Forschungszentrum Karlsruhe
in der Helmholtz-Gemeinschaft

Offshore Wind and Turbulence Profiles from the FINO1-Mast

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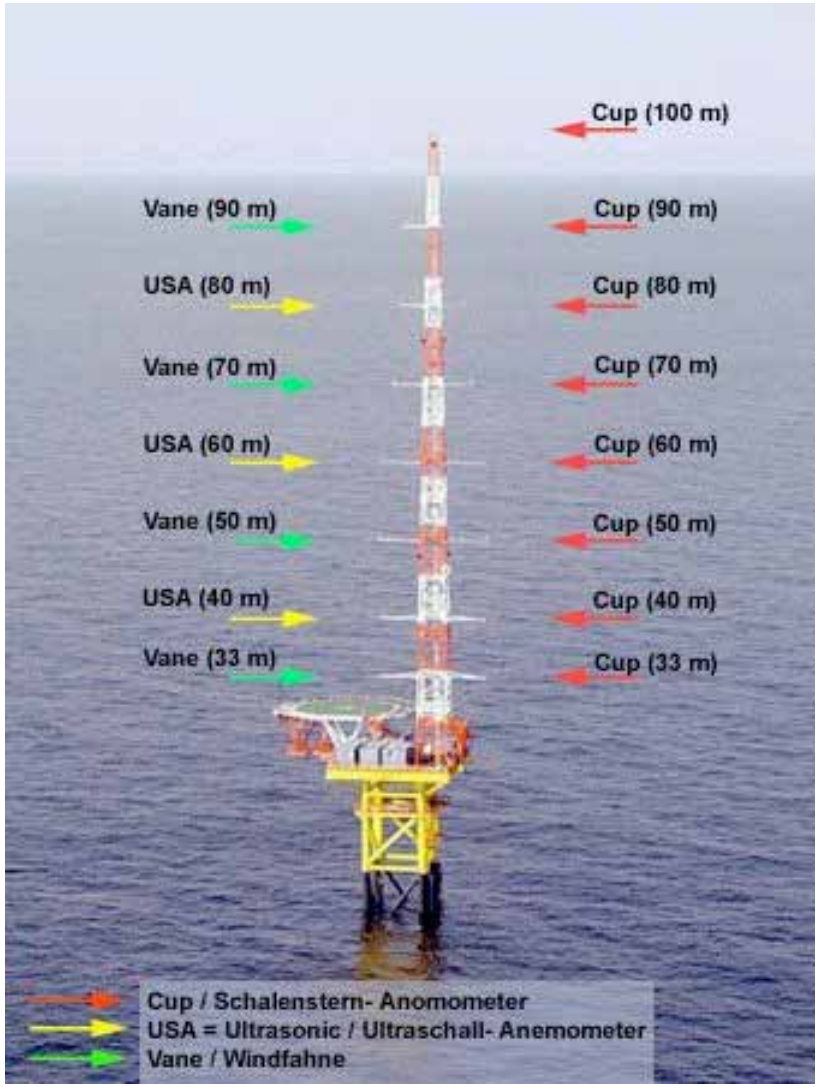
FINO1 research plattform

Long-running measurements

of wind components

from 33 to 100 metres

since September 2003



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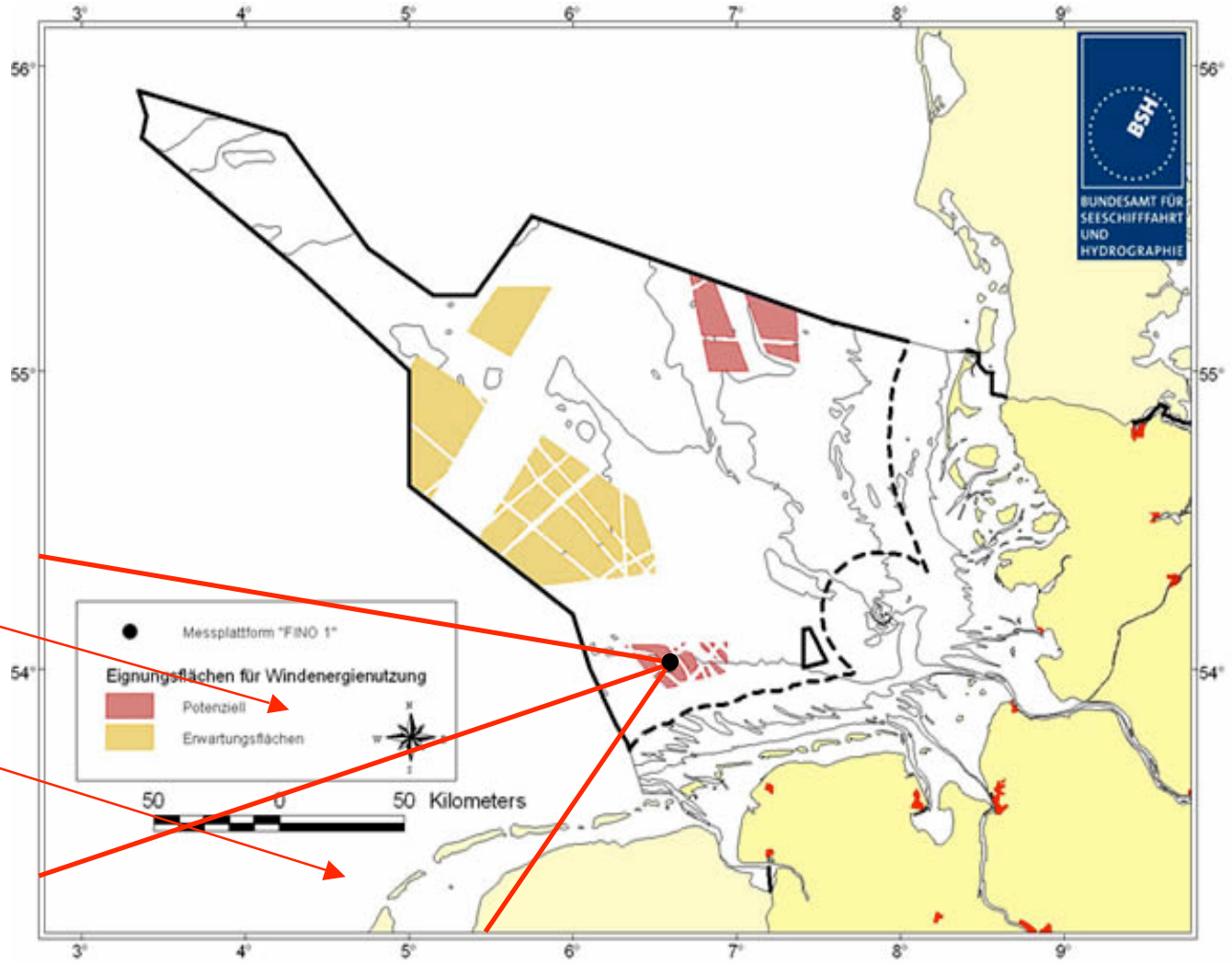
Location of FINO1 in the North Sea about 45 kilometres north of the island of Borkum



