

Measurement campaign in flat terrain, Nørrekær Enge, June- December 2015



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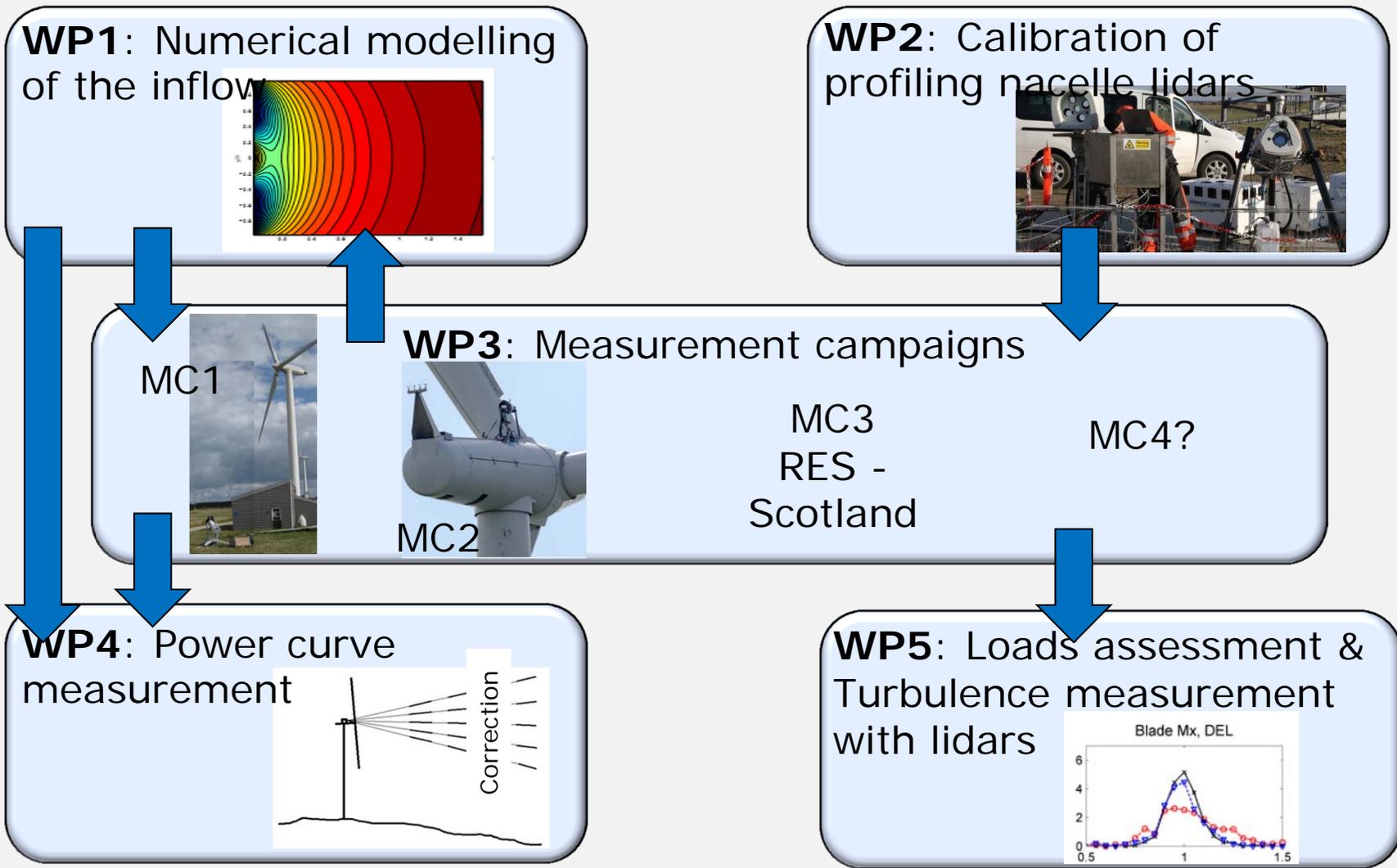


