

Low Frequency Noise and Other Stories

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BWEA 27 19th October 2005

Other Stories

- The “van den Berg” Effect
- 1st International Noise Conference on Wind Turbine Noise : 17 – 18th October 2005:
Berlin

What is Low Frequency Noise?

- Normal Hearing Range : 20 - 20 kHz
- Low Frequency Range : 20 - 160 (250) Hz
- Infrasound Range : < 20 Hz

Low Frequency Noise Study

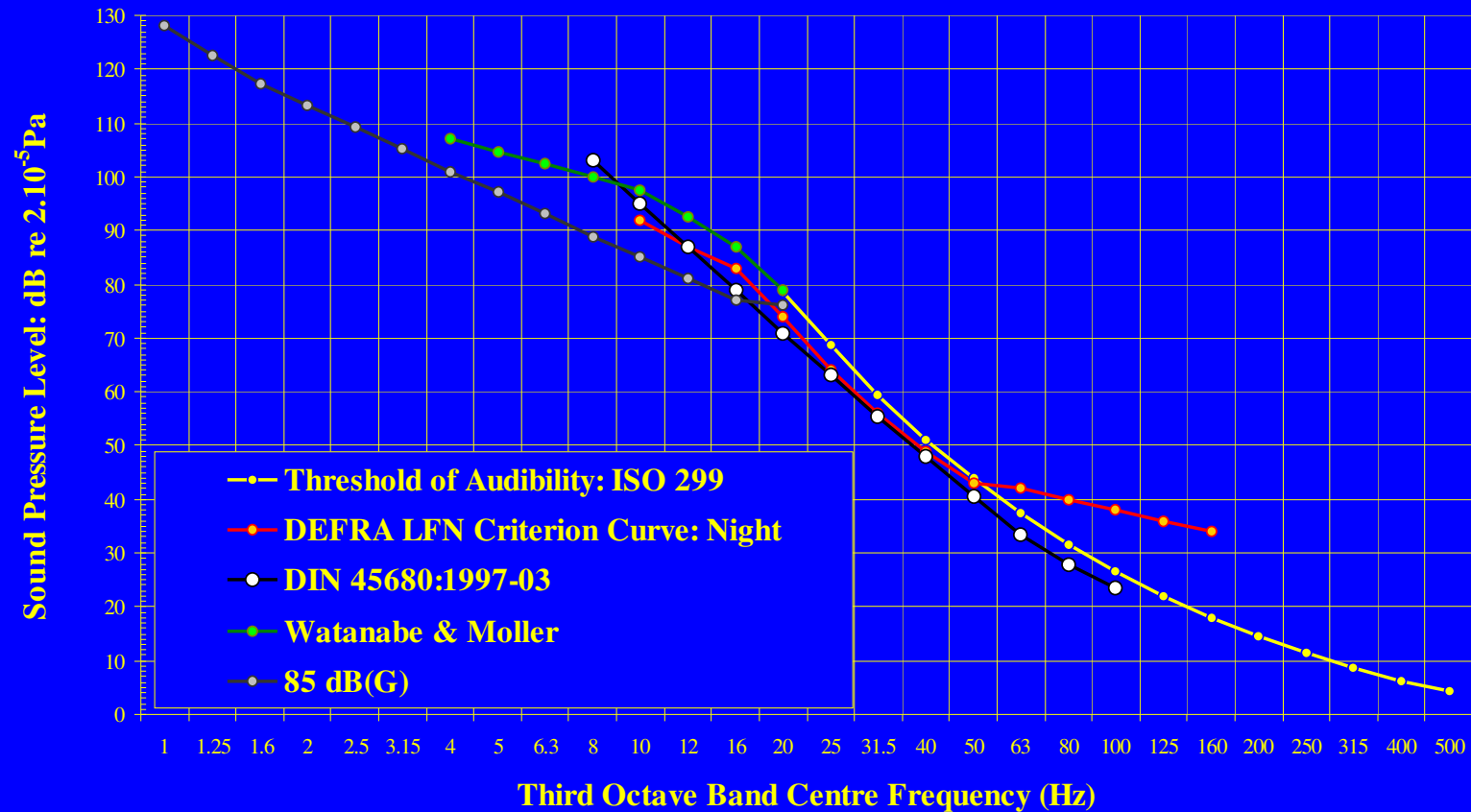
- To look at three sites in UK which have been reported in National Newspapers to be subject to high levels of low frequency noise;
- To undertake measurements at these sites to determine the level of exposure;
- To reported collected data for public dissemination

Assessment Methodology

- DEFRA Document: *Proposed criteria for assessment of low frequency noise disturbance*
- <http://www.defra.gov.uk/environment/noise/research/lowfrequency/index.htm>

Noise Criteria

Low Frequency Noise Criterion Curves



Where to Undertake Measurements

- Internally at location where noise experienced
- At a location which is worst-case, i.e. close to room boundaries
- Additional measurements of external noise at façade and in free-field conditions (ETSU-R-97 Location)

