Journal of Zhejiang University-SCIENCE A

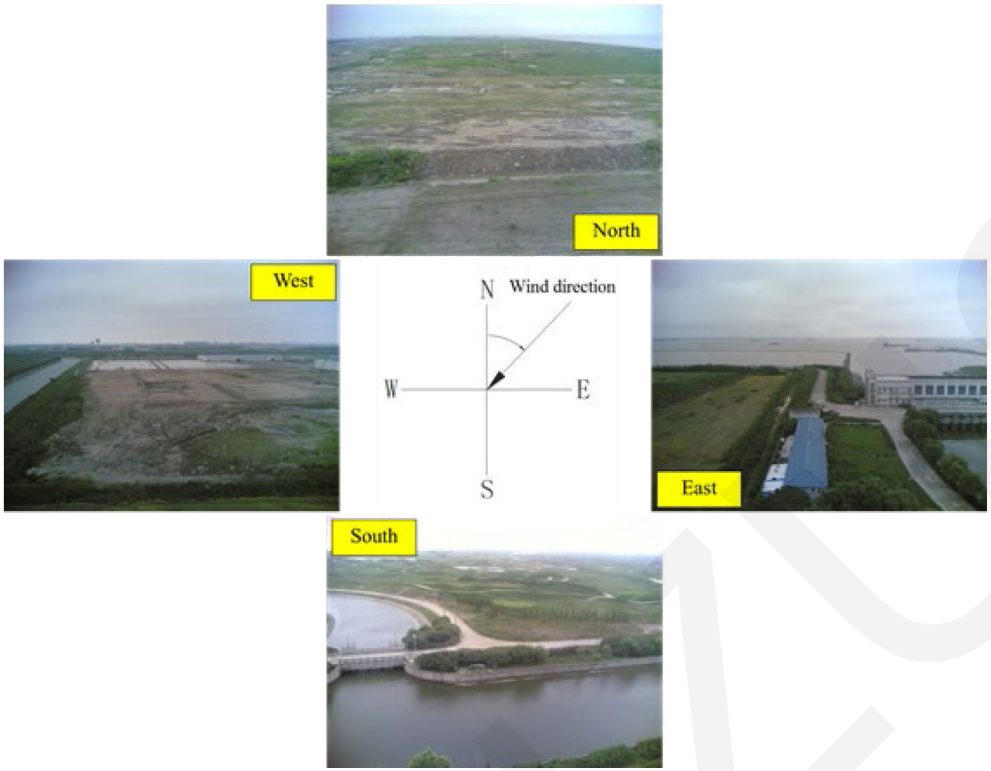
Wind characteristics near the ground during typhoon Meari

Xu WANG, Peng HUANG, Xian-feng YU,
Xin-rong WANG, Hai-ming LIU

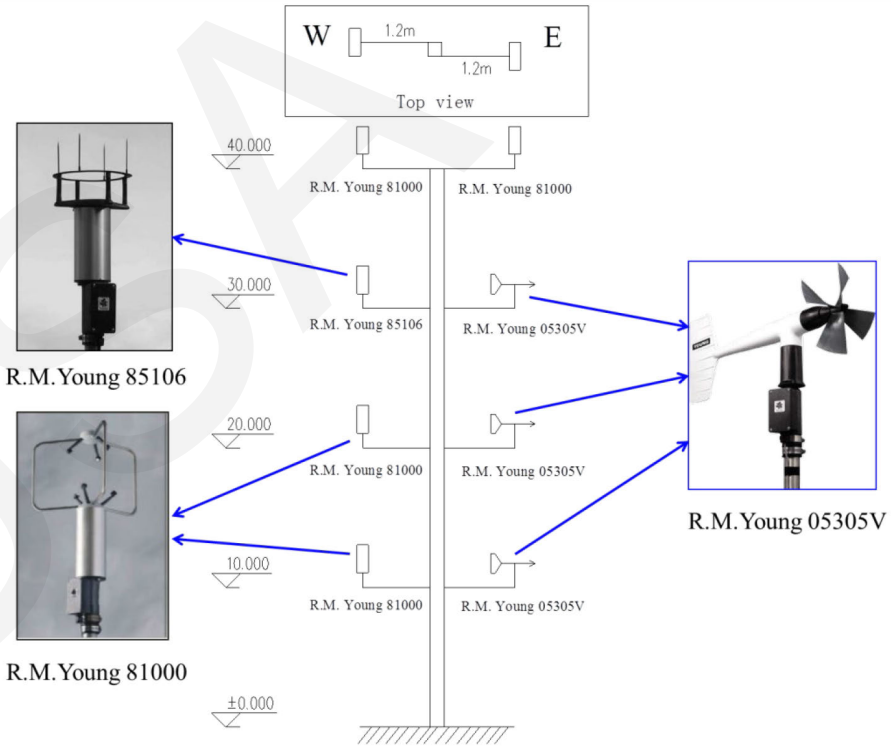
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Measurement procedures



