



114年第三十九屆天氣分析與預報研討會
39th Conference on Weather Analysis and Forecasting

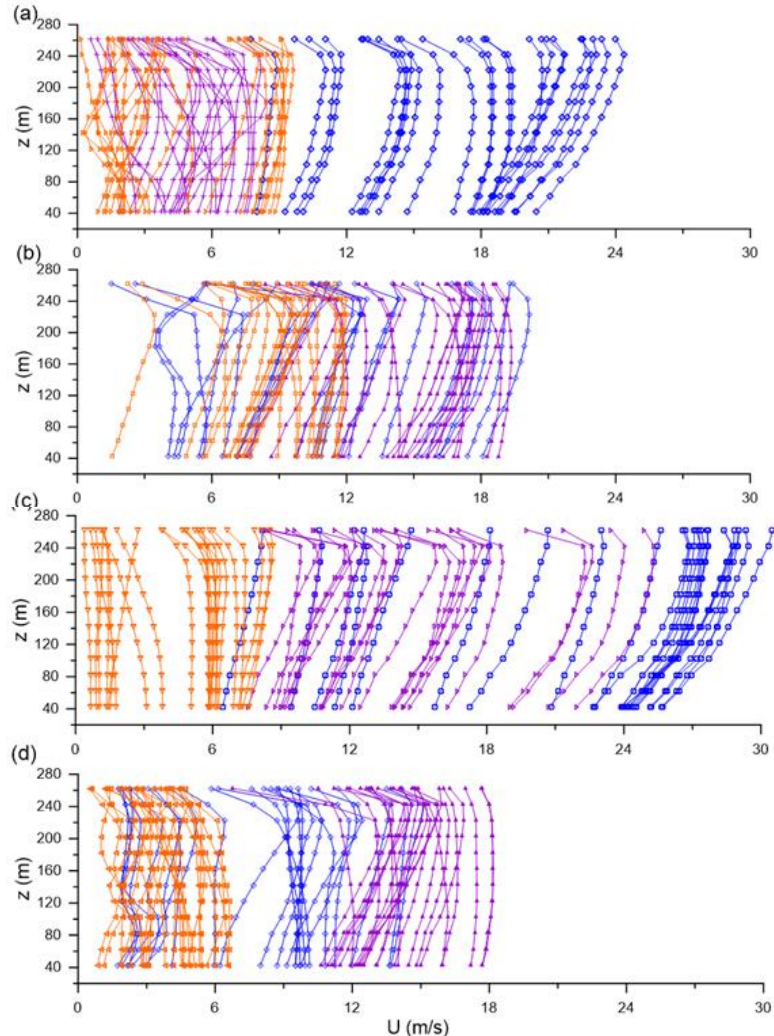
東北季風下都卜勒光達於台中梧棲漁港之大 氣邊界層的現象討論

**Doppler Lidar Observations of the Atmospheric Boundary Layer under the Northeast Monsoon at
Taichung Harbor**

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Previous Study -1

Wind profile from Hanbao



Hourly averaged wind speed profiles measured by LiDAR in the Hanbao intertidal zone during northeast monsoon conditions.

- (a) 2016.12.16-18
- (b) 2016.12.22-24
- (c) 2016.12.26-28
- (d) 2017.01.07-09

Wind velocity increases with height by a power factor known as the Hellman coefficient [1].

Reverse height is the height at which wind speed decreases with increasing altitude.



Reverse height was normally at 200-240m.
but some situation occurred below 200m.

[1] S. Rehman and N. M. Al-Abbadi, "Wind Shear Coefficient, Turbulence Intensity and Wind Power Potential Assessment for Dhulom, Saudi Arabia," in *Renewable Energy*, vol. 33, pp. 2653- 2660, 2008.

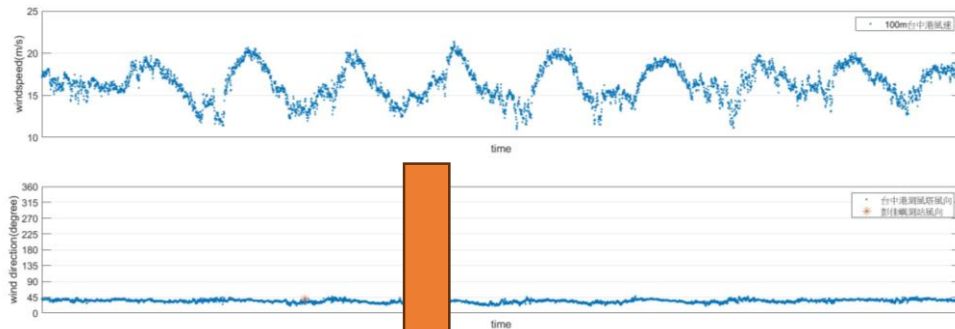
[2] Tsai, Y. S., Miao, J. J., Yu, C. M., and Chang, W. T., 2019. "Lidar observations of the typhoon boundary layer within the outer rainbands," *Boundary-Layer Meteorol.*, 171, 237–255.

[3] Banta, R. M., 2008. "Stable-boundary-layer regimes from the perspective of the low-level jet," *Acta Geophysica*, 56, 58–87.