Accessing Measurement Locations

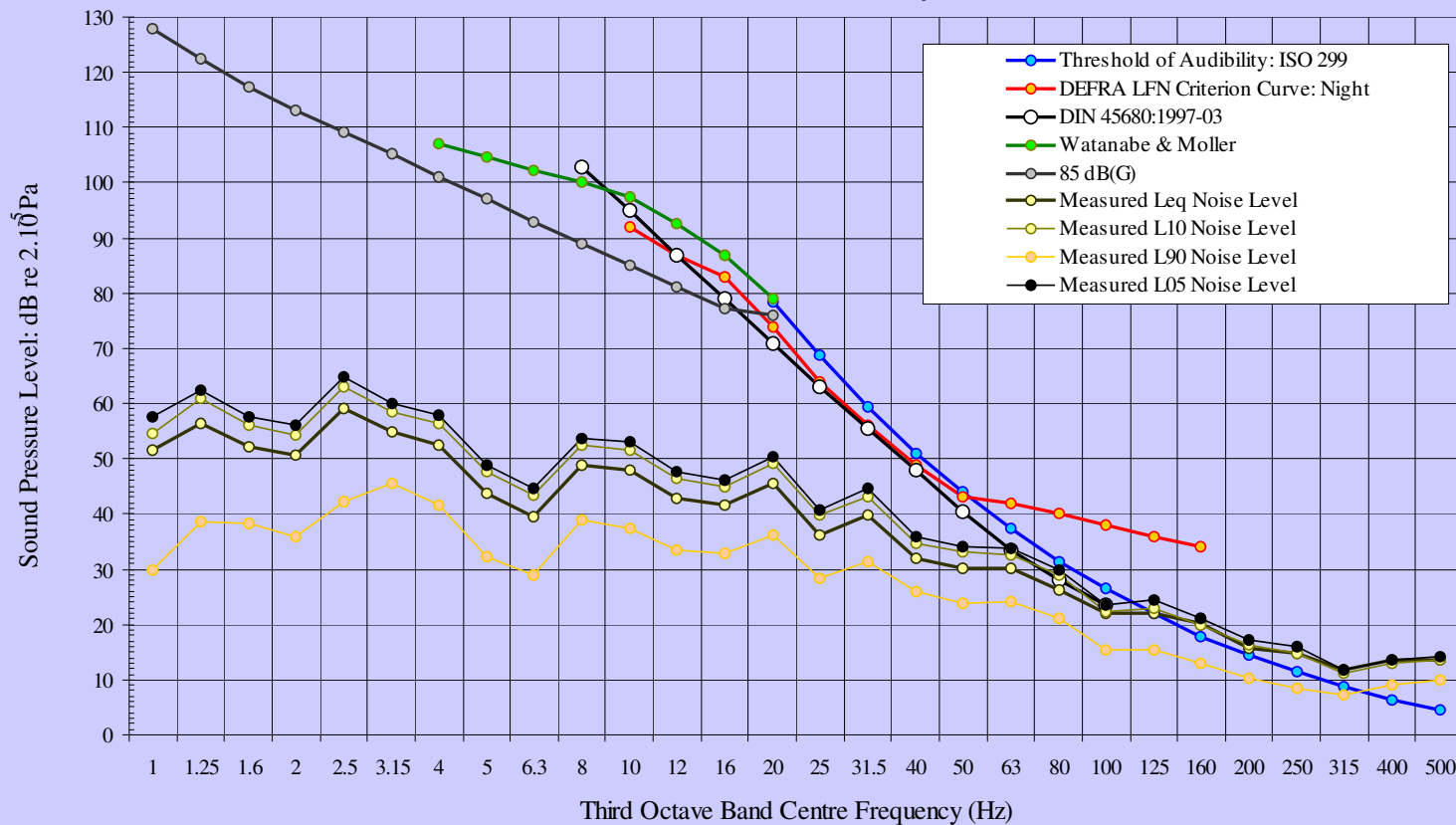
- Site 1: 2 Locations: 1 Measured
- Site 2: 2 Locations: None Measured
- Site 3: 1 Location: 1 Measured
- Site 4: 1 Location: Currently Monitoring