DTU Wind Energy
Department of Wind Energy

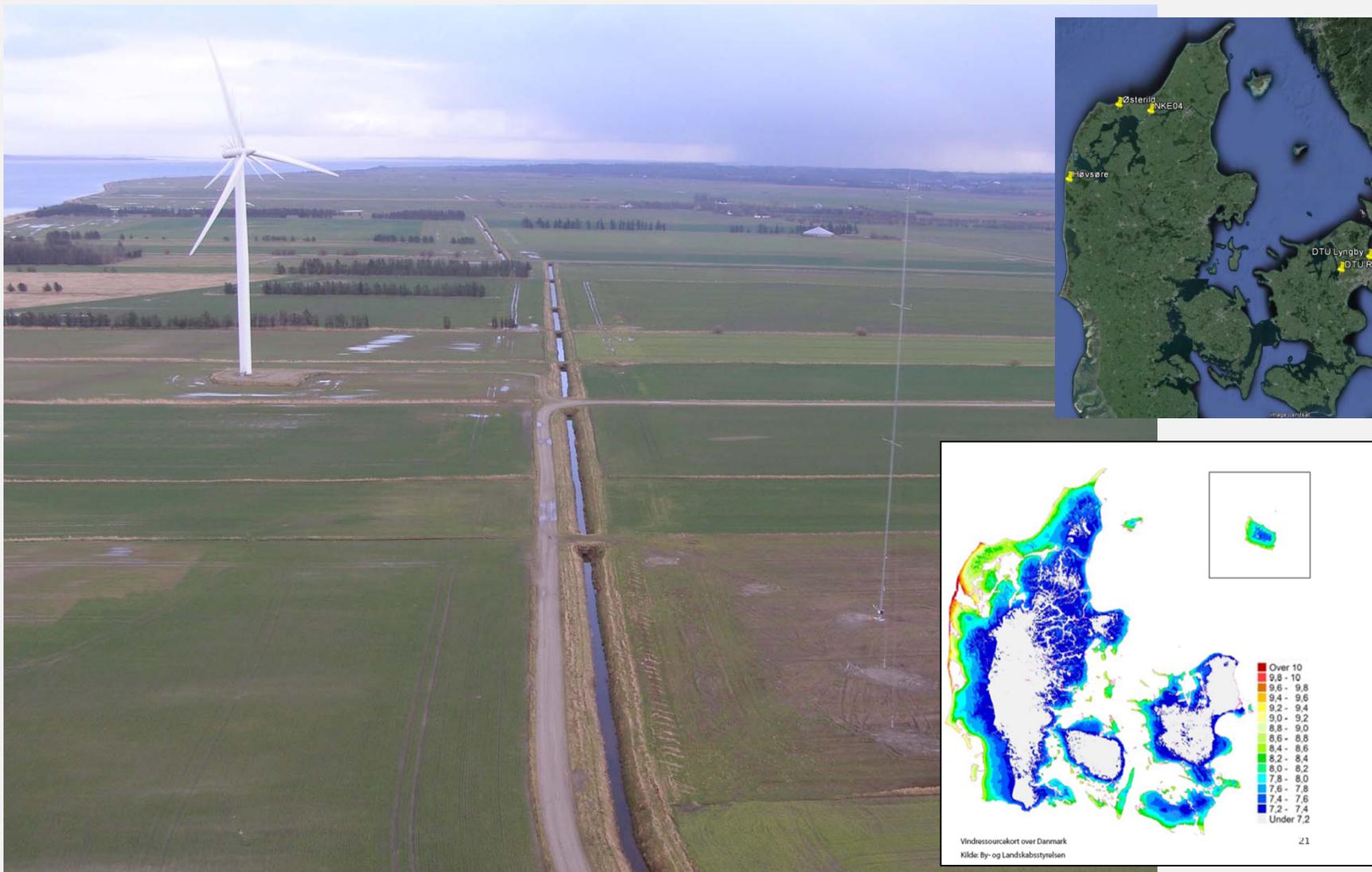


project UniTTe www.unitte.dk

Work Package 3: Interaction with other WPs



Unitte WP3 - MC2: *Nørrekær Enge*



Description

- **Baseline campaign of UniTTe**
 - Flat terrain, onshore
 - 13 Siemens 2.3 MW turbines
 - Period: 1st June 2015 to 19th Jan. 2016
 - More than 7 months
 - Data: ~30k * 10min periods
 - Instrumentation
 - + met. mast
 - + turbine 04 with scada, loads, etc
 - 2 nacelle lidars:
 - Avent 5B & Zephir DM
 - spinner anemometer
 - (other project)