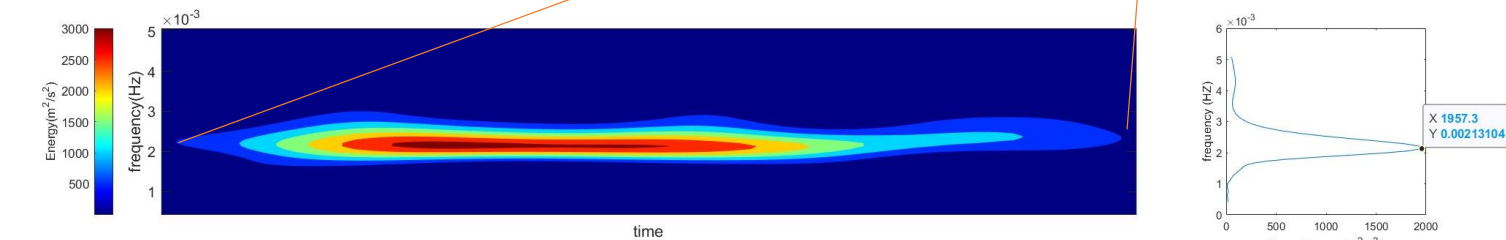
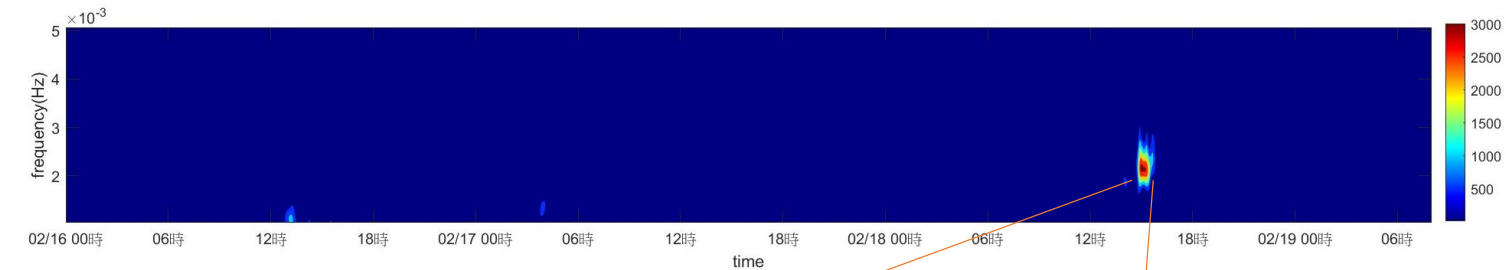
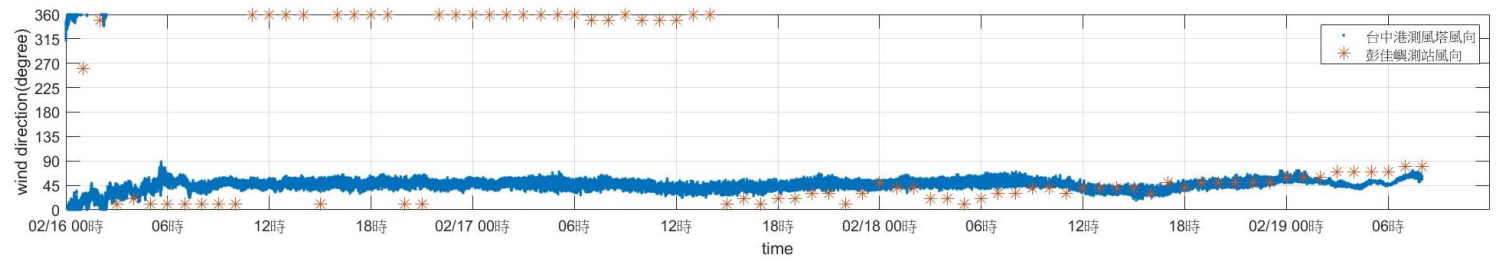
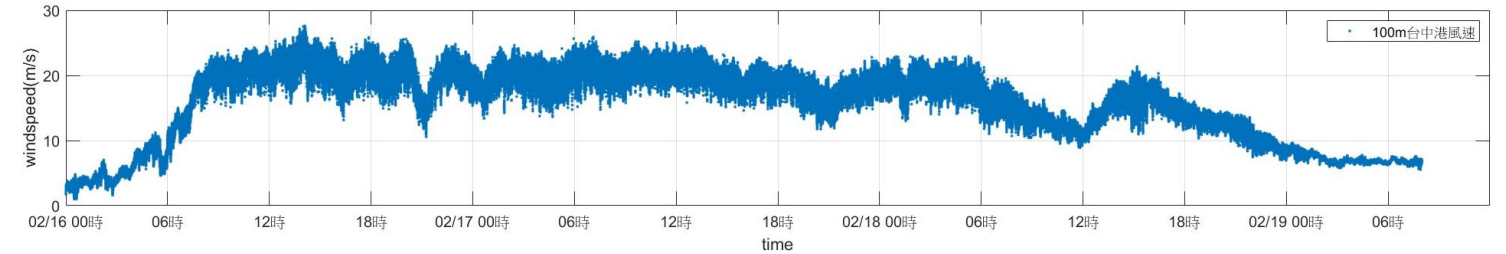
Previous Study -2