Reasons for No Measurements

- Availability of resident
- Changes in circumstances

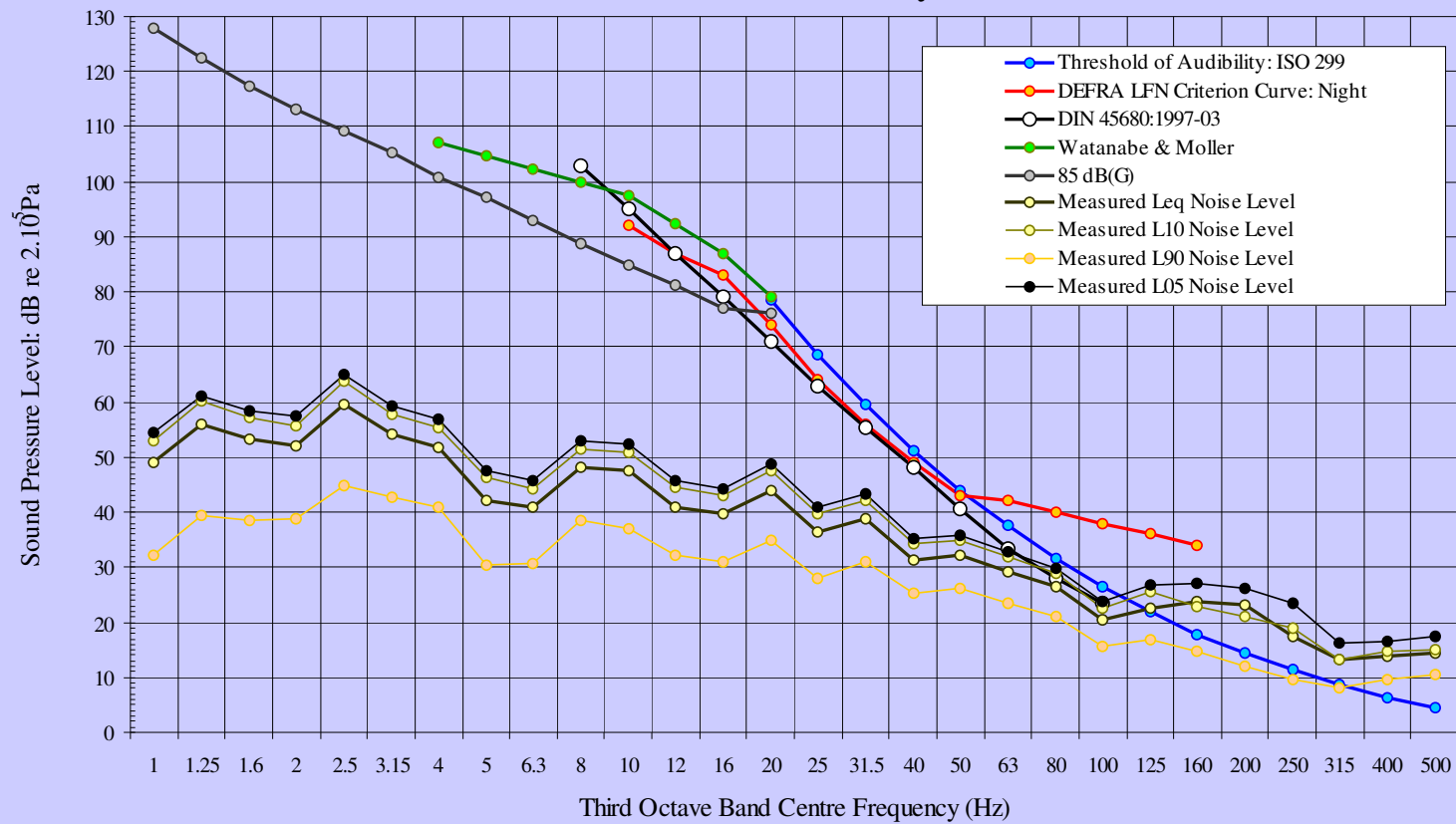
Site 1 Location 1

Low Frequency Noise Assessment
Location 1: 02:35 14th May 2005