Photographs of the terrain around the observation station

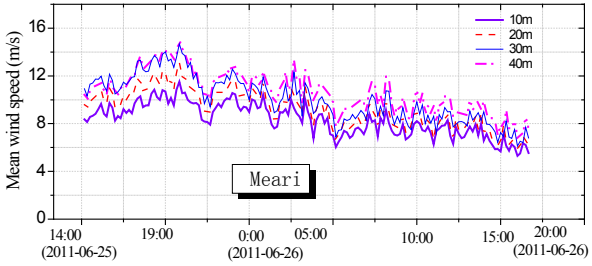


Arrangements of anemometers (units: m)

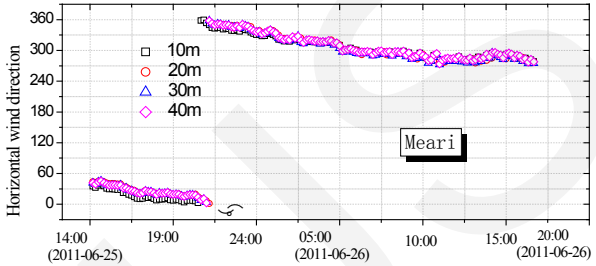
Results

1. 10-min mean wind speed and wind directions

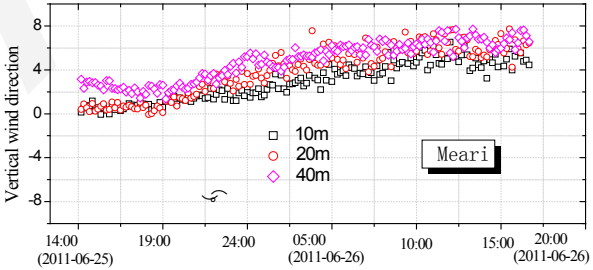
The mean wind speed generally increased with observation height, but the variation in mean wind direction with time was similar at different observation heights.