250-280°

210-250°

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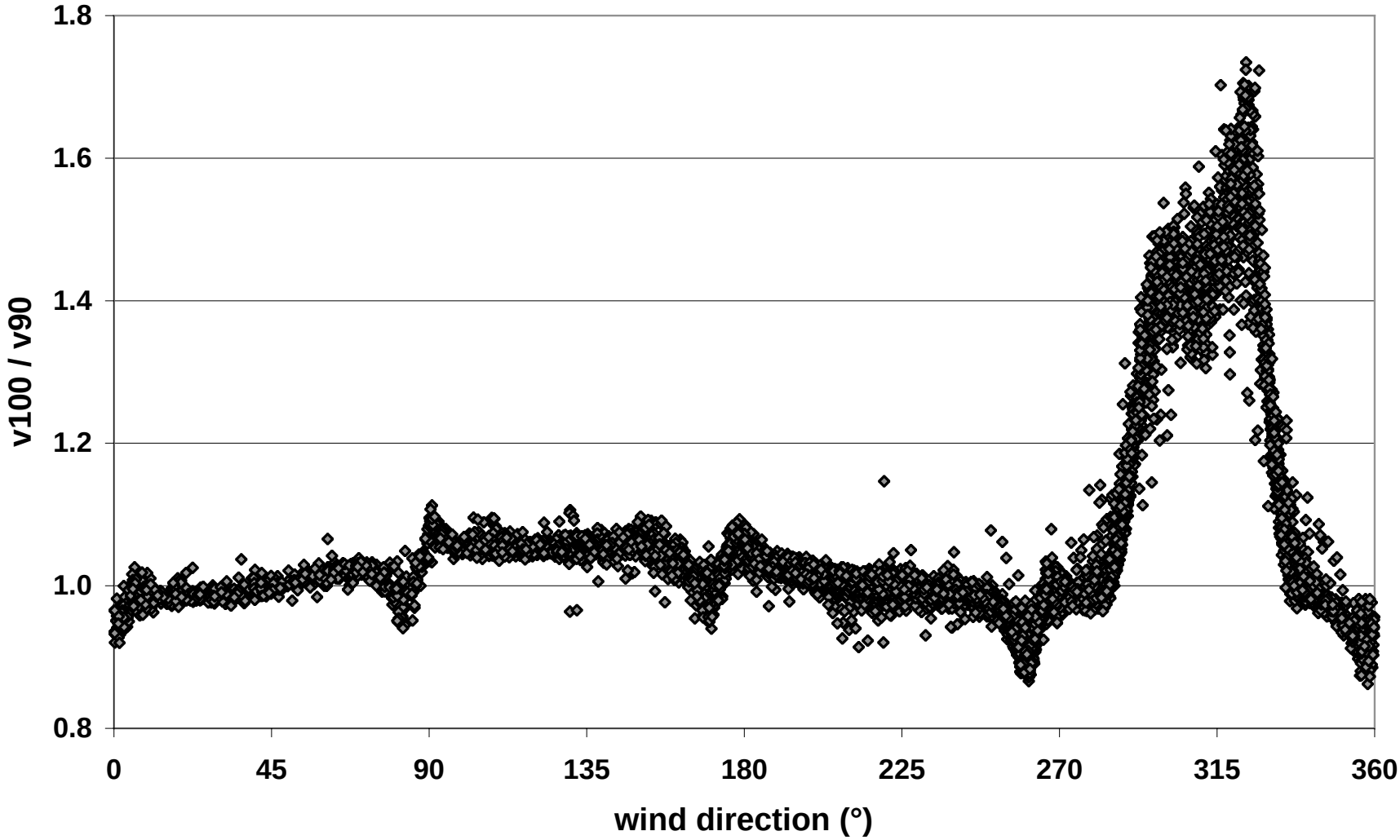
Mast shadow effects on wind speed measurements (v100 / v90, Oct 2004 – Jan 2005)