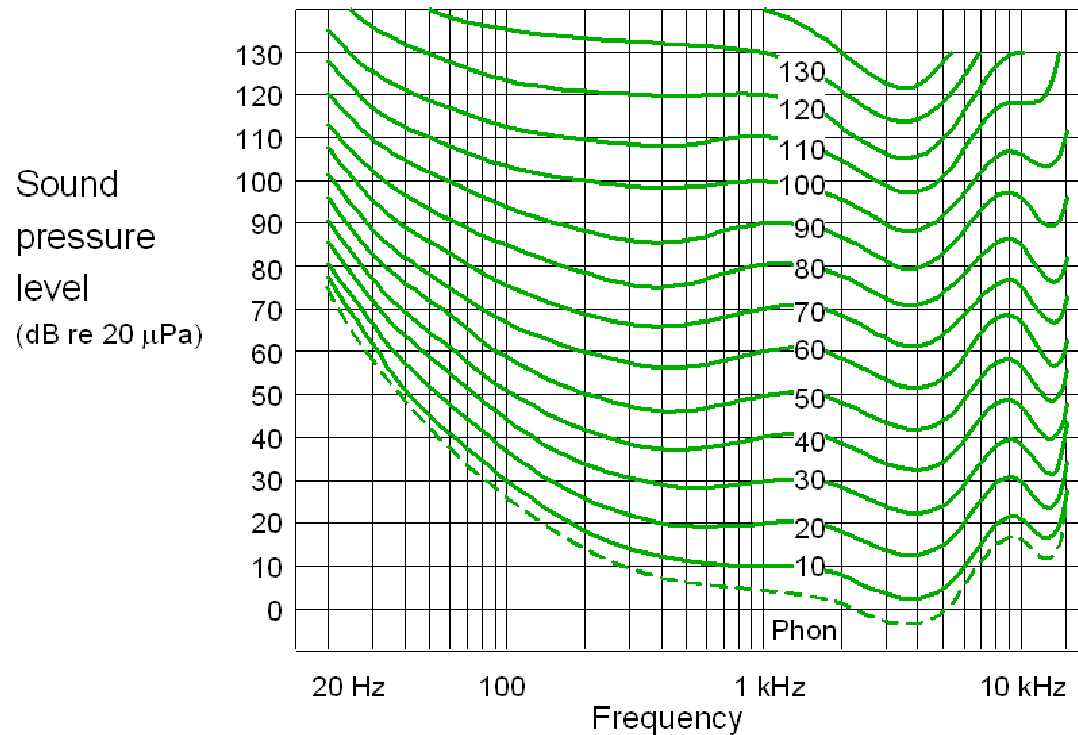
Site1 Location 1

Low Frequency Noise Assessment
Location 1: 03:10 14th May 2005



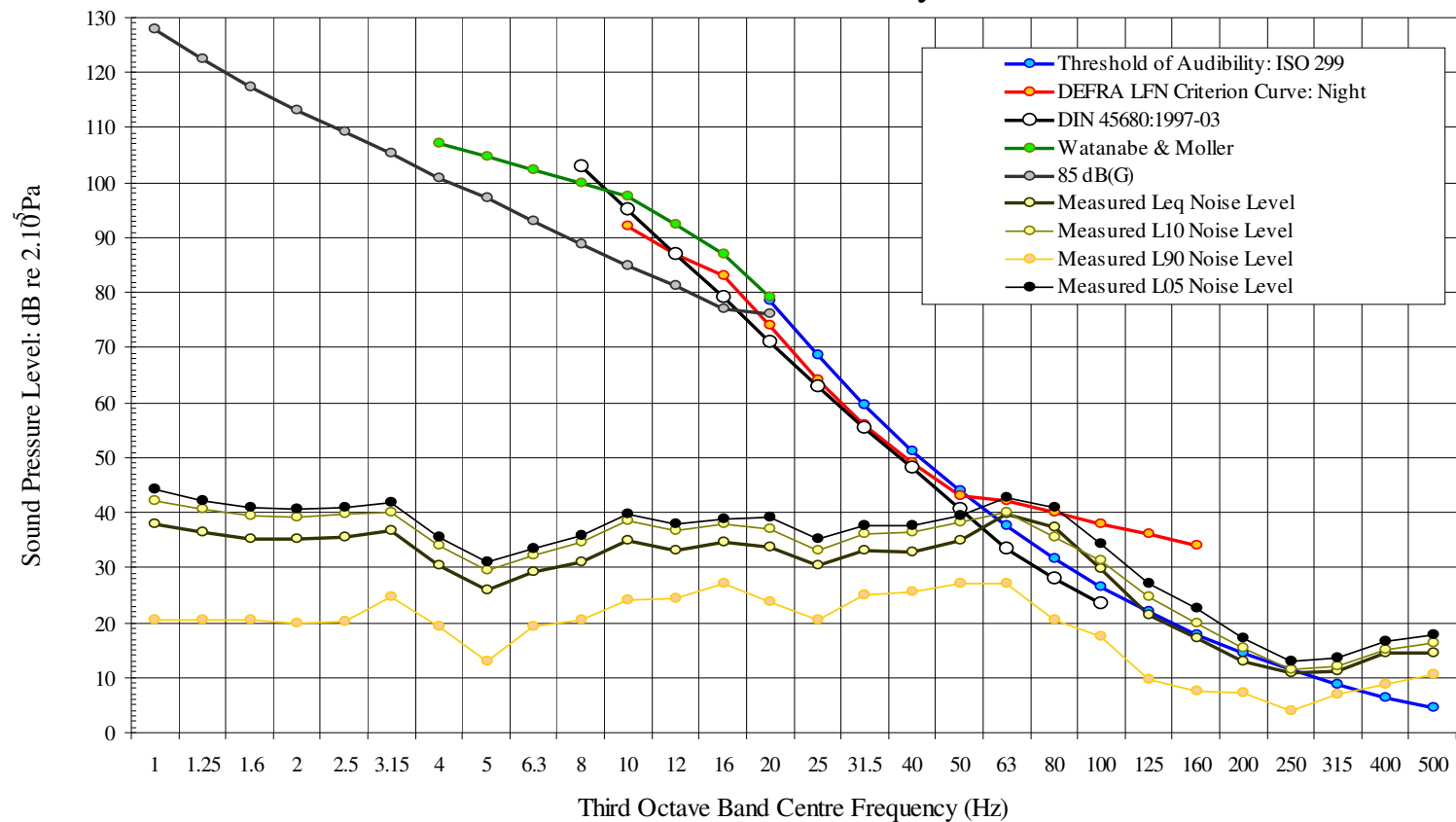
Potential Change in Perceived Noise Level