10-min mean wind speed

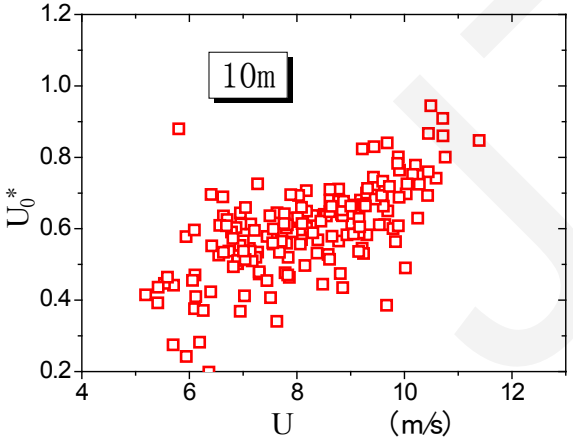


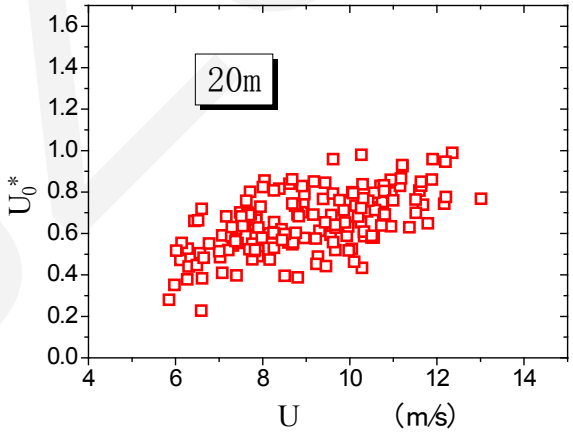
10-min mean horizontal wind direction

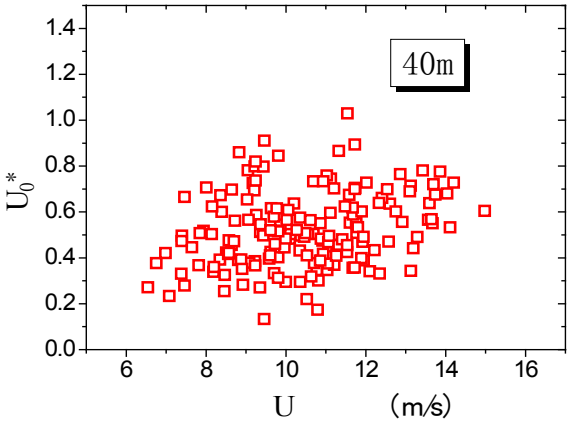


10-min mean vertical wind direction

2. Variation in friction velocity with 10-min mean wind speed

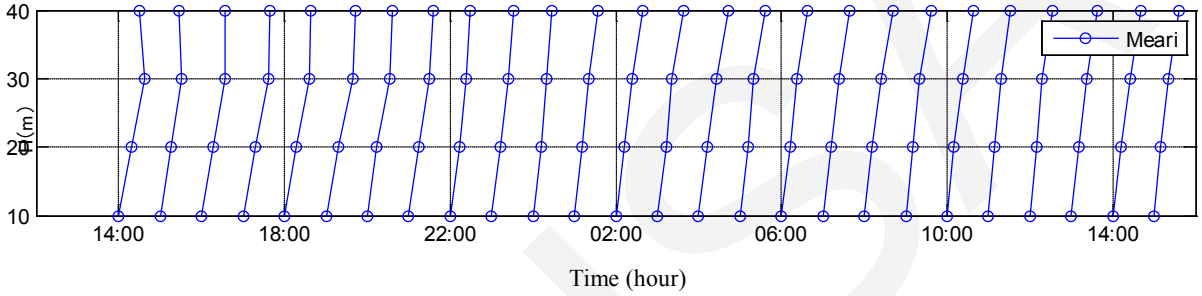




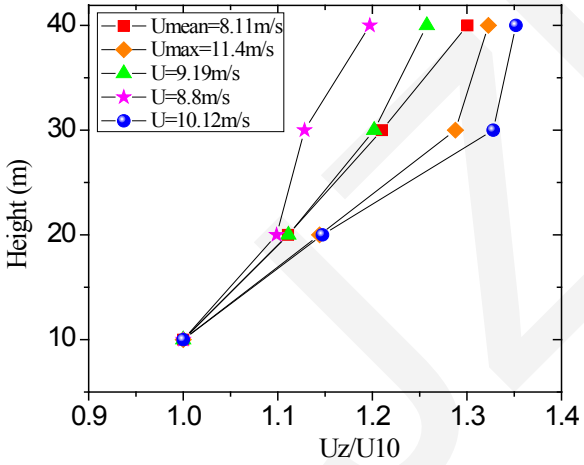


Results

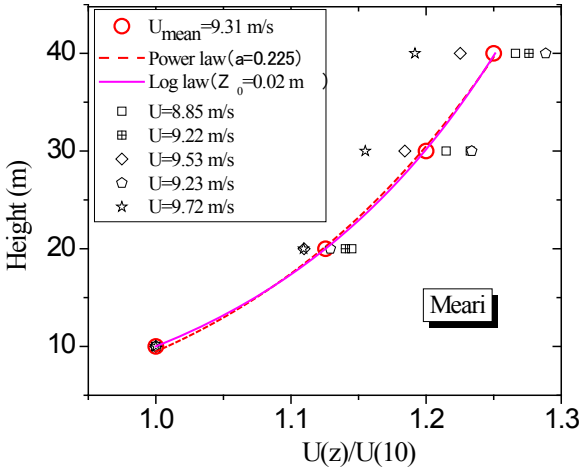
3. Characteristics of the measured typhoon wind-velocity profile