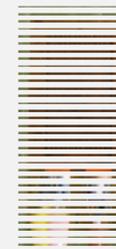


Unitte WP3 - MC2: *Nørrekær Enge*

Turbine Measurement Equipment:

- Strain Gauges (Brand: Micro-Measurements)
- SG Amplifiers (4 Wheatstone bridge per amp., V/V -> V)
- DAU - Data Acquisition Unit (DAU)
 - 16 analogue inputs -5V..+5V -> 0..65536 [digits]
 - 6 digital inputs (used for e.g. wind speed)
 - 35 Hz sampling rate (anti aliasing filter: 12.8 Hz , -3 dB)
- Daqwin - Sampling software at PC
- Communication - network (udp)
- Encoder for Yaw position
- Power transducer + CT's

Measurement system including calibrations will be documented in a *Measurement System & Calibration report*



Unitte WP3 - MC2: *Nørrekær Enge*

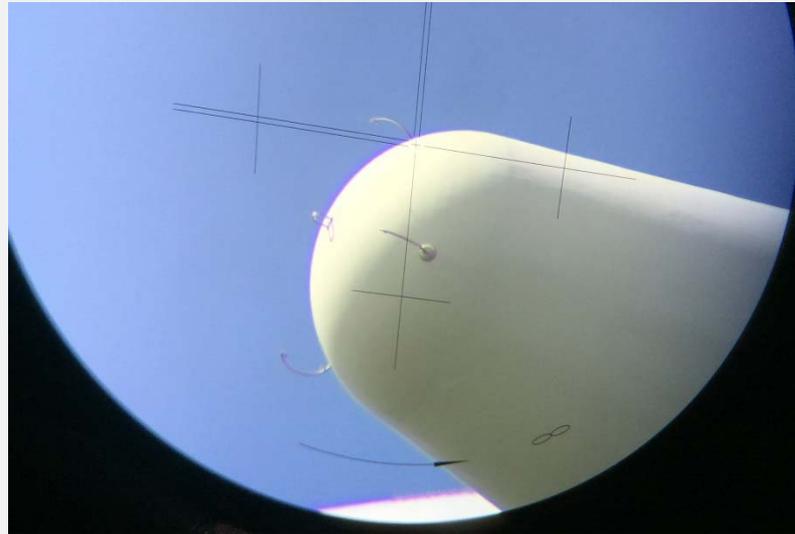
Sensors in Turbine measurement system (measured):

- Flap and edge wise bending moment in 2 blade roots
- Tower top bending and torsional moments
- Tower bottom bending
- 3 axial accelerometer in nacelle
- Power
- Yaw direction
- ROMO Spinner anemometer (wind speed, yaw error, rotor pos.)
- Data from turbine controller e.g. operational status, pitch angels, rotor azimuth pos. and generator RPM.

Post processed (at time series level):