Normal Equal Loudness Contours for pure tones



Site 1: Location 1

Low Frequency Noise Assessment
Location 1: 03:10 15th May 2005

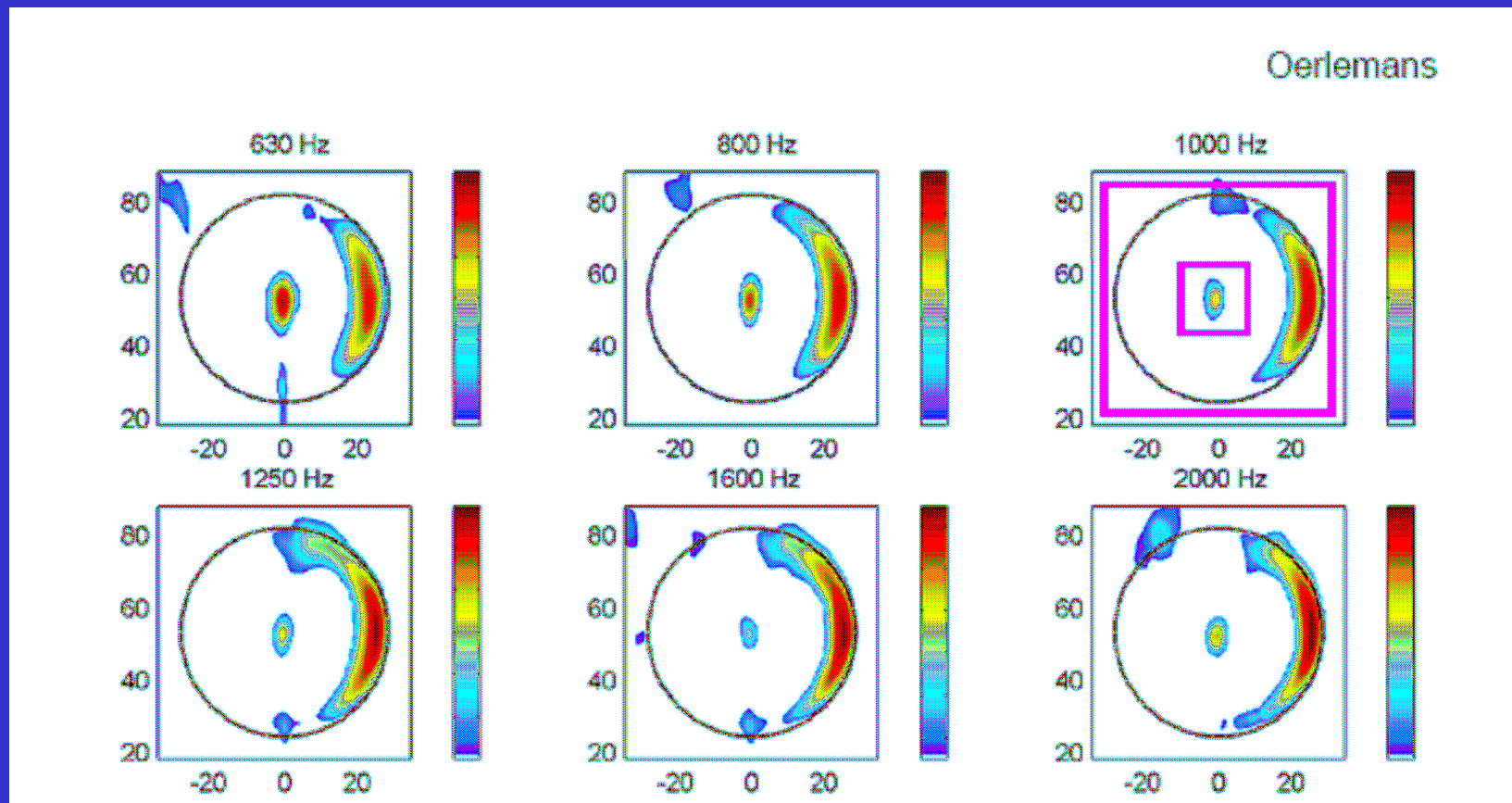


Why Modulation?



Localisation and
Quantification
Of Noise Sources
On a wind turbine:
Orelemans and Lopez
1st Int. Noise Conf.

