

**INTERNOISE 2014**

**16 – 19 November in Melbourne, Australia**

**Wind Turbine Noise Measurements – How are Results influenced by different Methods of deriving Wind Speeds?**

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# Before the Wind Farm is being built

- Noise limits (in the UK) are set relative to a wind speed (usually either measured at 10 m or 'standardised' to 10 m height when wind speed measurements carried out at/near hub height)
- Based on the assumption that background noise increases with wind speed
- Thus noise limits are set relative to increasing background noise level (prevailing BG level + 5 dB where this is higher than the lower fixed noise limits)
- Mandatory to measure wind speed synchronised to the background noise survey unless a flat 'simplified' noise limit of 35 dB  $L_{A90}$  is applied at all wind speeds.



# After the Wind Farm has been built

- Residential noise measurements near operational wind farms/turbine
  - to investigate noise complaints
  - to show compliance with planning conditions (where noise limits are set relative to wind speeds)
- Aim is to reproduce site conditions before WF has been built, usually single point of WS measurements within WF site
- Get as close to original measurements within given possibilities on site



# Possible Situations

- Noise limits re measured 10 m height -> install 10 m met mast for wind measurement = directly comparable
  - Possible issue: no 10 m mast installed but only turbine data available (i.e. Hub height wind speed)
- Height for speed measurements not specified in planning conditions
  - Do 'detective work' to find out at which height wind speed had been measured for Planning Application OR agree height with Planning Officer



# Possible Situations (cont.)

- Noise limits re ‘standardised’ 10 m wind speed (i.e. wind speed at hub height extrapolated to 10 m height)
  - Hub height wind speed measured for noise assessment, either met mast or stand-alone device
  - If available, should the met mast be used for compliance?
  - If no met mast on site, should nacelle anemometer be used, or a power curve derived wind speed (supplemented by nacelle anemometer)



# Wind Speed Measurements

- Tall meteorological mast (anemometer at hub height or two heights to calculate hub height wind speed)
- SoDAR/LiDAR
- Power curve derived hub height wind speed
- Nacelle anemometer
- 10 m high meteorological mast



# Project

- Five wind farms with wind turbines from three different manufacturers
- Number of wind turbines ranging from three to ten, hub heights from 50 m to 80 m and rated power from 800 kW to 2 MW
- Tall meteorological mast at three WFs, 10 m mast at two WFs, SoDAR at one WF
- Only night-time assessed