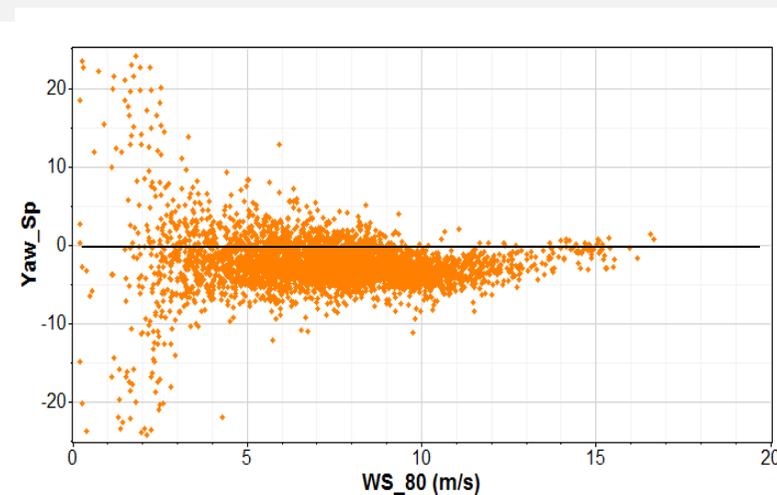
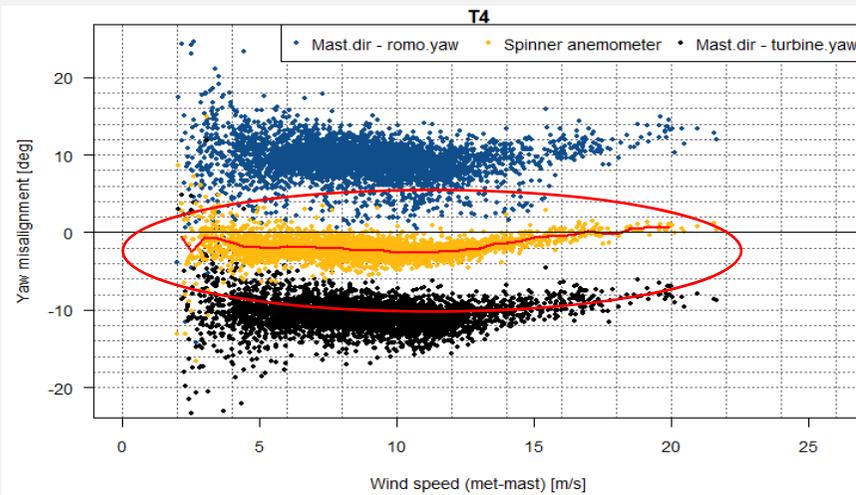
- Calibrated loads [kNm]
- Down wind and lateral bending moments in tower
- Thrust, C_t