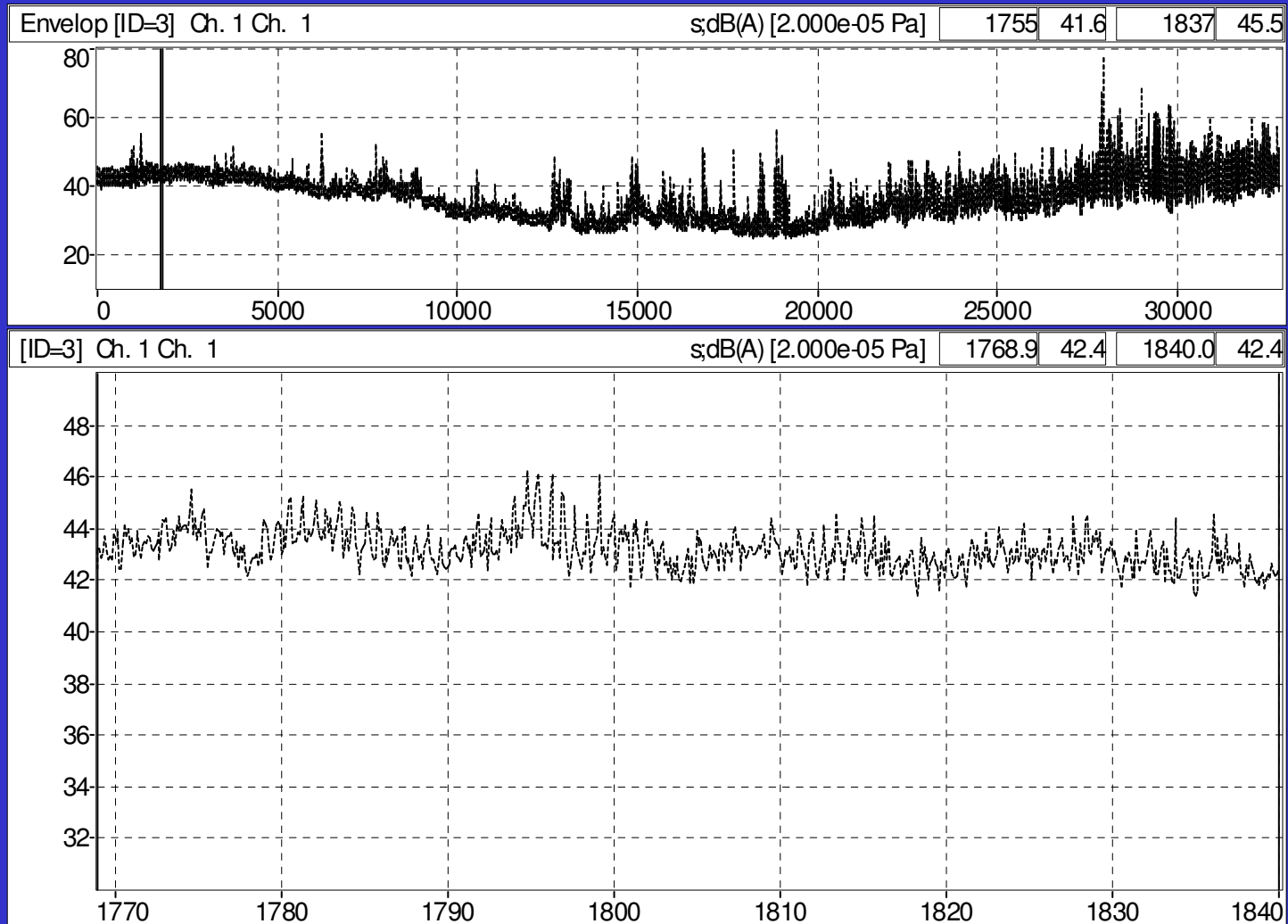
Third Octave Band Analysis



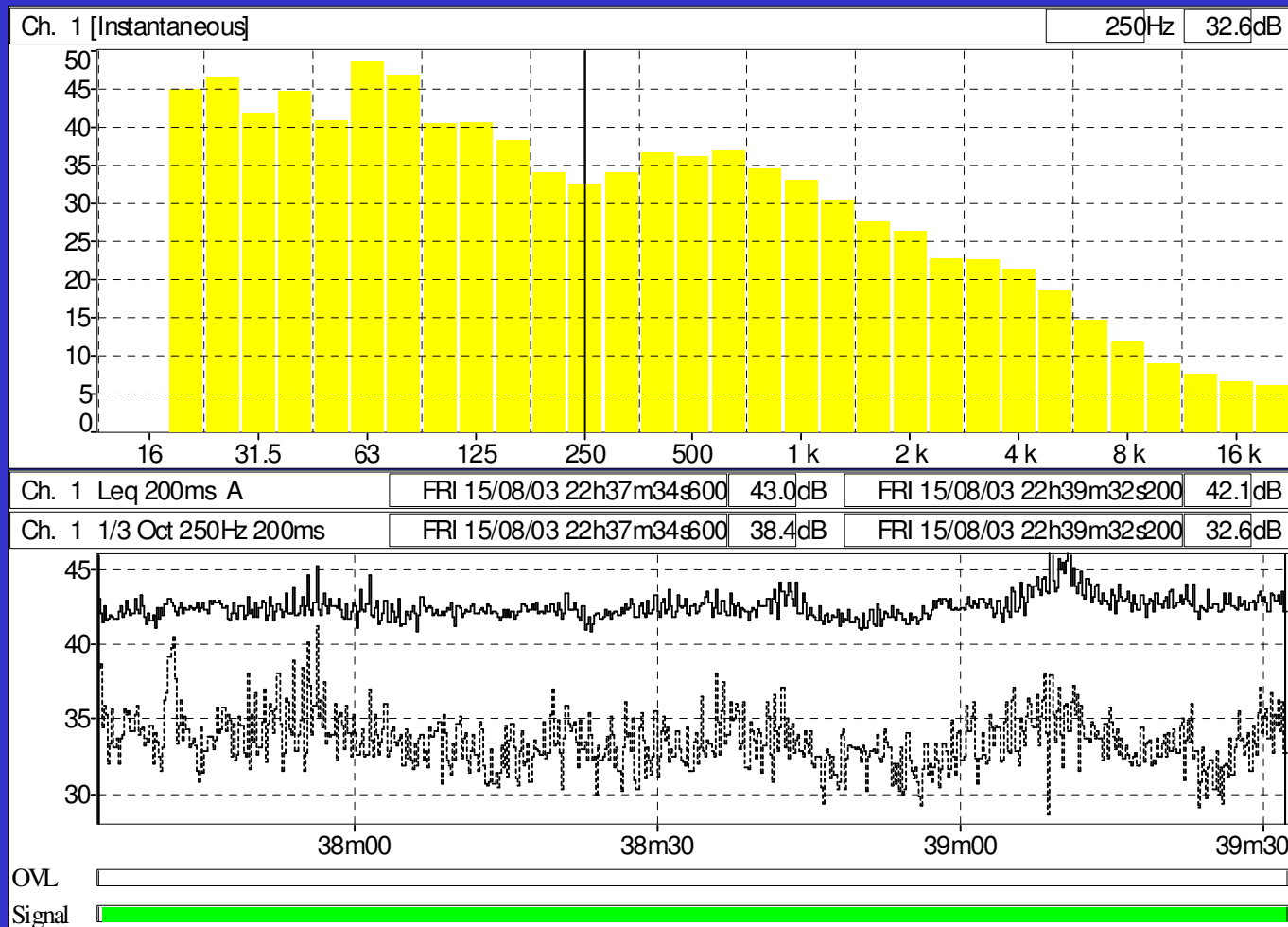
Modulation at Problem Sites

- Site 1: Pitch Regulated: Westerly Turbines “misbehave” for Easterly wind conditions
- Site 2: Stall Regulated: De-Rated Power resulting in Stall Regulation at lower wind speeds
- Site 3: Stall Regulated: Shorter Towers for Radar Issues
- Site 4: Stall Regulated: Very Sheltered Receptor Locations