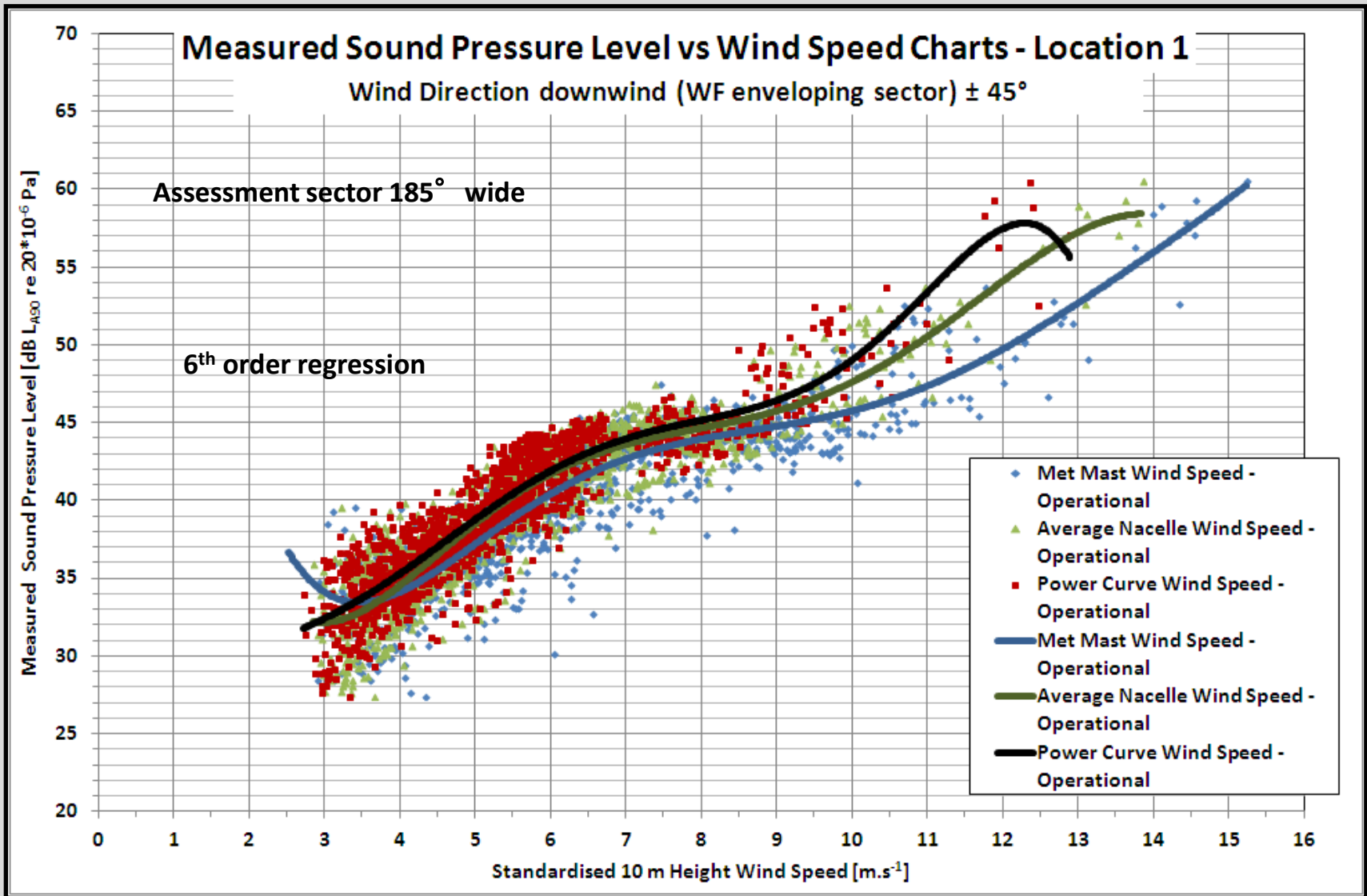
# Wind Farms

Wind Farm #	No. of WT	Hub Height [m]	Distance Measurement Location to nearest Turbine(s) [m]	Met Mast Anemometer Height(s)
1	10	80	640 and 780	79
2	5	60	670 and 790	2x 60 1x 40 1x 10
3	9	80	400 and 485	10
4	3	50	735	2x 50 SoDAR at 50 m

Fifth wind farm excluded from further assessment due to insufficient data at higher wind speeds.