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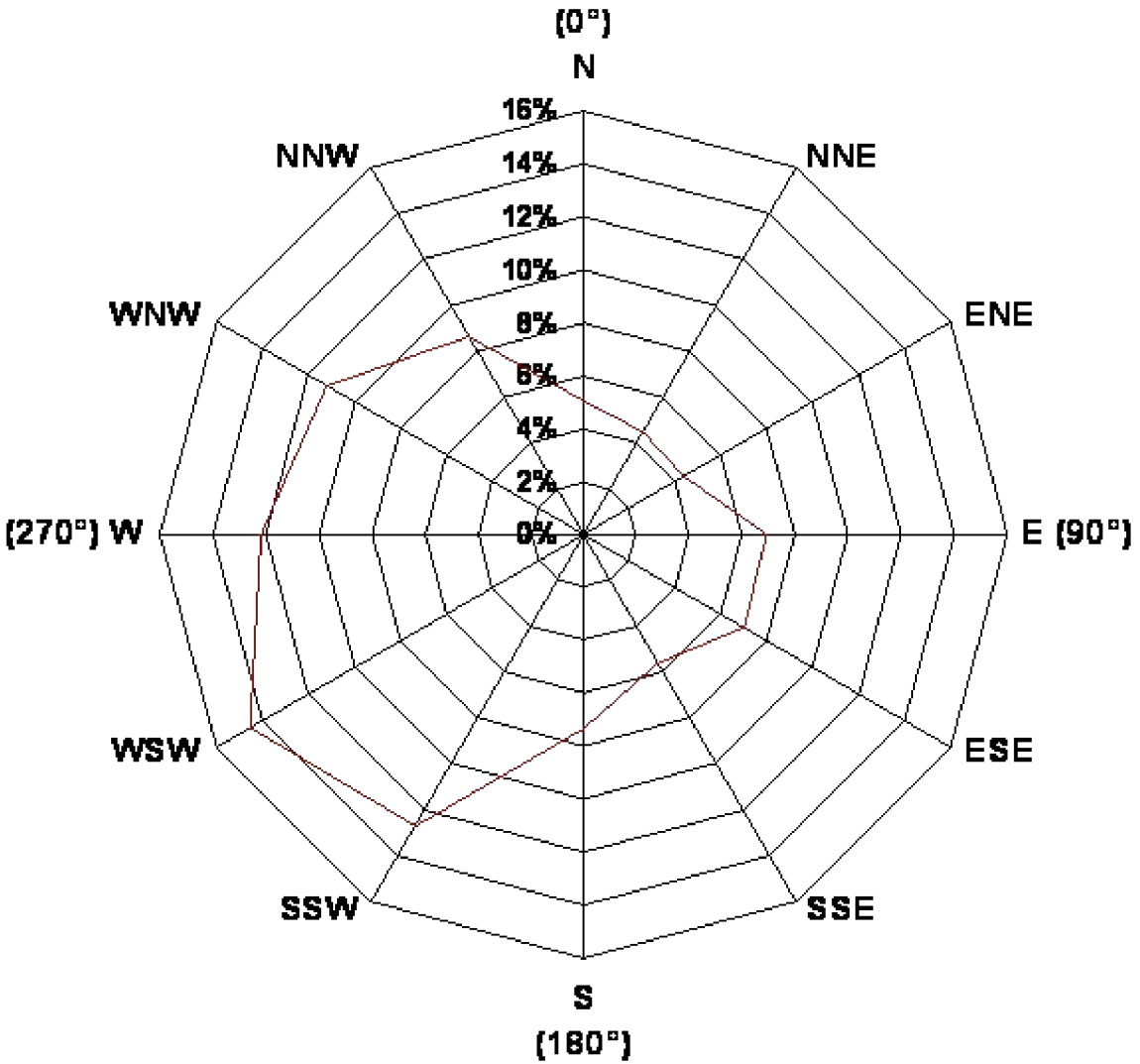
Wind rose
90m height, 2004



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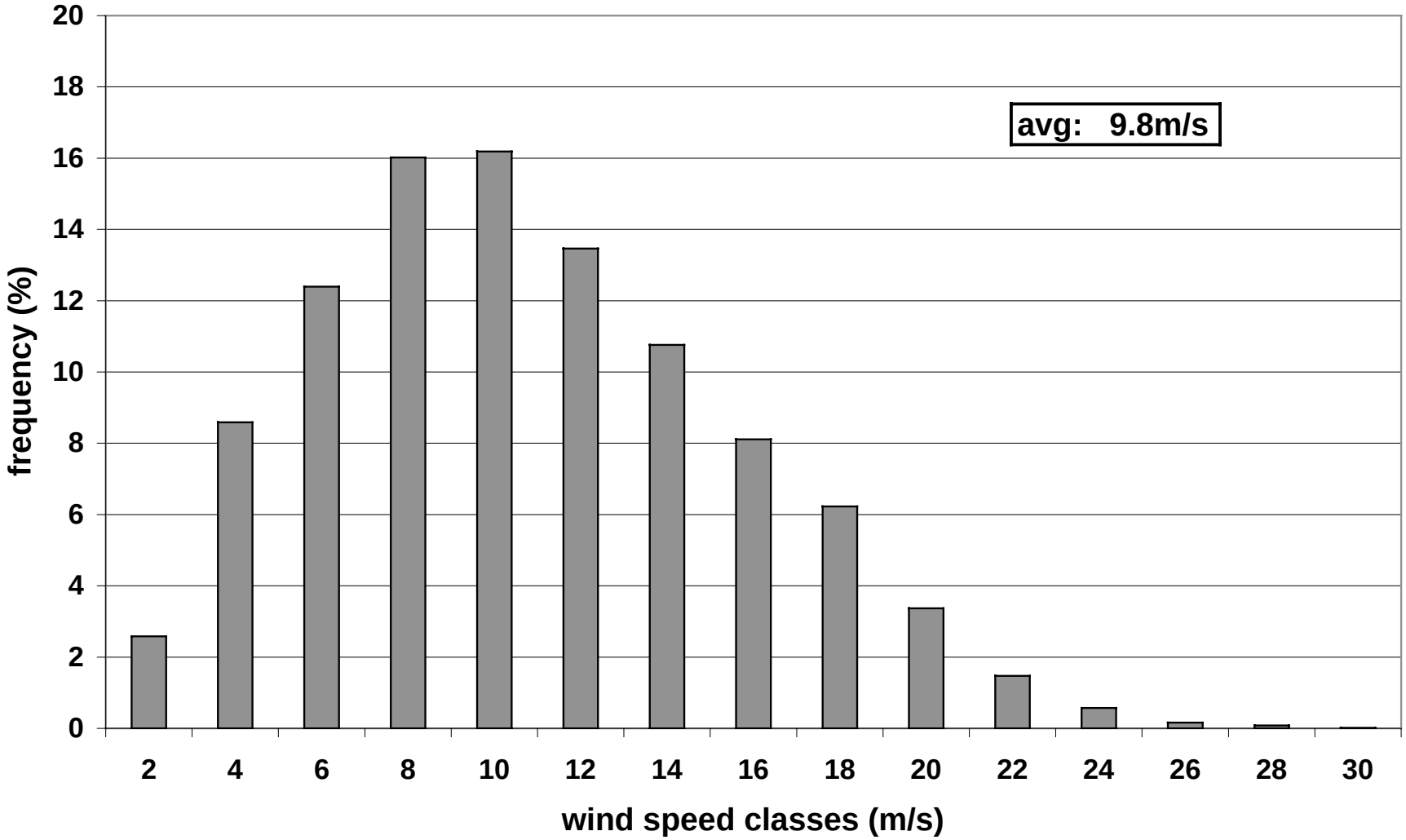
Distribution of wind speed classes 100m height, 2004



