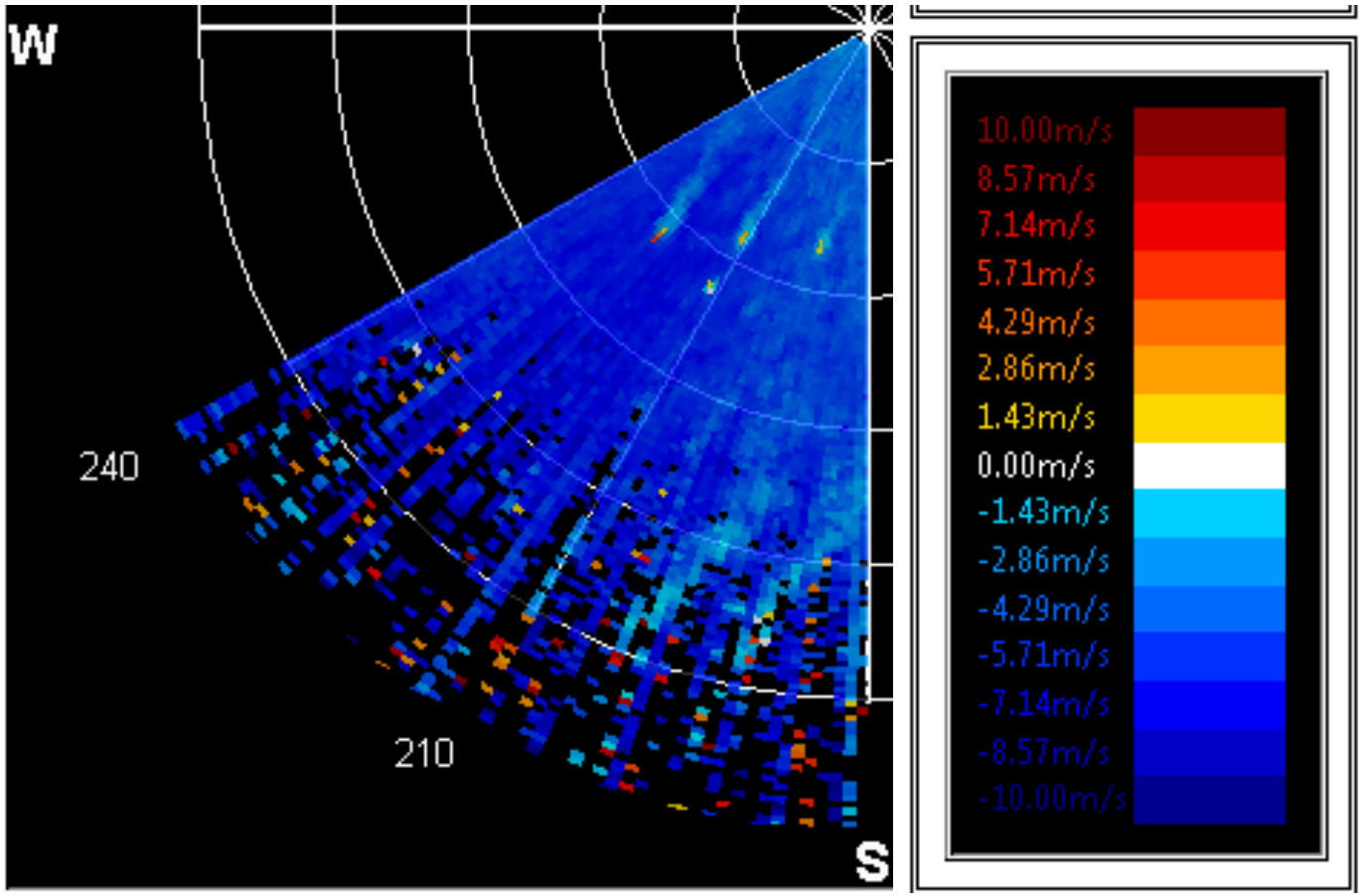
Campaign Setup

- New scan setup



First picture

- 60° PPI at 3° elevation with a scan speed of 6°/sec
- 1st row wakes of 3 Nordex research turbines
- 2nd row wakes of prototypes



Outlook

- Planed duration of the campaign
  - November 2013 – April 2014
- Research aims
  - Test of WLS100S performance for wake measurements
  - Tests of different scan patterns for wake studies
  - Investigations of wake characteristics
    - Extension and persistency for different weather conditions
    - Meandering
  - Model validation studies