Spinner anemometer



Before campaign

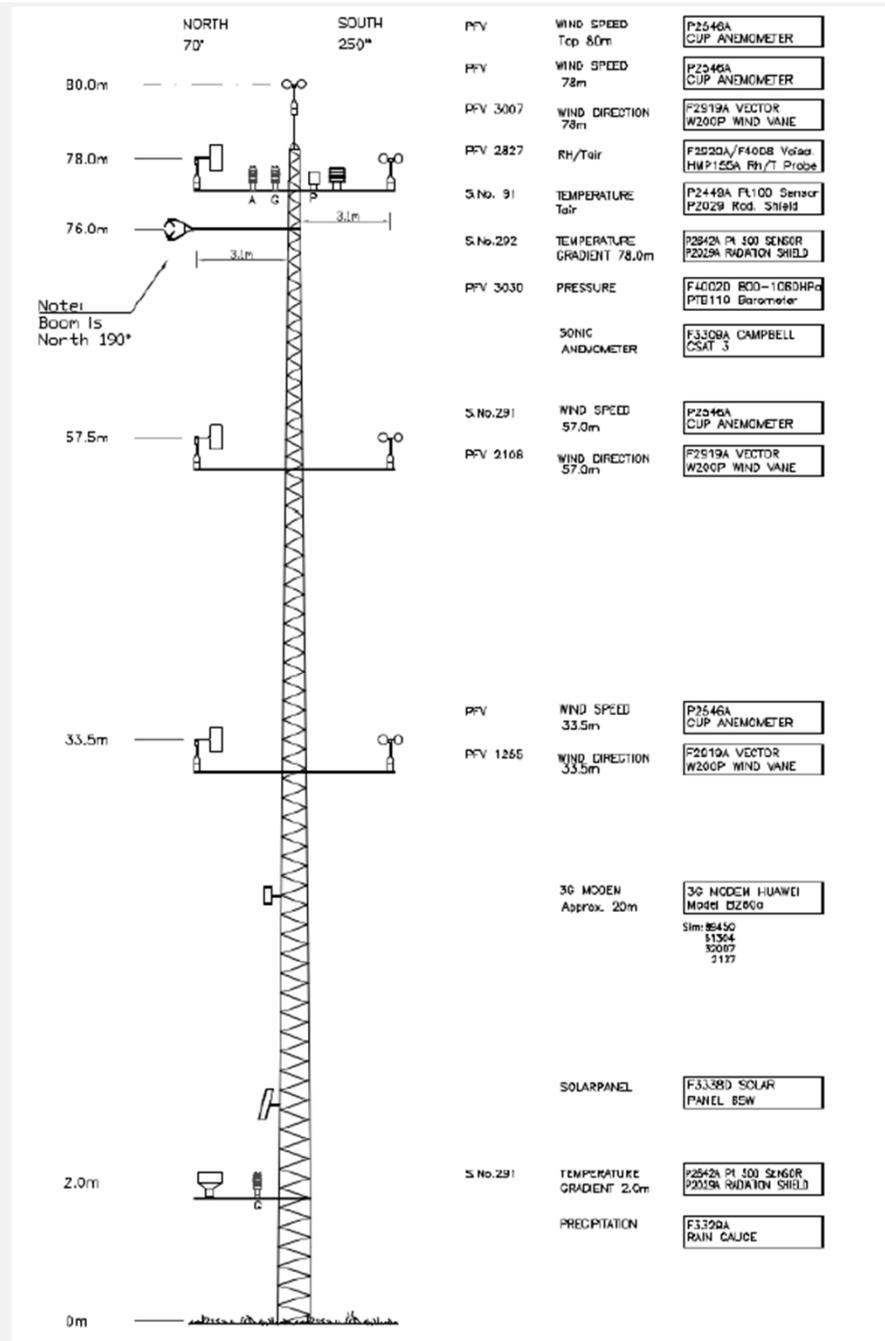
After



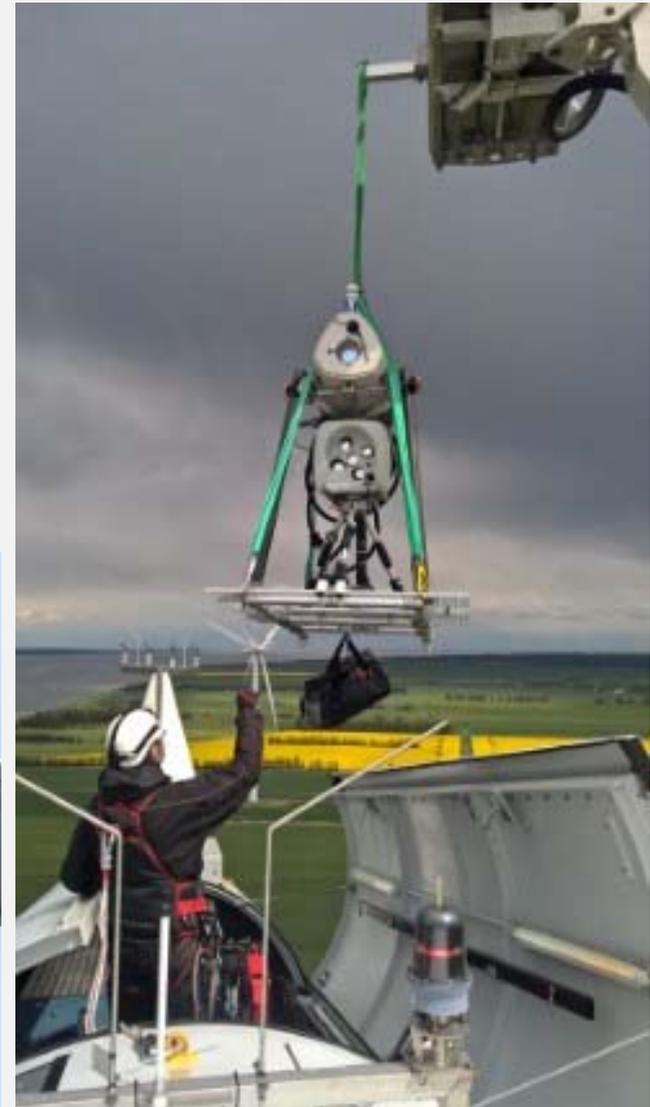
Met mast



- 2.5D - Hub height
- Wind speed, direction, pressure, temperature measurements
- Cups, vanes and 1 sonic
- Campbell datalogger