Wavelet Transform analysis from Taichung Wind Tower

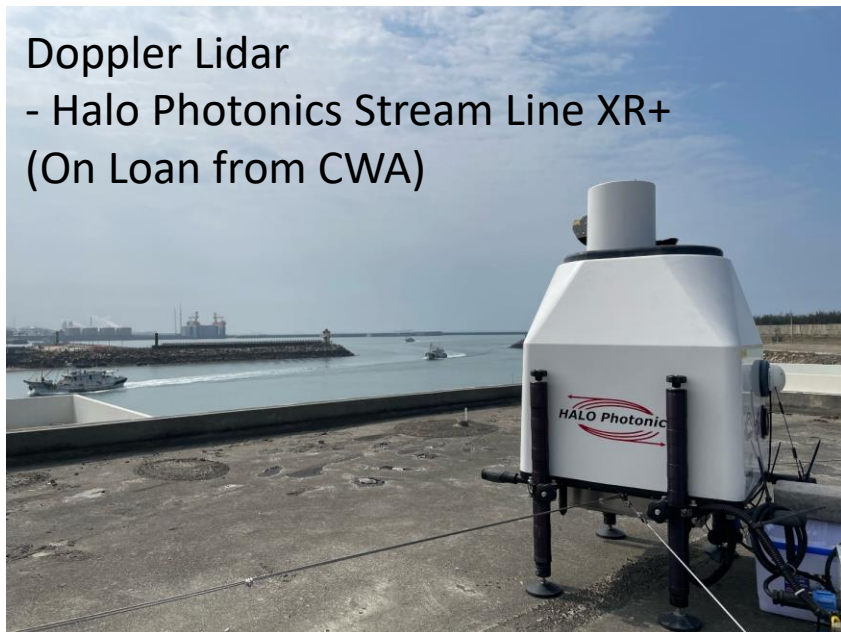
Wavelet Transform uses short-duration waveforms to provide both time and frequency localization. It is effective for analyzing non-stationary or transient signals.



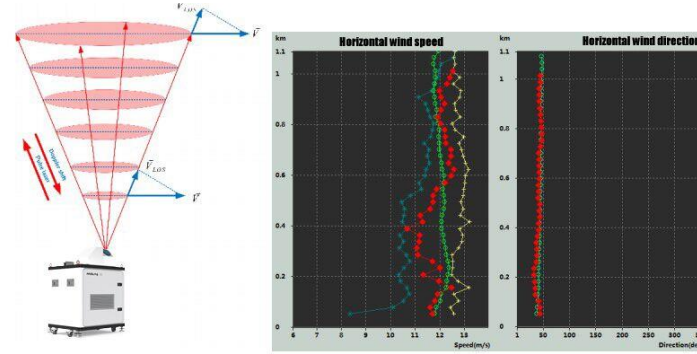
10m/s horizontal wind velocity difference in the period of 8.5min



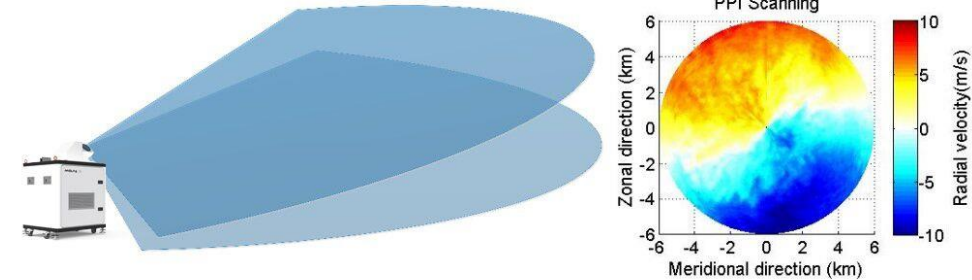
Wind Lidar Scanning Strategies



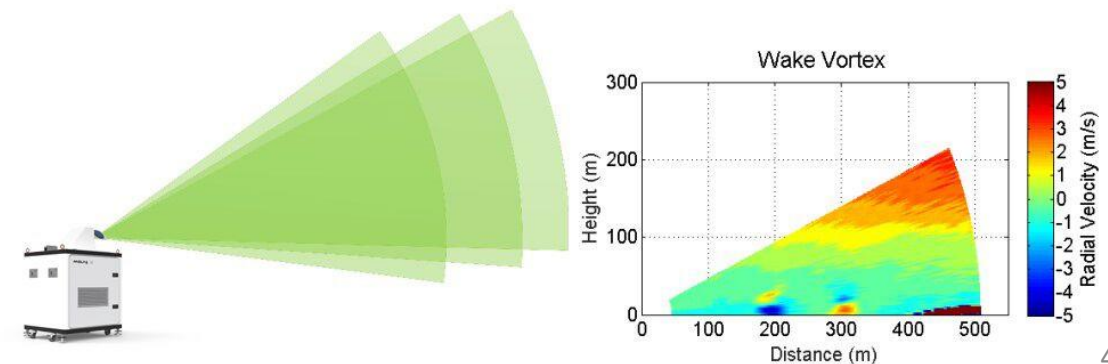
1. VAD -> 6 Beams at elevation angle(θ) = 75°