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Gradient-Richardson-Number as a measure of atmospheric stability

$$Ri = \frac{g}{T} \frac{\frac{\partial \theta}{\partial z}}{\left(\frac{\partial v}{\partial z}\right)^2}$$

with

- **g** = gravitational constant
- **T** = temperature (K)
- _ = potential temperature (K)
- **z** = height (m)
- **v** = horizontal wind speed (m/s)

atmospheric layering	**Ri**
stable	> 0
neutral	= 0
unstable	< 0

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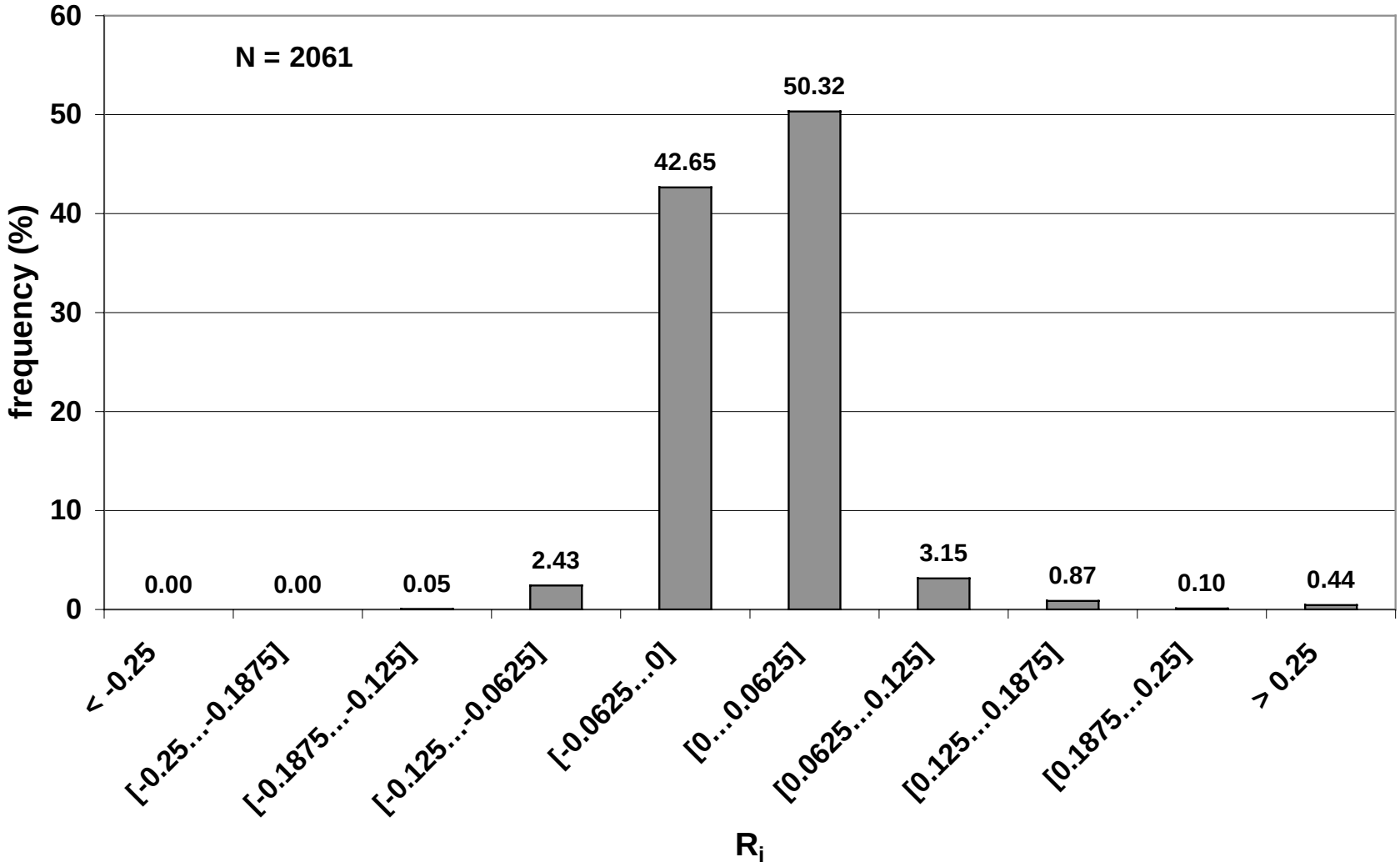
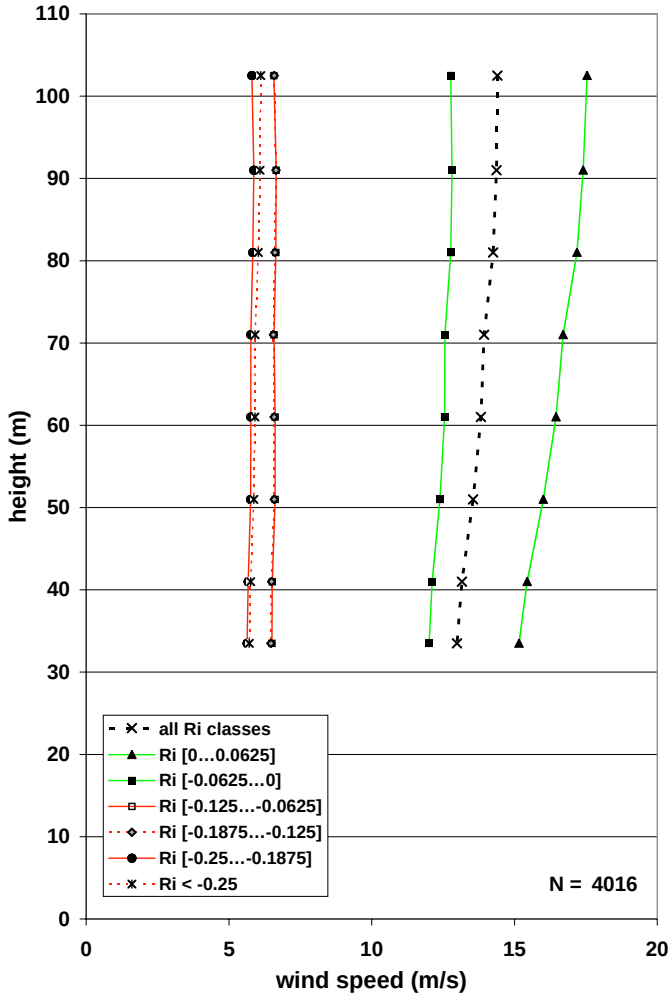
Frequency distribution of R_i
April 2004 – July 2004, 210-250°