Potential Sources of Modulation



Potential Sources of Modulation

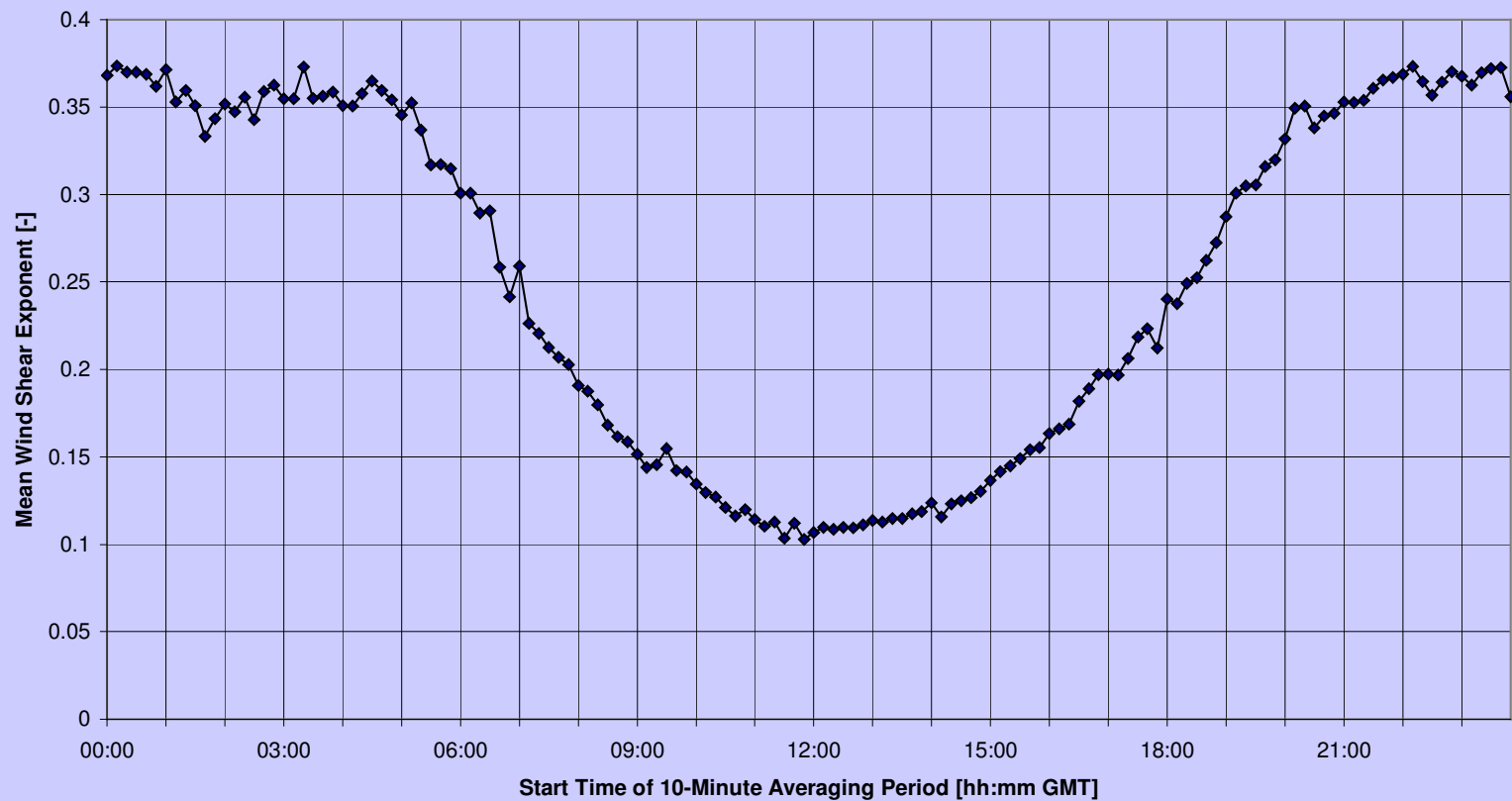


Causes of Modulation

- High Wind Shear: van den Berg?
- High Yaw Error?
- Above Rated Power Wind Speed: Stall Regulated Wind Turbines?