2. PPI(Plan Position Indicator)

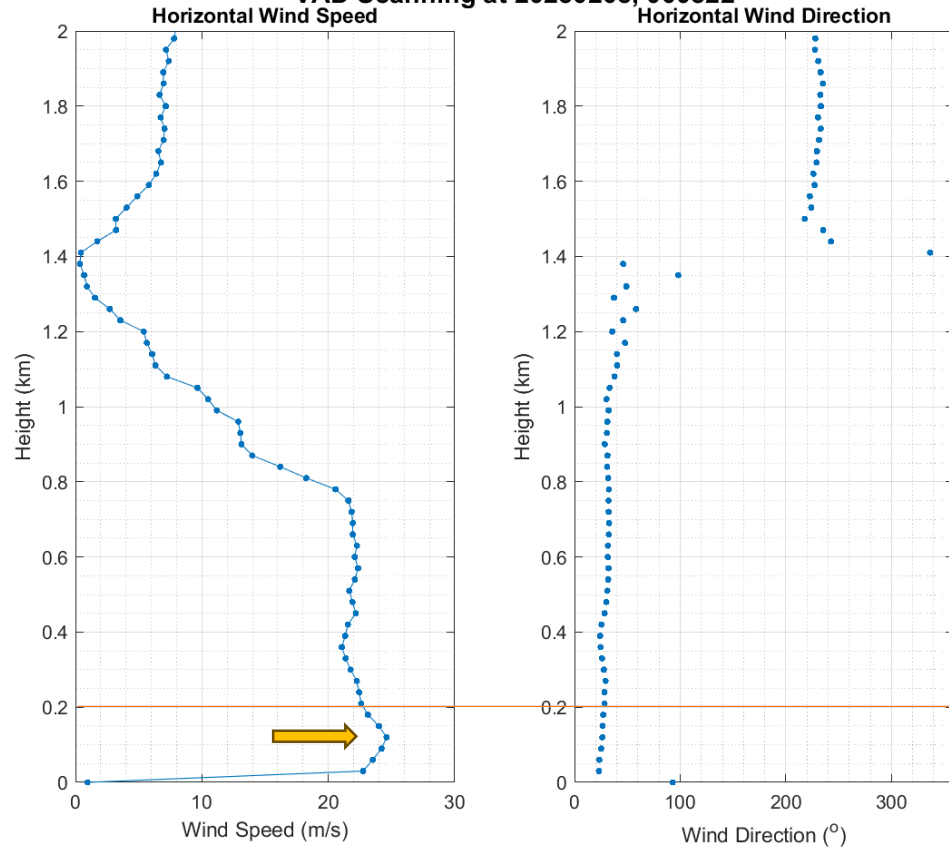


3. RHI(Range Height Indicator)

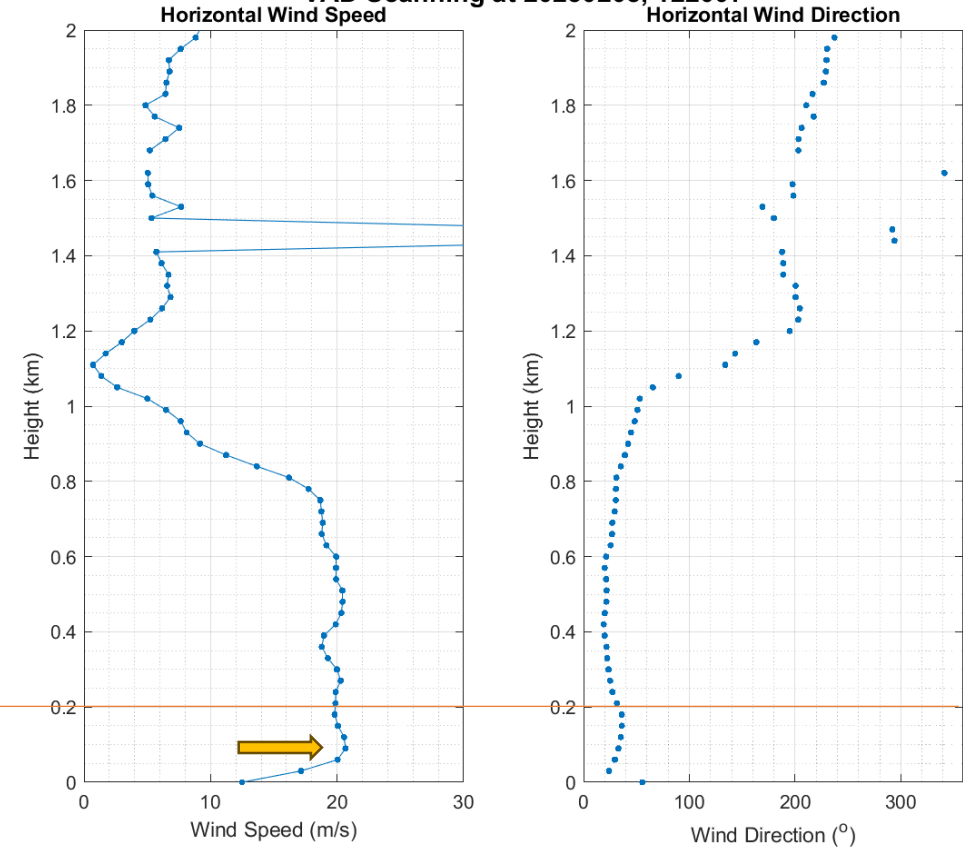


Wind Profile at 2025.02.08

VAD Scanning at 20250208, 000822