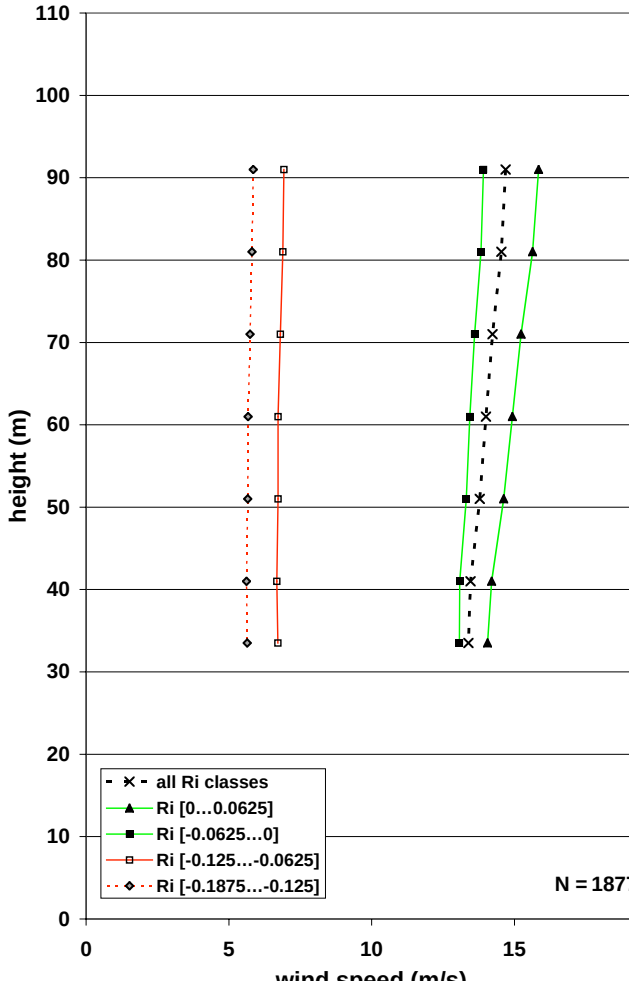


Wind profiles depending on different Ri-classes
October 2004 – January 2005, different wind directions

210-250°



250-280°



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Determination of turbulence intensity

$$t = \frac{\sigma_u}{\bar{v}}$$

with

- **t** = turbulence intensity
- σ_u = standard deviation of horizontal wind speed (m/s)
- **v** = mean horizontal wind speed (m/s) [based on 10 minute averages]