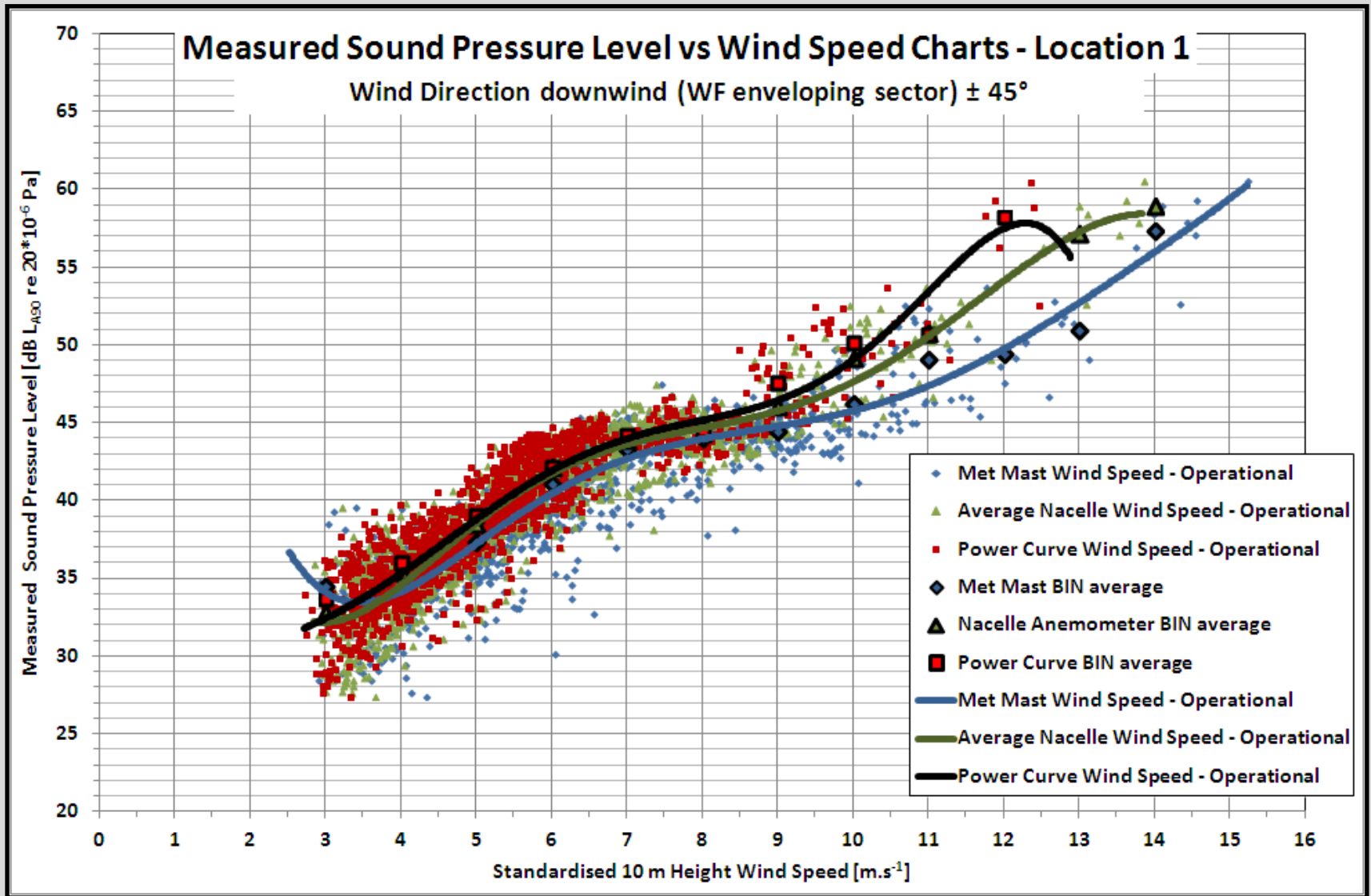
# Wind Farm 1



Wind speed: met mast measurement at hub height; average nacelle anemometers and average power curve derived wind speed



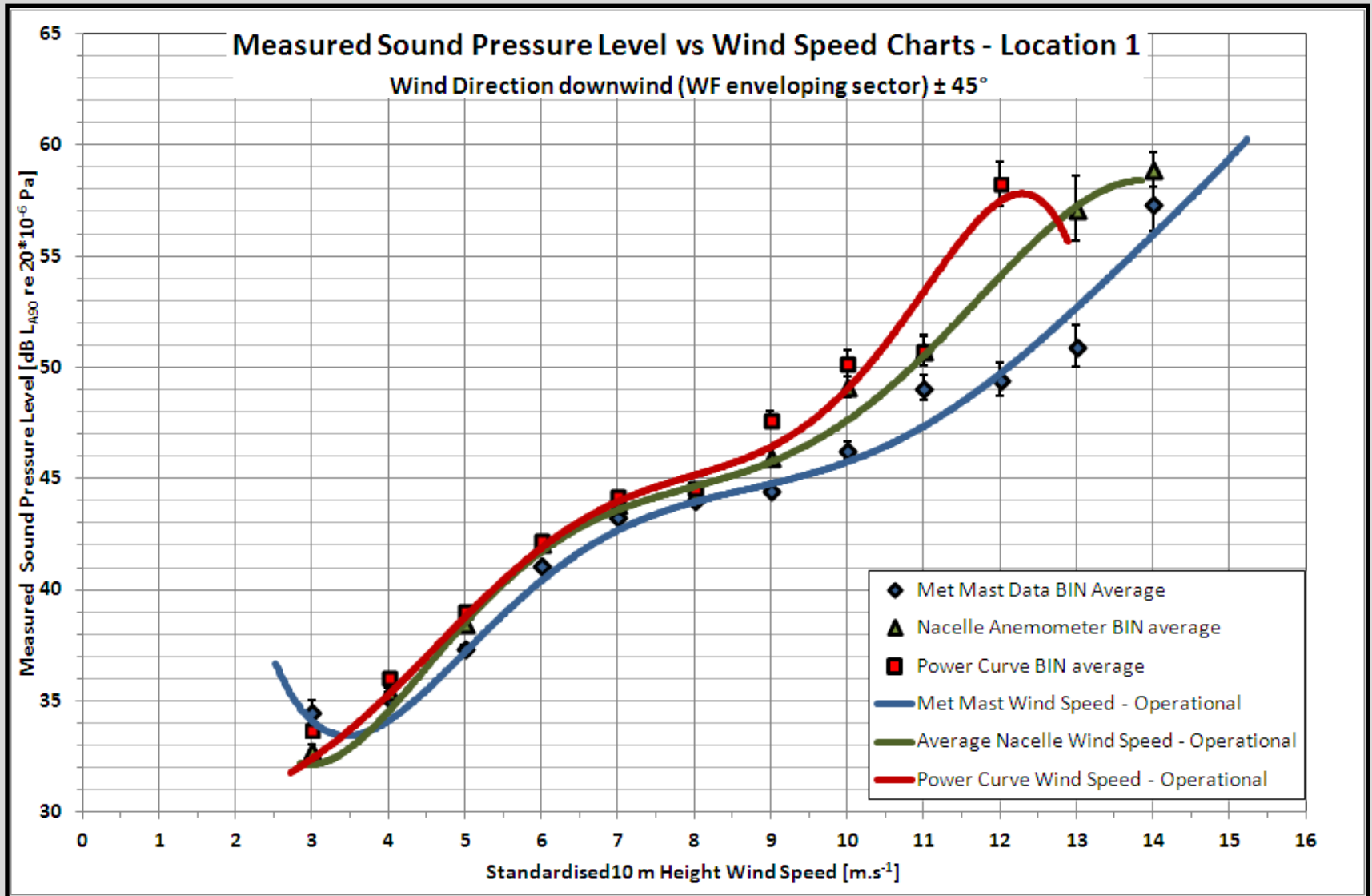
# Wind Farm 1



Wind speed: met mast measurement at hub height; average nacelle anemometers and average power curve derived wind speed