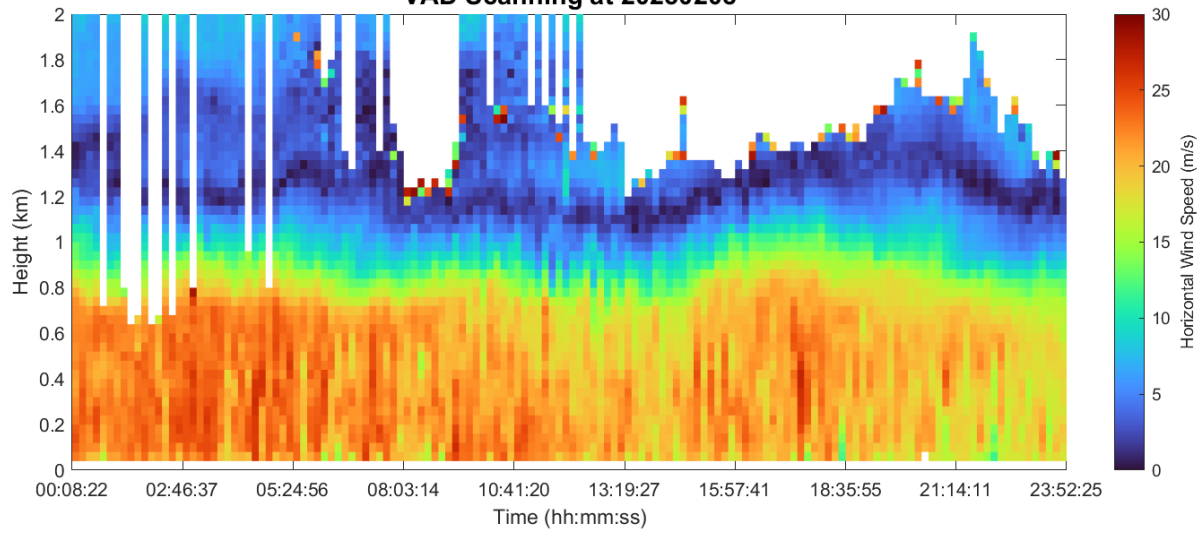


VAD Scanning at 20250208, 122007

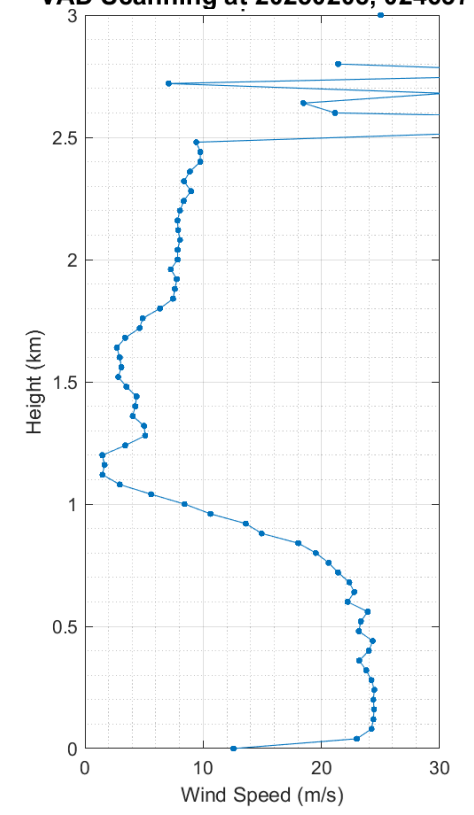


Wind Profile through time series

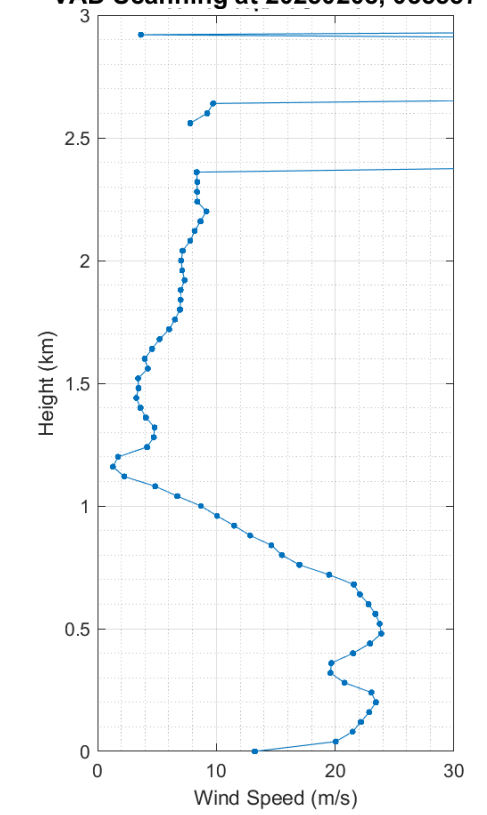