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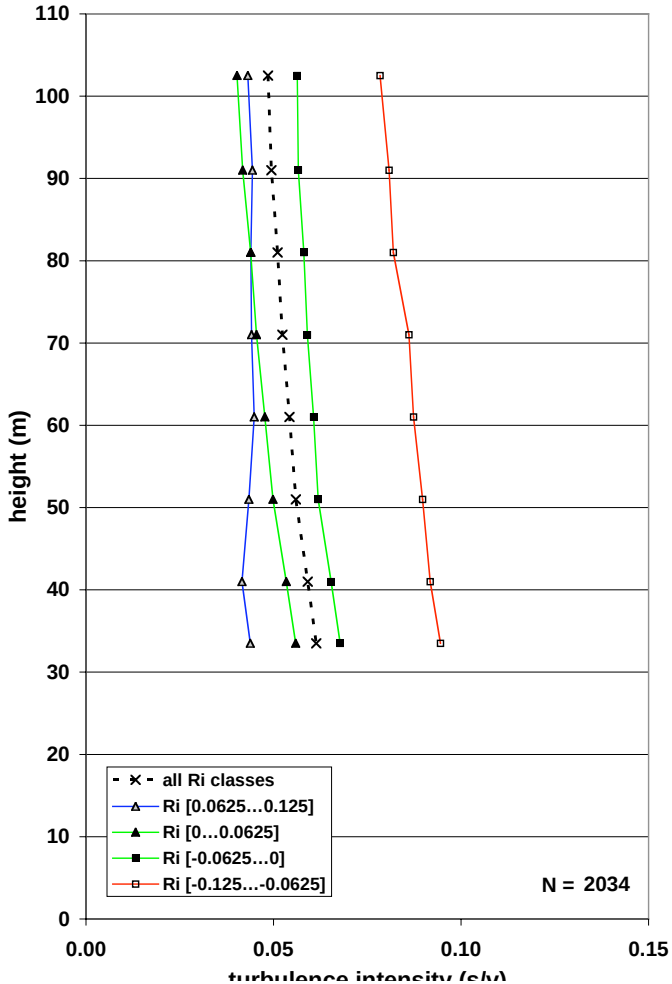
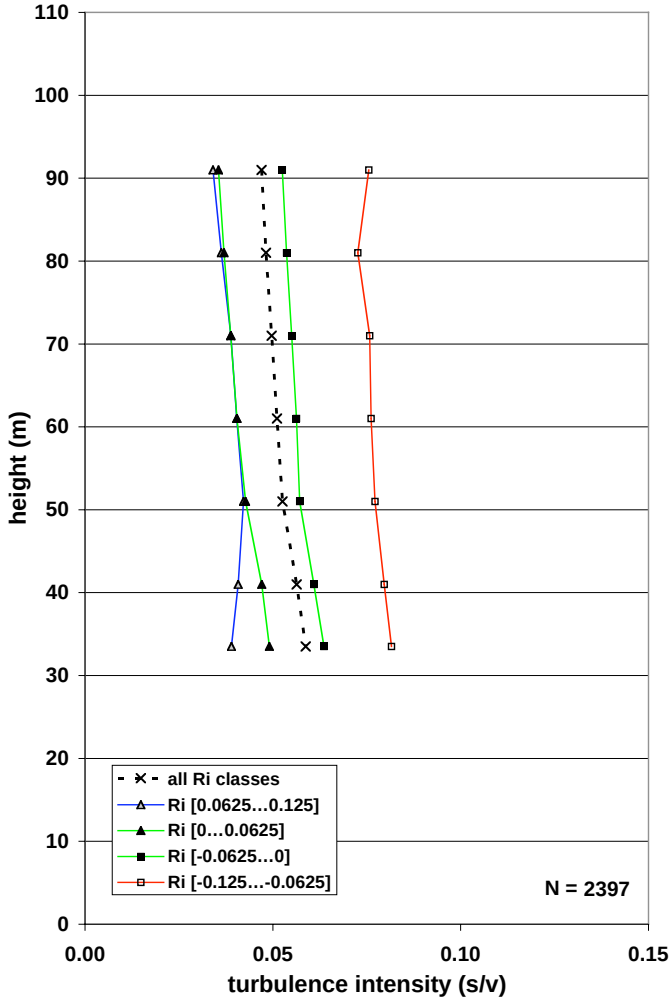
Turbulence intensity profiles depending on different Ri-classes April 2004 – July 2004, different wind directions

210-250°



250-280°



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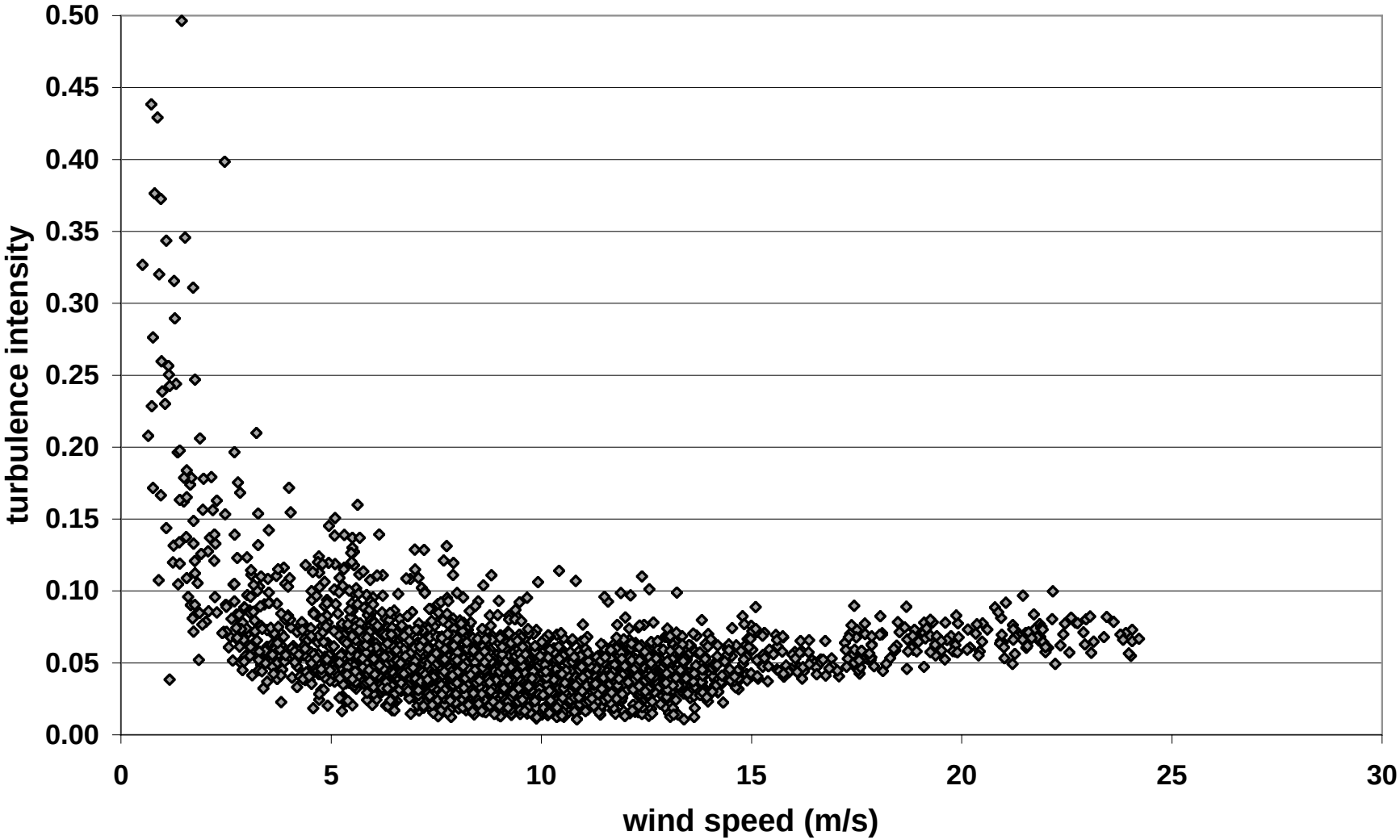
Turbulence intensity depending on wind speed (v100)
April 2004 – July 2004, 210-250°