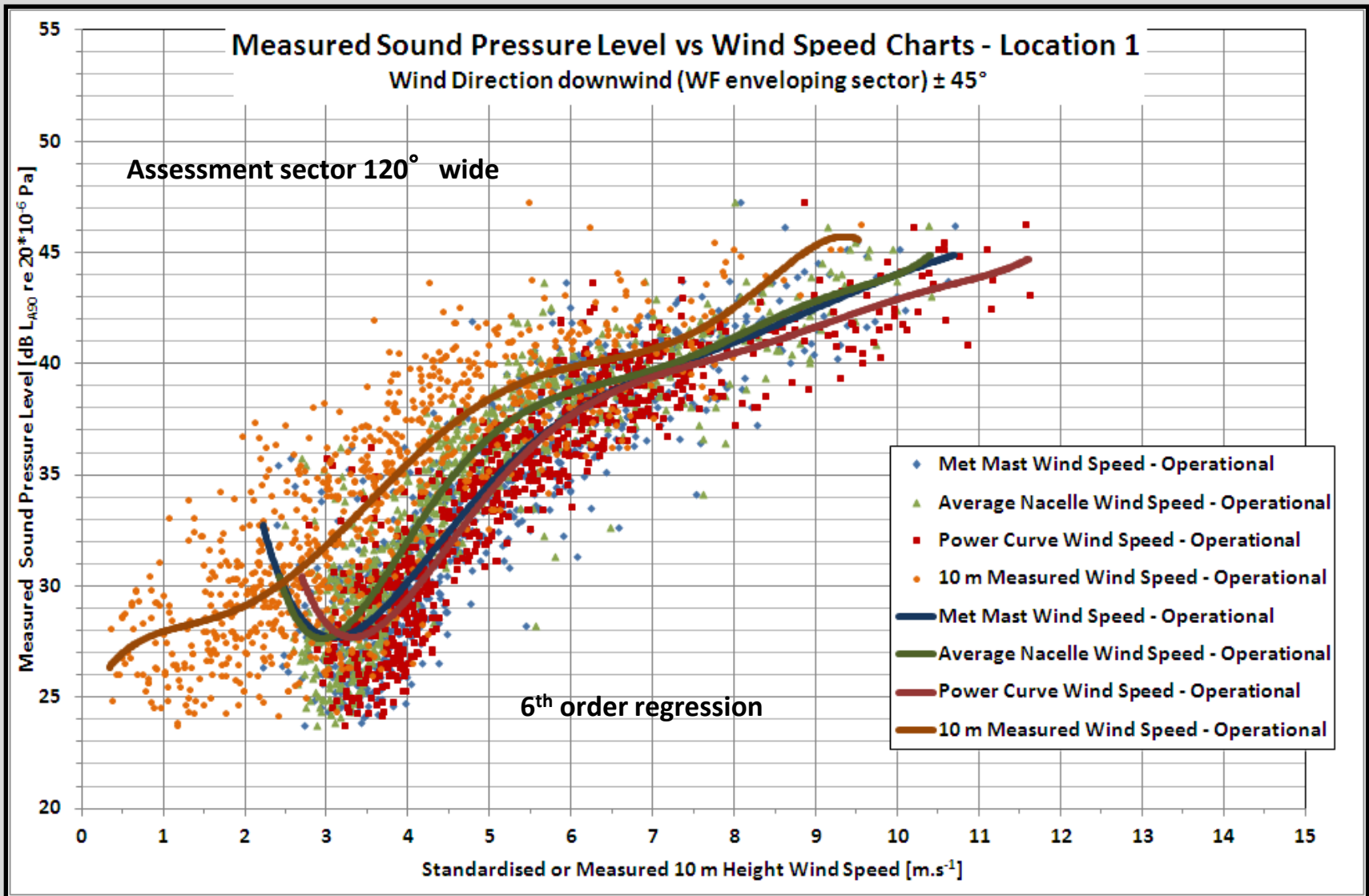
# Wind Farm 1



Wind speed: met mast measurement at hub height; average nacelle anemometers and average power curve derived wind speed