VAD Scanning at 20250208



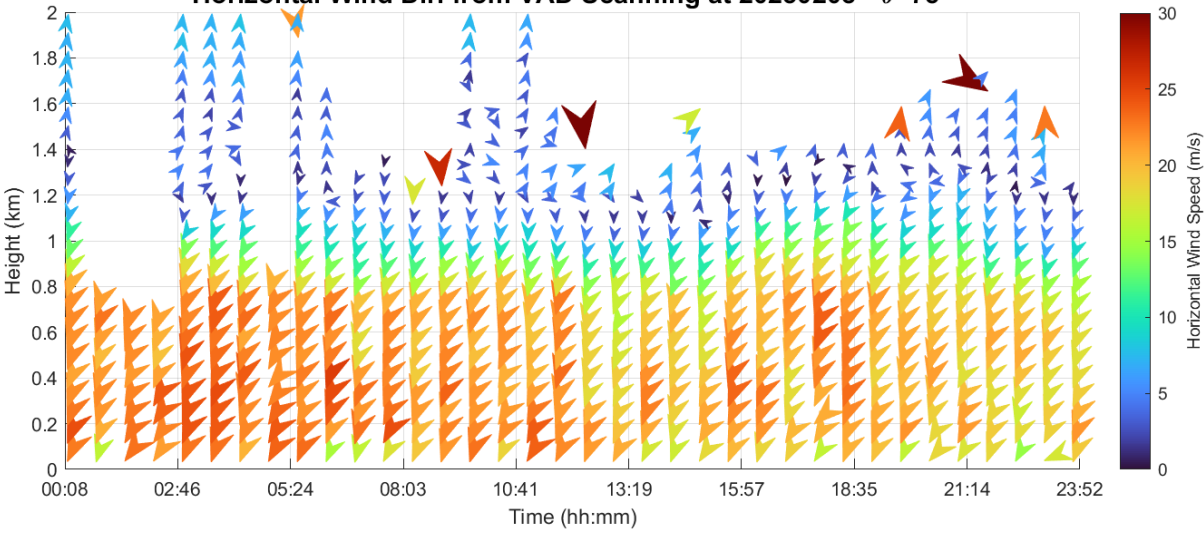
VAD Scanning at 20250208, 024637



VAD Scanning at 20250208, 035557

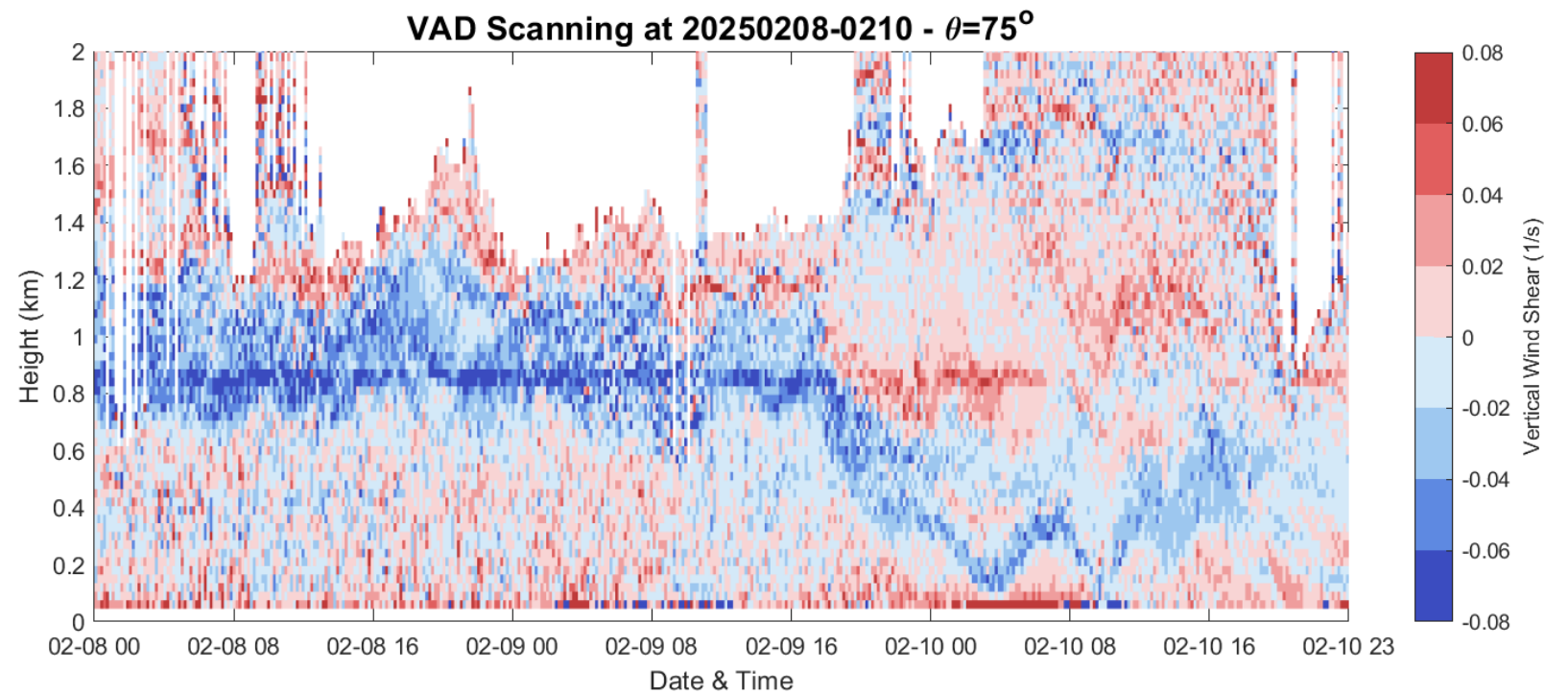
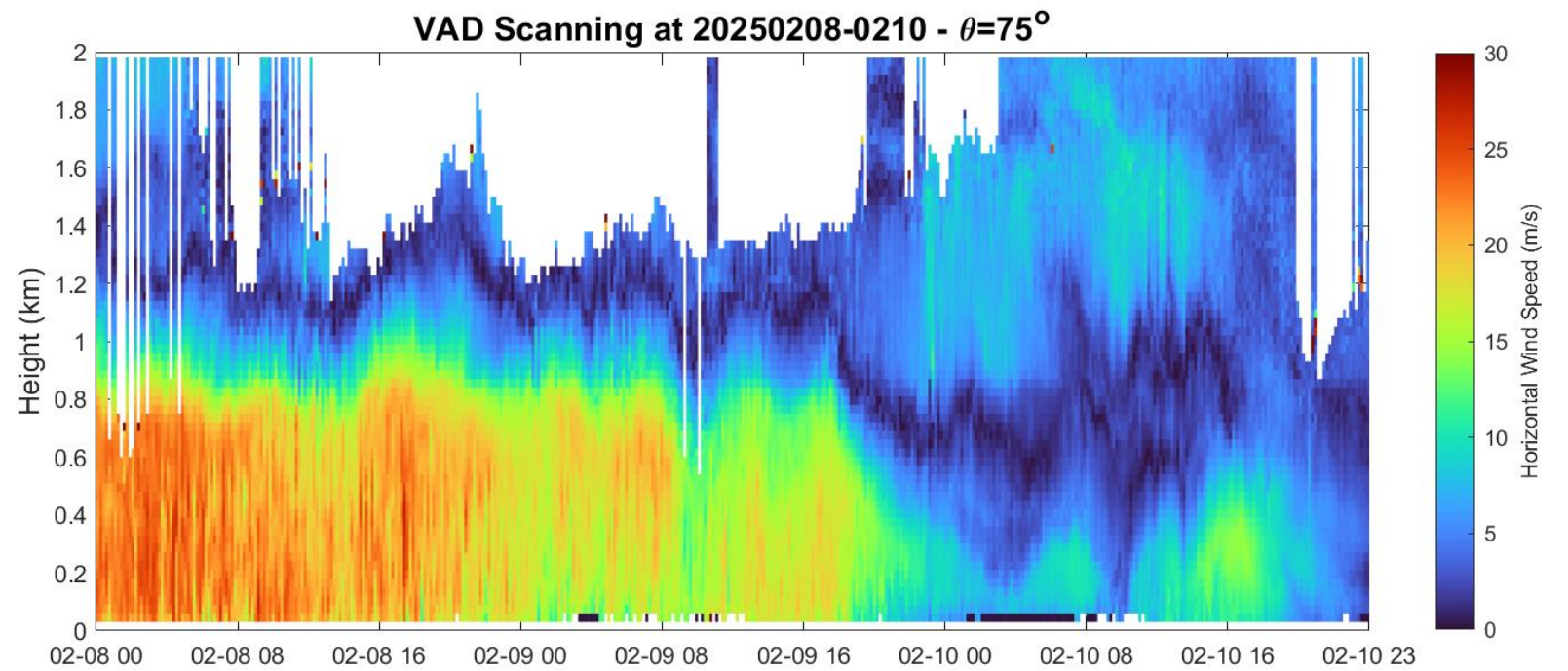