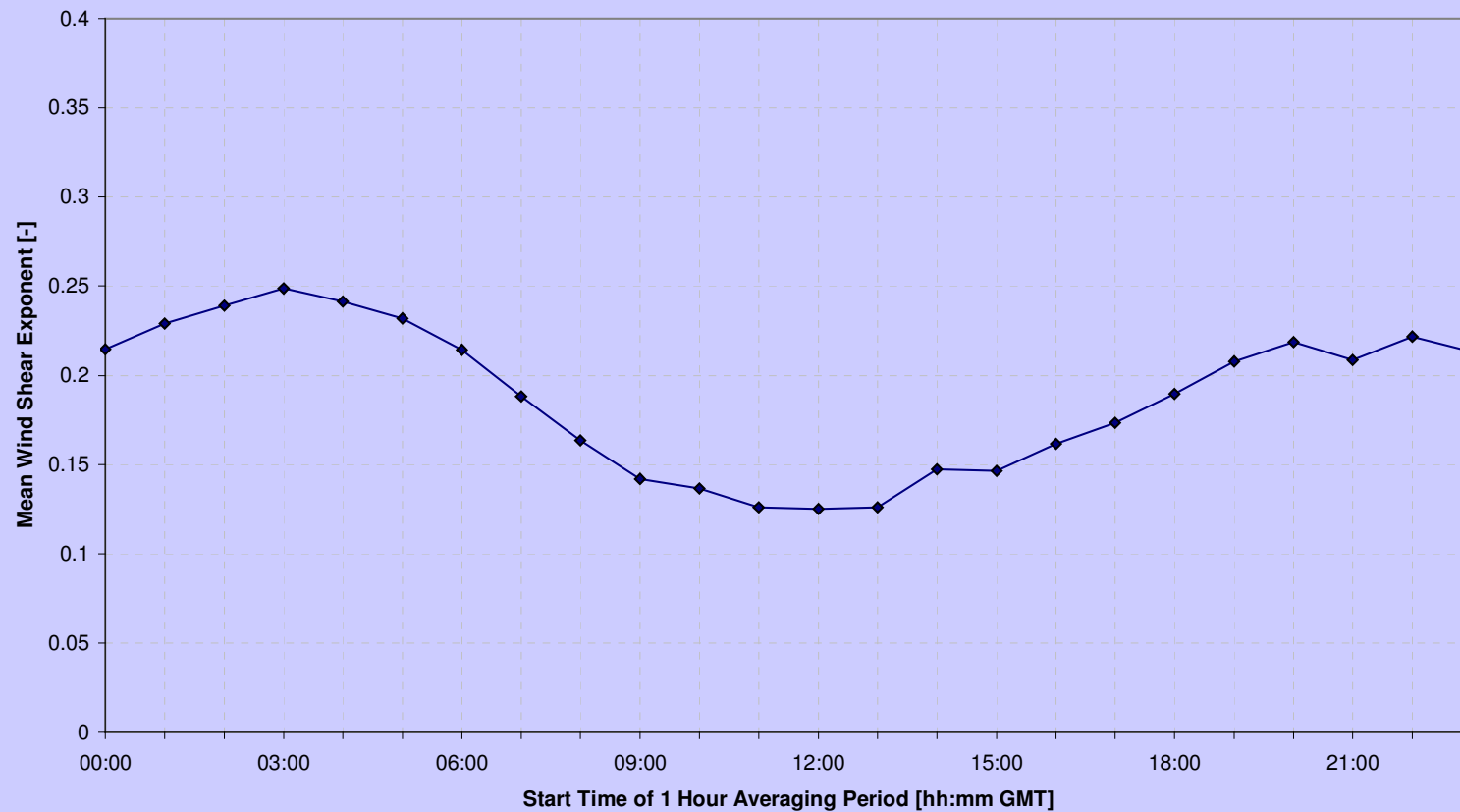
Wind Shear: Flat Site

Average Diurnal Wind Shear Exponent 50m - 20m
1st April 2004 - 31st March 2005

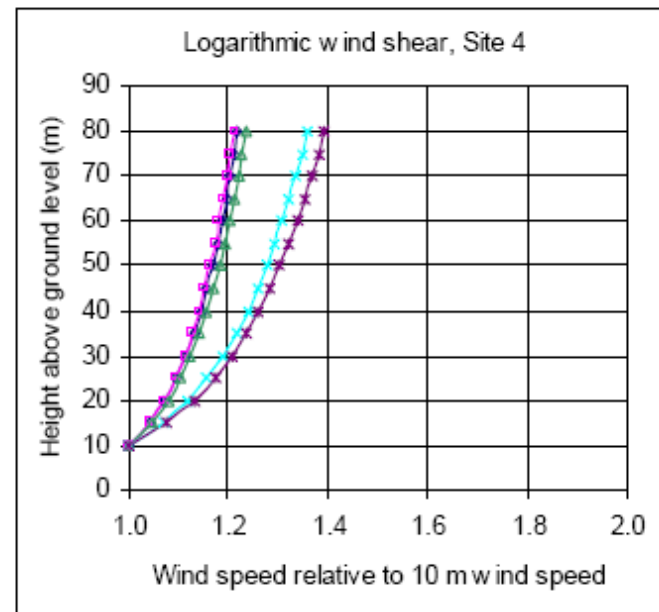
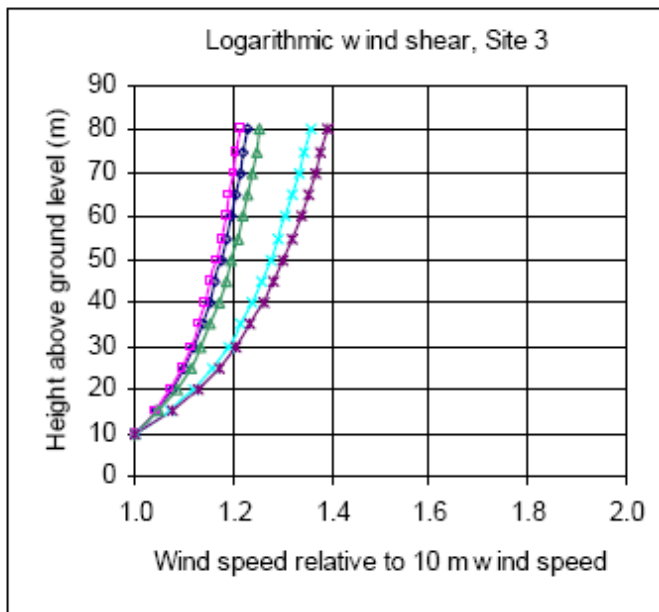


Wind Shear: More Complex

Average Diurnal Wind Shear Exponent 40m - 20m
26th February 2004 - 6th January 2005



Wind Shear: Hilly and Complex



—●— All data —□— Day —△— Night —×— Z0 = 0.03m —*— Z0=0.05m

The use of 10 m wind speed measurements in the assessment of wind farm developments
Paul Botha: 1st. Int Conference on wind turbine noise

Wind Shear Summary

- Flat Sites: Night time wind shear may give rise to higher levels of amplitude modulation
- More Complex Sites: Reduced wind shear effect at night

Other Causes of Increased Modulation

- Yaw error: Site 1 turbines may be as much as 60° off correct wind direction
- Wake Effects: In Stable atmospheric conditions wake will not mix due to no turbulence

Summary

- Infrasound is not a source of concern with respect to wind turbine noise;
- Low frequency noise is generally not an issue unless high levels of modulation associated with turbine operation;
- Modulation caused by a number of sources;
- Thought should be given to flat site locations where high wind shear at night may be an issue especially for modern, taller and larger rotor wind turbines.