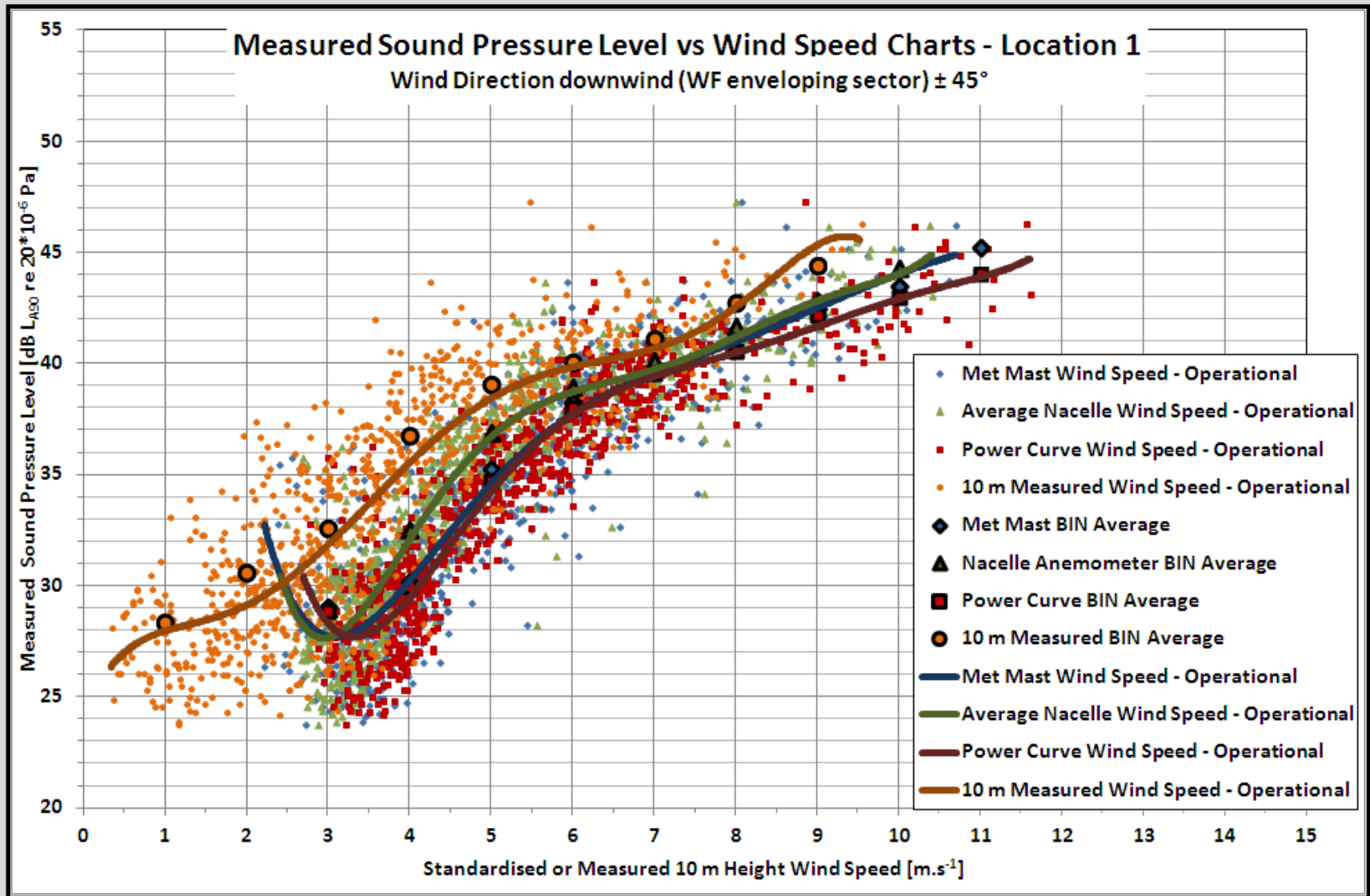
# Wind Farm 2



Wind speed: met mast measurement at hub height; average nacelle anemometers, average power curve derived wind speed and measurements at 10 m height