Mean wind-speed profiles over one-hour time intervals during typhoon Meari



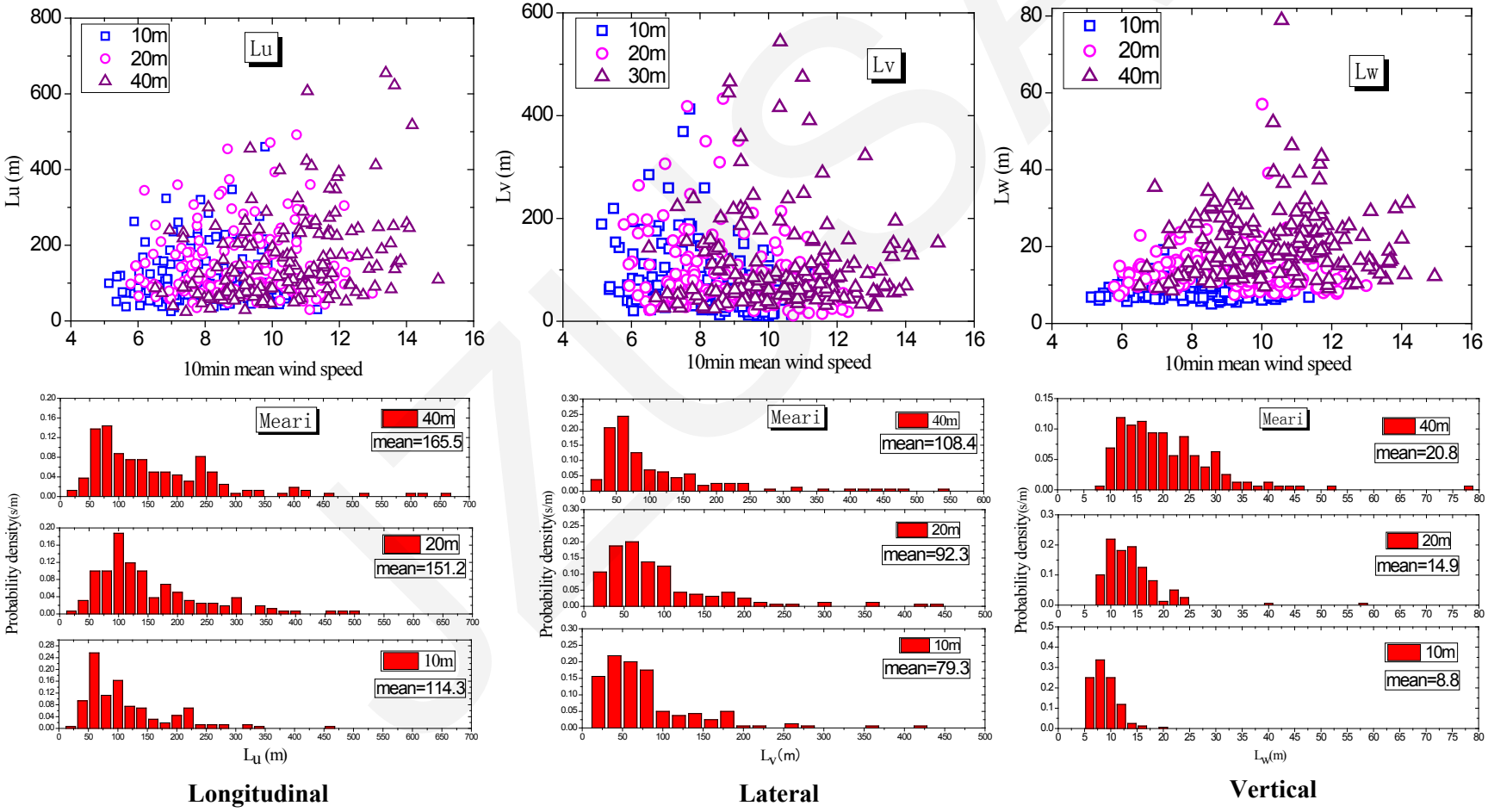
Measured mean wind-speed profiles



Comparison between the measured wind-speed profile and the profiles from the empirical models

Results

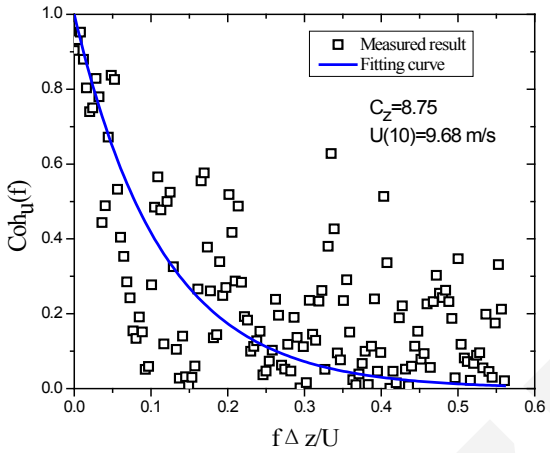
4. **Variation in turbulence integral scales with wind speed and probability density of the turbulence integral scale**