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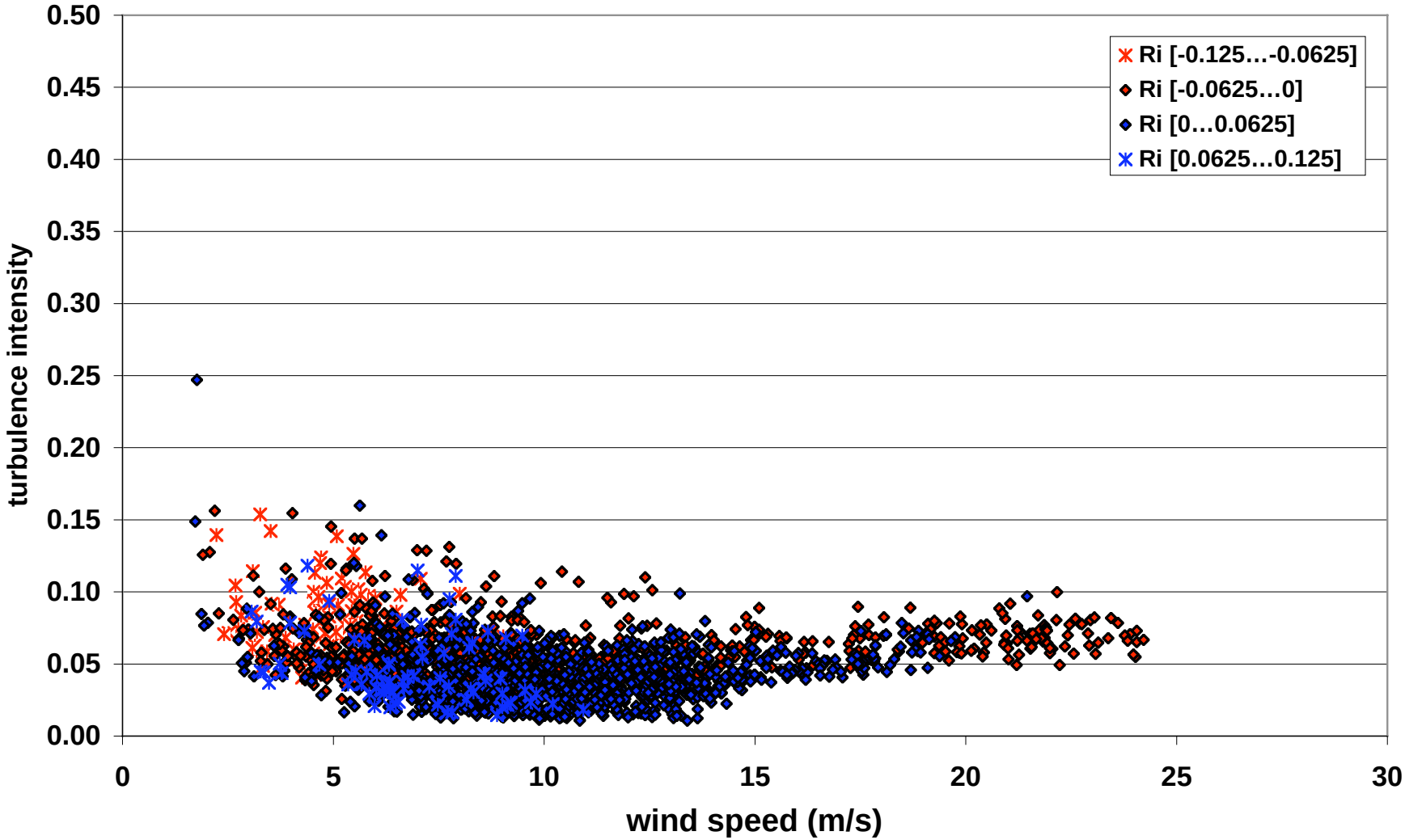
Turbulence intensity depending on wind speed (v100)
April 2004 – July 2004, 210-250°