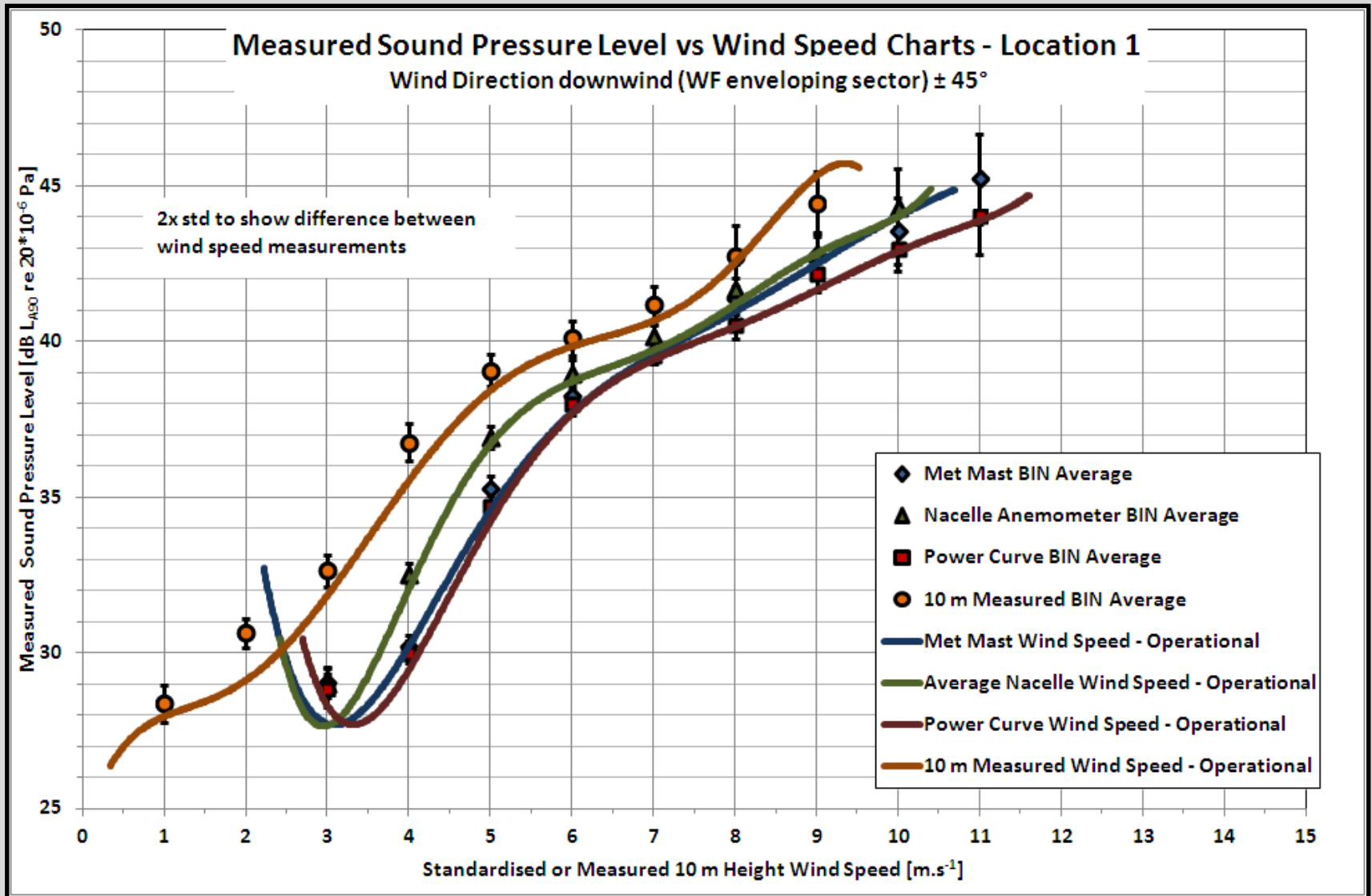
# Wind Farm 2



Wind speed: met mast measurement at hub height; average nacelle anemometers, average power curve derived wind speed and measurements at 10 m height