Horizontal Wind Dir. from VAD Scanning at 20250208 - $\theta=75^\circ$



Wind Shear

under Northeast Monsoon



Vertical Wind Shear = $\frac{dU}{dz}$

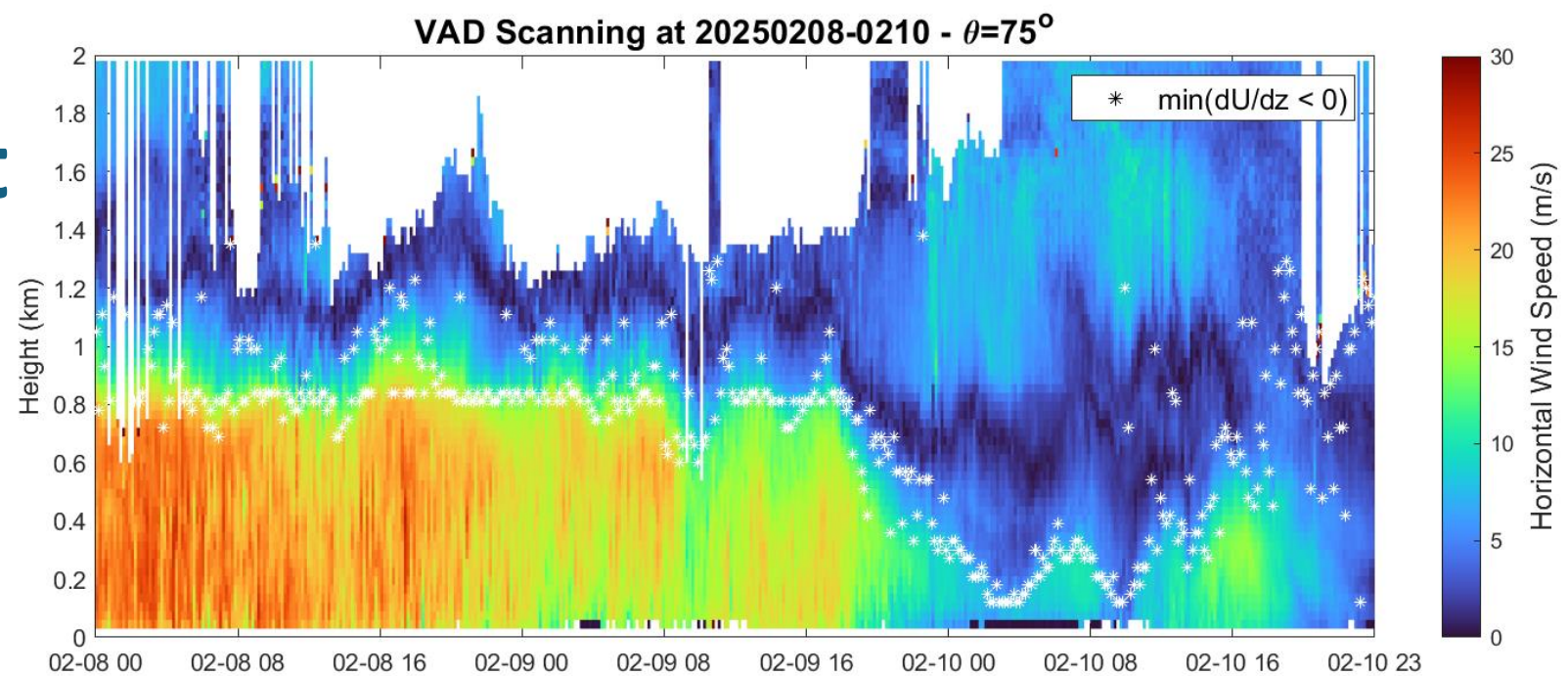
U is horizontal wind velocity
dz is altitude change between two
range gates