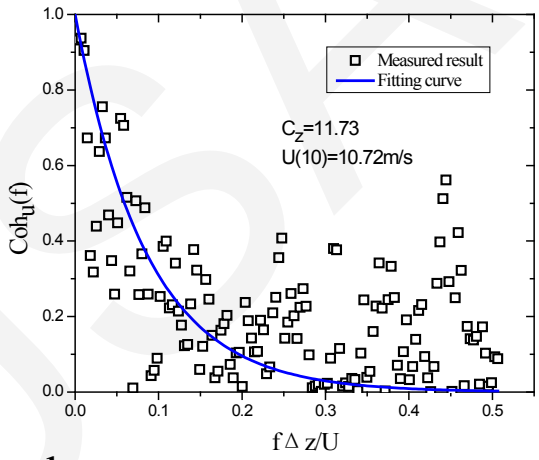


Longitudinal **Lateral** **Vertical**

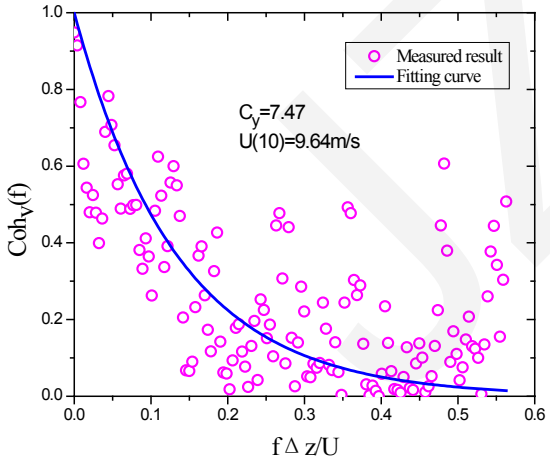
Results

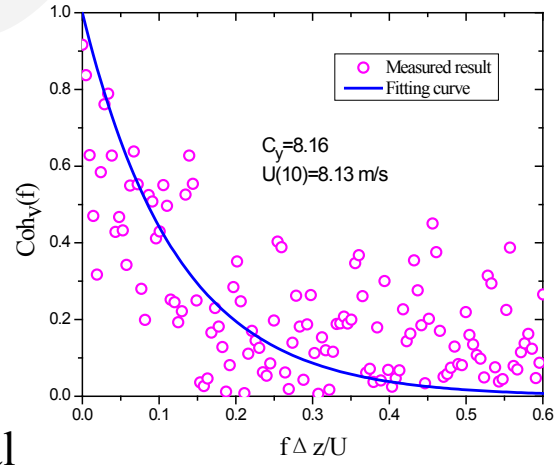
5. Comparison between coherence functions and measured results