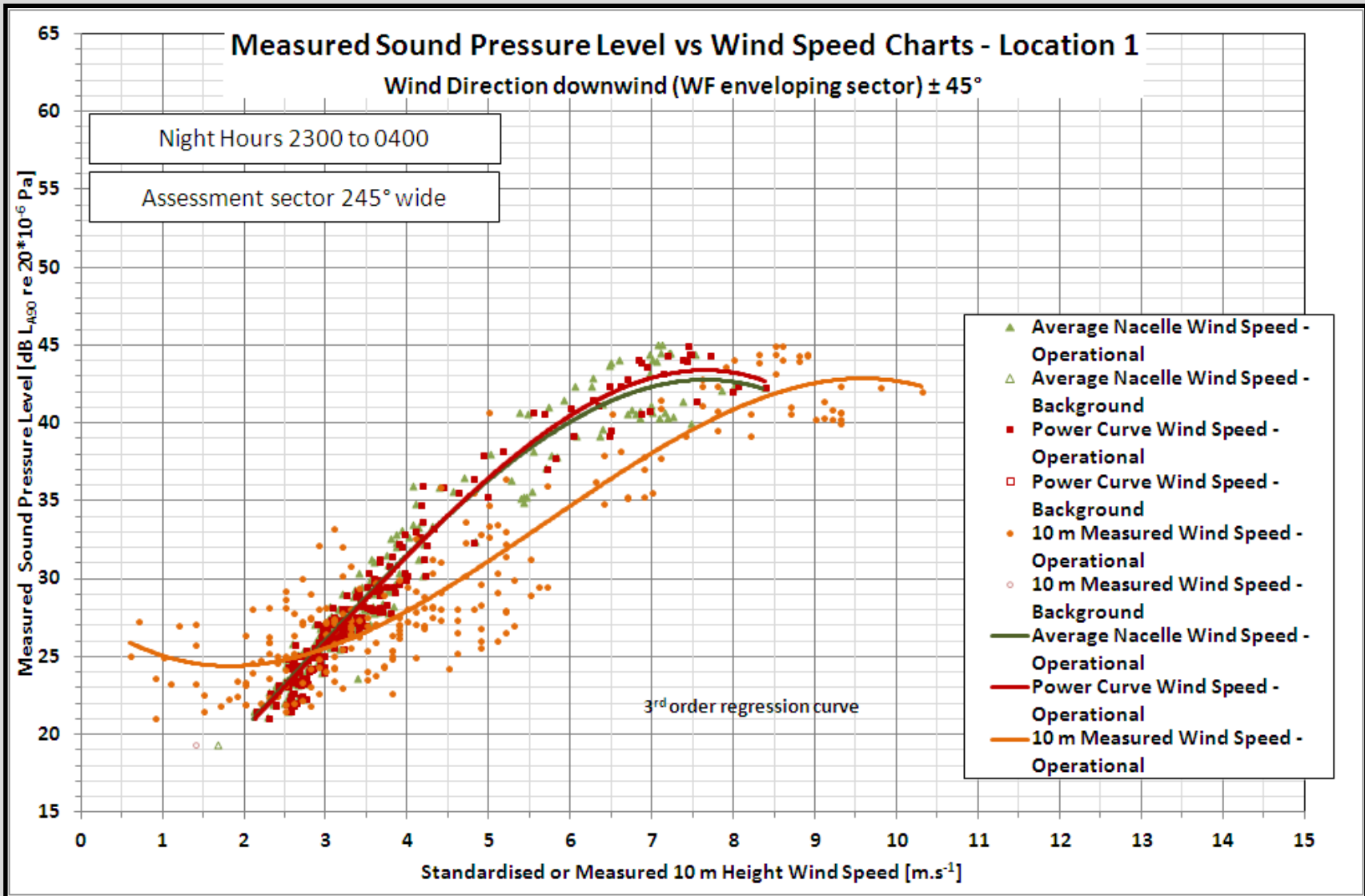
# Wind Farm 2



Wind speed: met mast measurement at hub height; average nacelle anemometers, average power curve derived wind speed and measurements at 10 m height



# Wind Farm 3

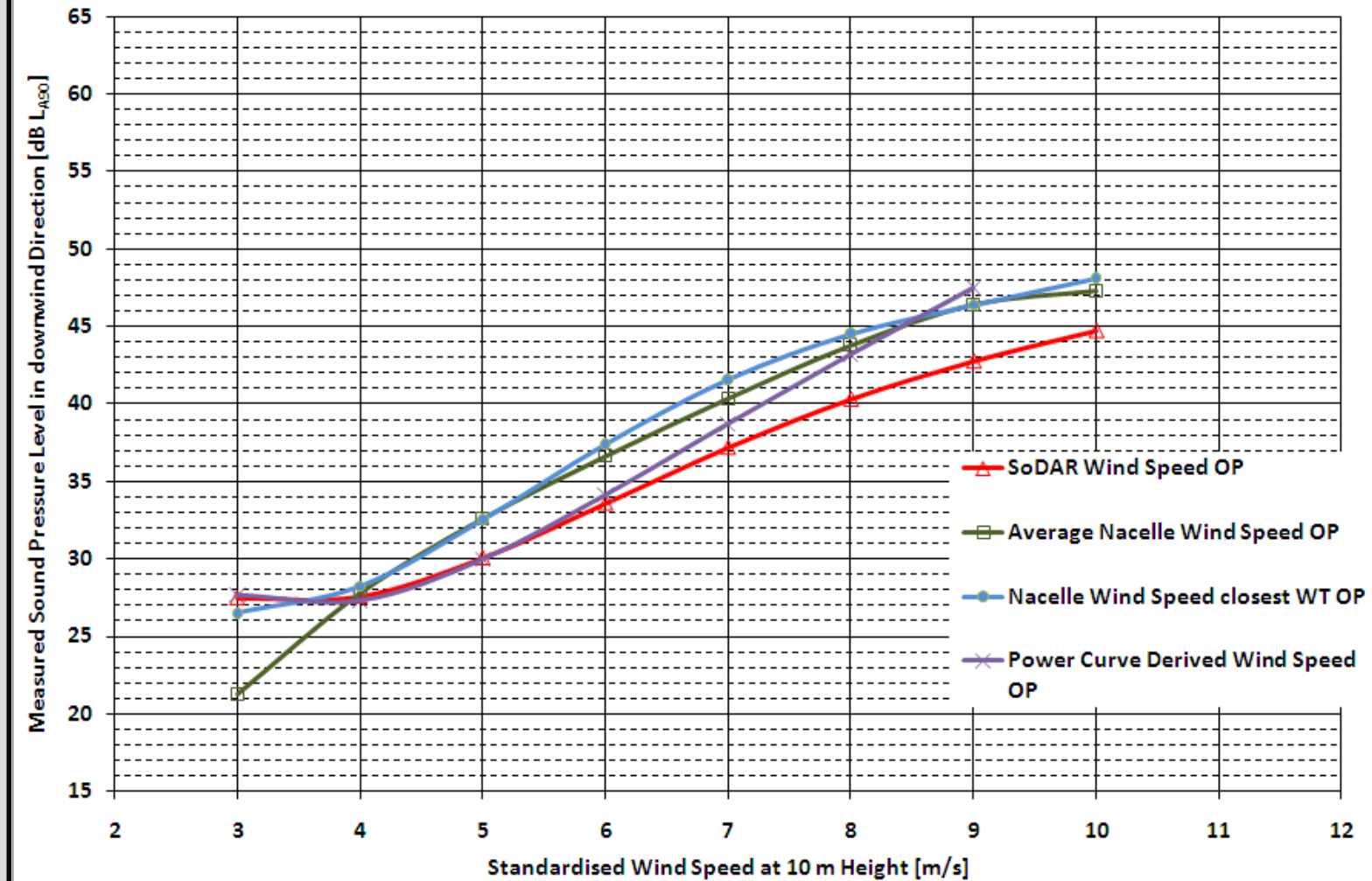


Wind speed: average nacelle anemometers, average power curve derived wind speed and measurements at 10 m height only



# Wind Farm 4

Sound Pressure Level against Wind Speed derived from different Sources





Thank you for your attention.