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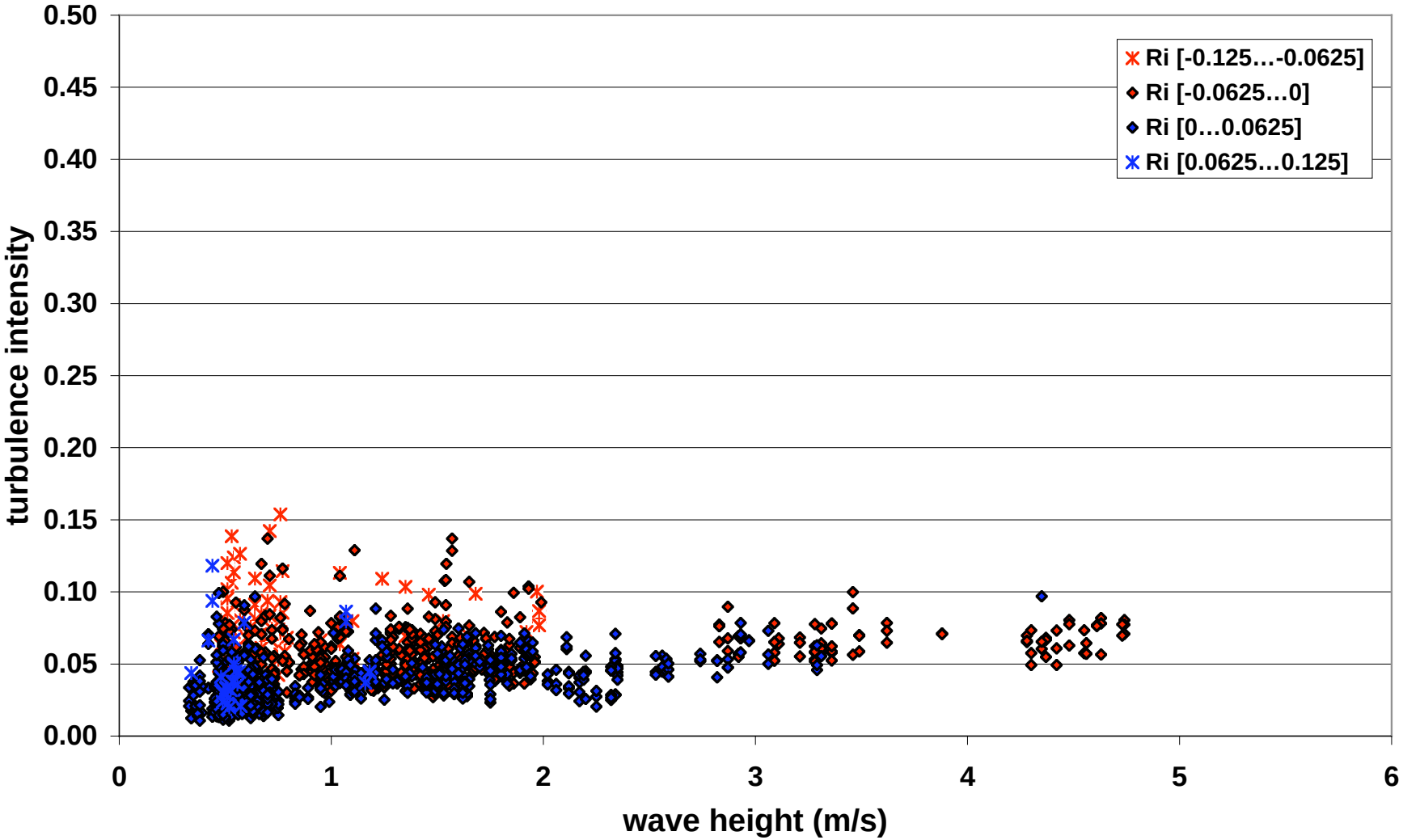
Turbulence intensity depending on wave height
April 2004 – July 2004, 210-250°



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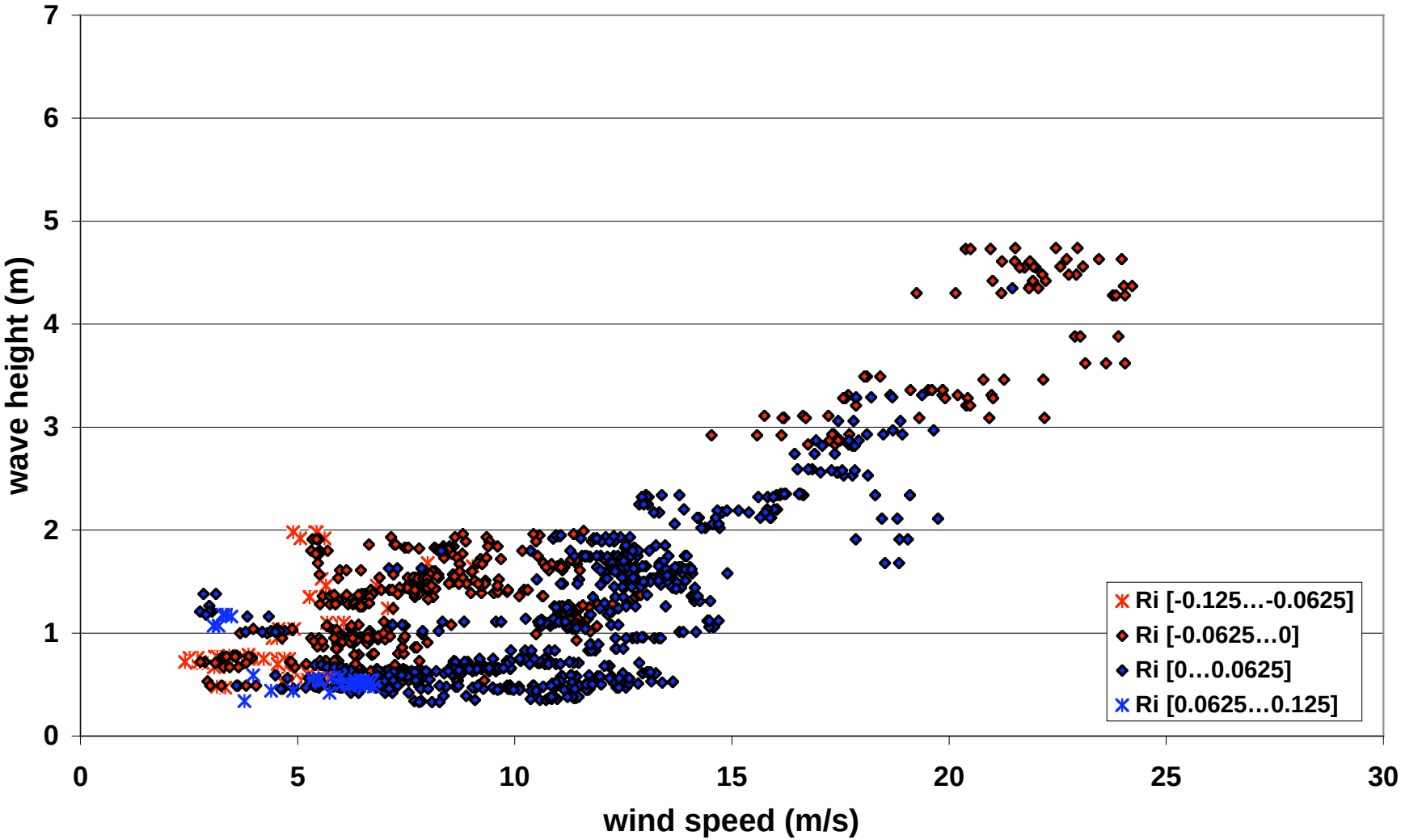
Wave heigth depending on wind speed (v100)
April 2004 – July 2004, 210-250°



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Thanks for your attention!

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