Longitudinal

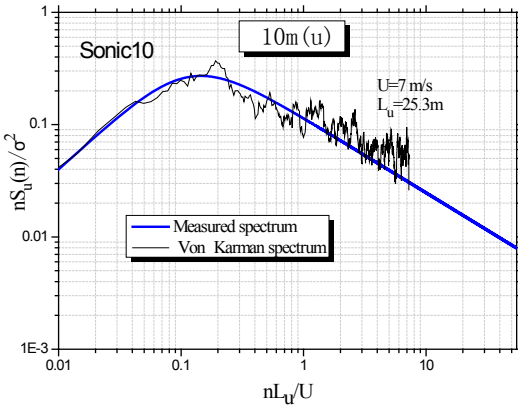


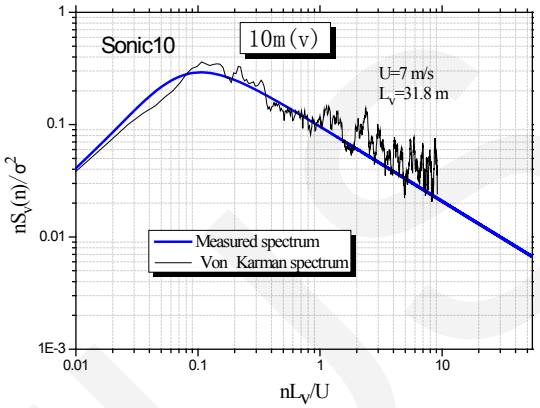


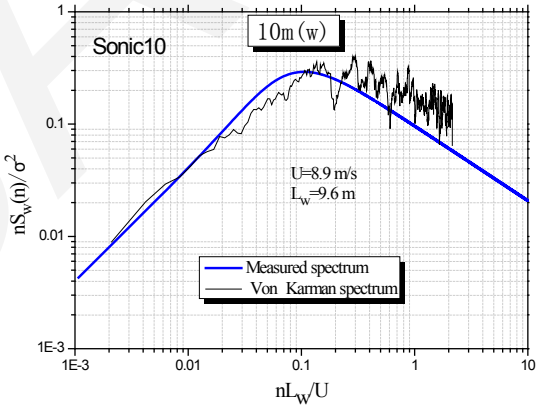
Lateral

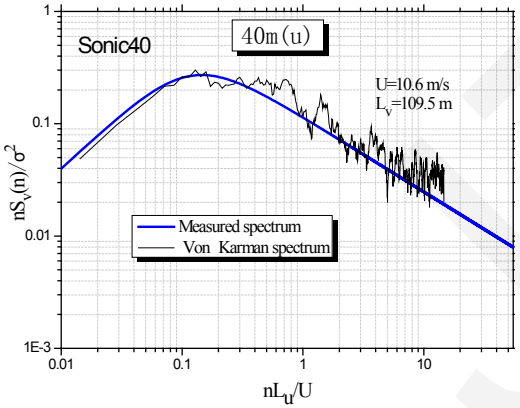
Results

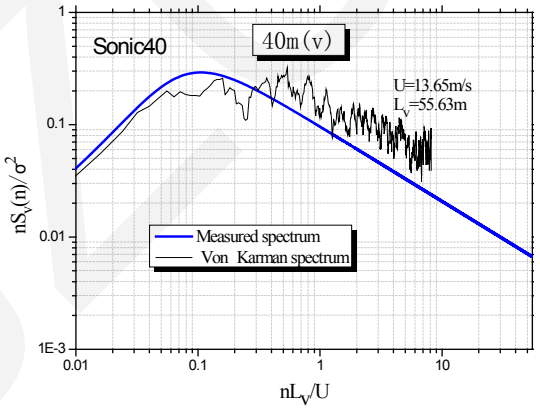
6. Comparison between the measured power spectra and Von Karman spectra

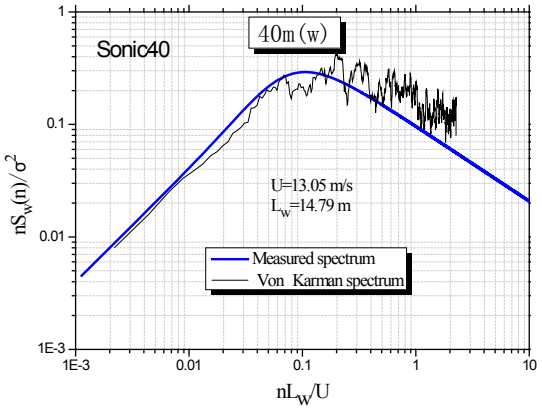












Conclusions

- The variation in friction velocity with height was insignificant, with values at heights of 10, 20, and 40 m of 0.60, 0.62, and 0.58 m/s respectively. Measured wind-speed profiles can be expressed well by both the power law and the log law.
- The autocorrelation coefficient decreased markedly with a lag and the rate of change varied with height. The cross-correlation coefficients of wind-speed components and the decay factor of the coherence function for longitudinal and lateral components increased slightly with wind speed.
- The turbulence integral scale increased with mean wind speed, and the ratios of turbulence integral scale among the turbulence components averaged over all 10-min data were 1: 0.69: 0.08, 1: 0.61: 0.09, and 1: 0.65: 0.13 at 10 m, 20 m, and 40 m respectively. The ratio of lateral and longitudinal turbulence integral scales in this study was close to those of Xiao (2009) and Song (2012) and larger than those of other studies.
- The slope of the rates of turbulence spectra in the inertial range was less than -5/3 at first, but gradually came to satisfy the Kolmogorov 5/3 law over time during typhoon Meari. The longitudinal wind-power fluctuation spectrum can be roughly fitted using the Von Karman spectrum, but there is a slight deviation in the high-frequency band for the lateral and vertical wind-power fluctuation spectra.