MC2 – Nørrekær Enge



The Avent 5-beam (5B) and ZephIR Dual Mode (ZDM) lidars



- **Two profiling nacelle lidars**

- i.e. able to measure at several heights

- actual NKE setup:

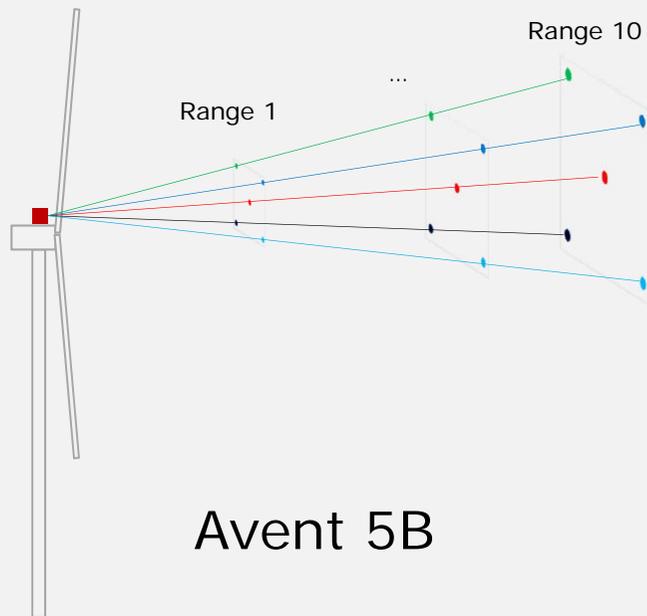
- 1 LOS /sec * 10 ranges

- 0.5D to 3D

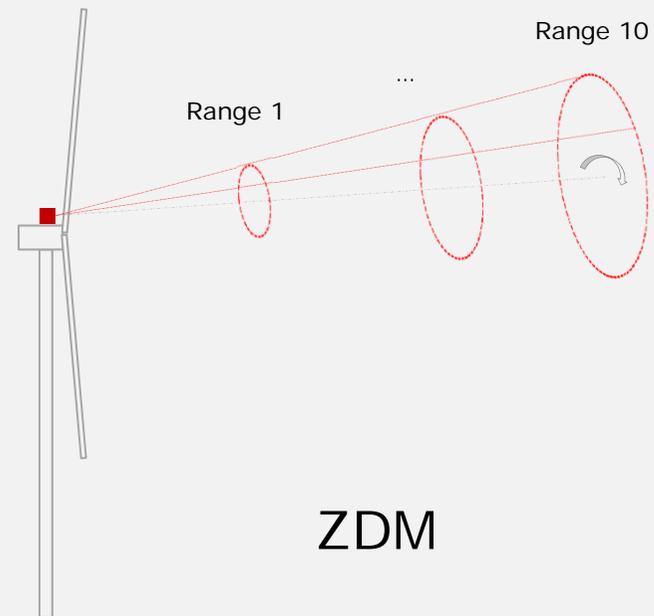
- 5 successive ranges

- 0.1D; 0.3D; 1D; 1.3D; 2.5D

- ~50Hz LOS velocities