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# **WIND TURBINE NOISE 2015**

## **INCE/EUROPE**

Date: Monday 20th April to Thursday 23rd April 2015

Venue: Radisson Blu Hotel, Glasgow, Scotland

The 2015 Wind Turbine Noise conference will be held in Glasgow. It is Scotland's largest city and a wonderful mixture of ancient and modern.



# References (selection)

British Standards Institution: BS EN 61400-11:2013 Wind turbines – Part 11: Acoustic noise measurement techniques, 2013

<http://www.zephirlidar.com/image-gallery>, accessed 13/08/2013

Thanks go to

Tilly the Van

Nigel the Caravan

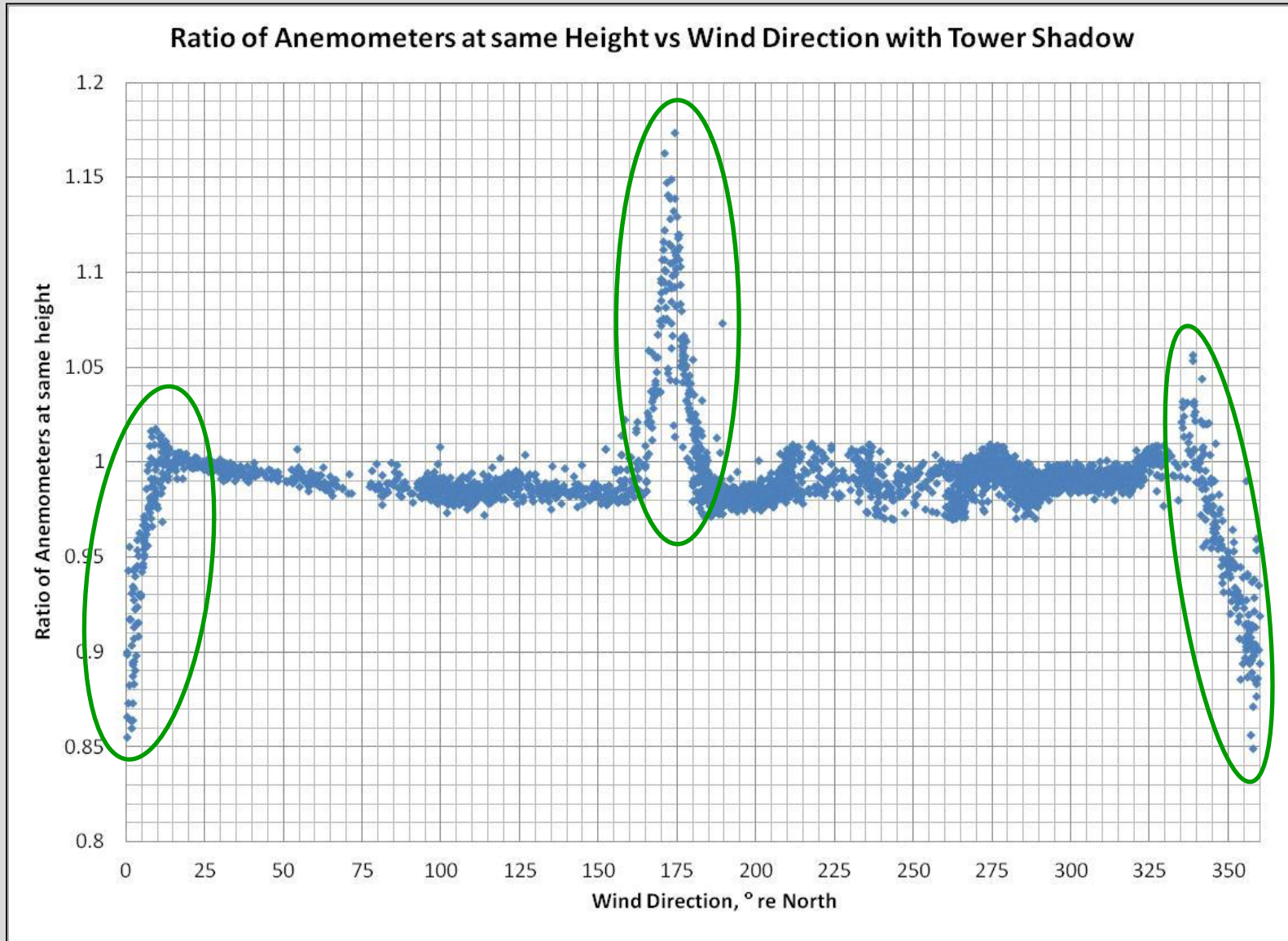
Woody the Dog

for featuring in some of the pictures.

All pictures apart from the ZePHIR one are taken by HMPL staff.



# Example of Tower Shadow Effect



# Example for Nacelle Anemometer vs. SoDAR