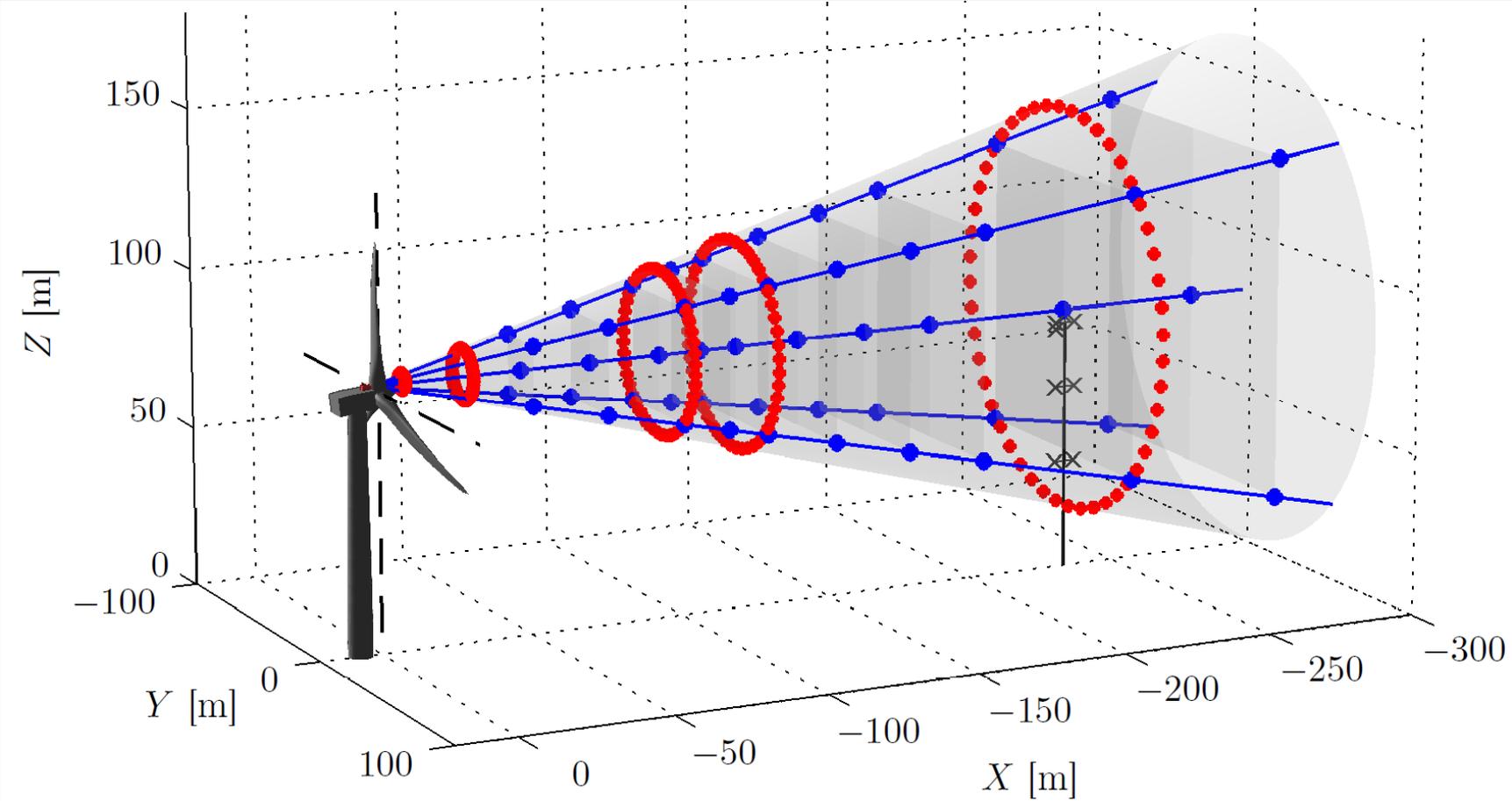


Avent 5B



ZDM

The Avent 5-beam (5B) and ZephIR Dual Mode (ZDM) lidars



Data access

Measurements available in internal and external database (with custom access rights)

	DTU	Vattenfall	Siemens	Avent	ZephIR
Turbine				 Except blade pitch and rotor position	 Except blade pitch and rotor position
Mast					
5 Beams Lidar					
ZDM					
Spinner Anemo					

Questions?