Boundary Layer Thickness Movement of the Northeast Monsoon

Top of the Boundary Altitude
Define as minimum of $dU/dz < 0$

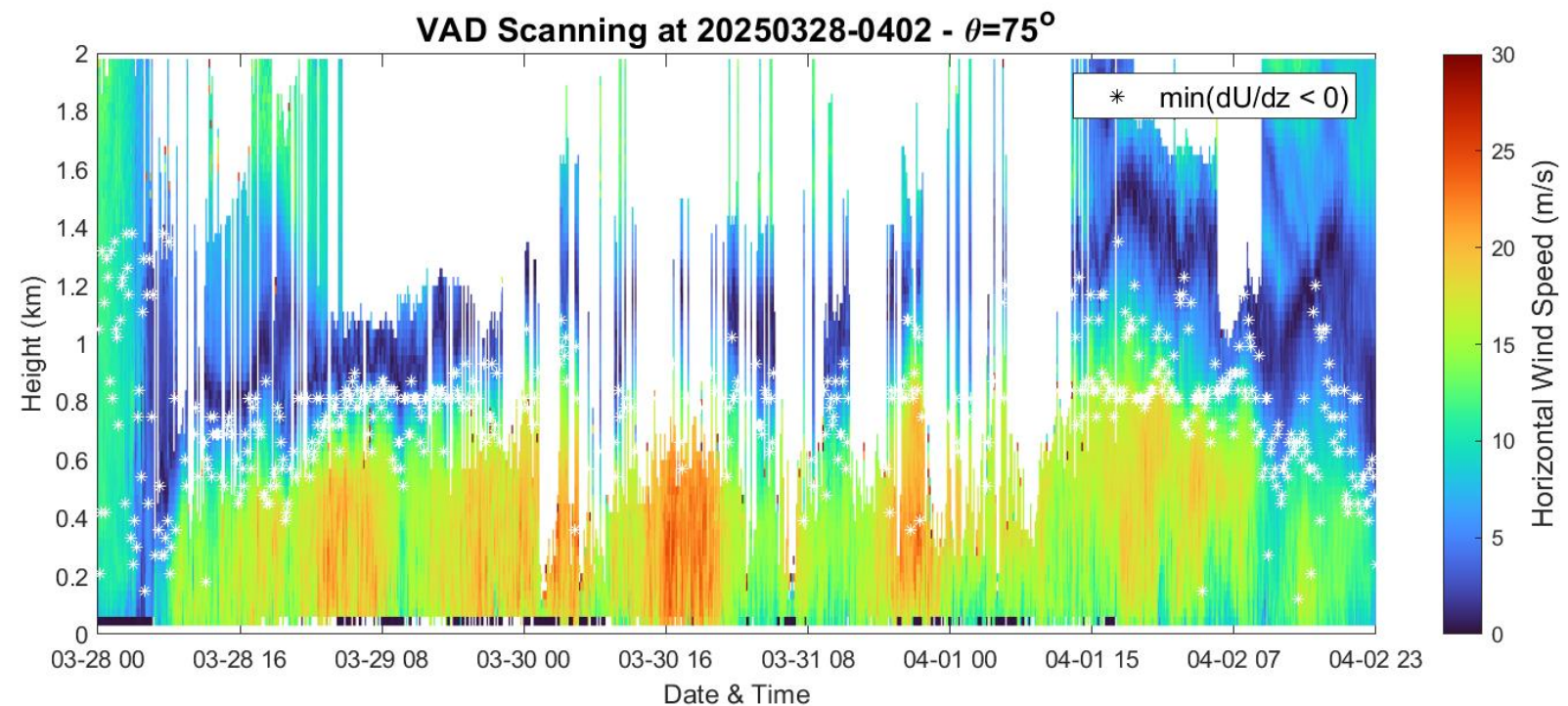
Case 1:

Date: 2025.02.08 - 02.10



Case 2:

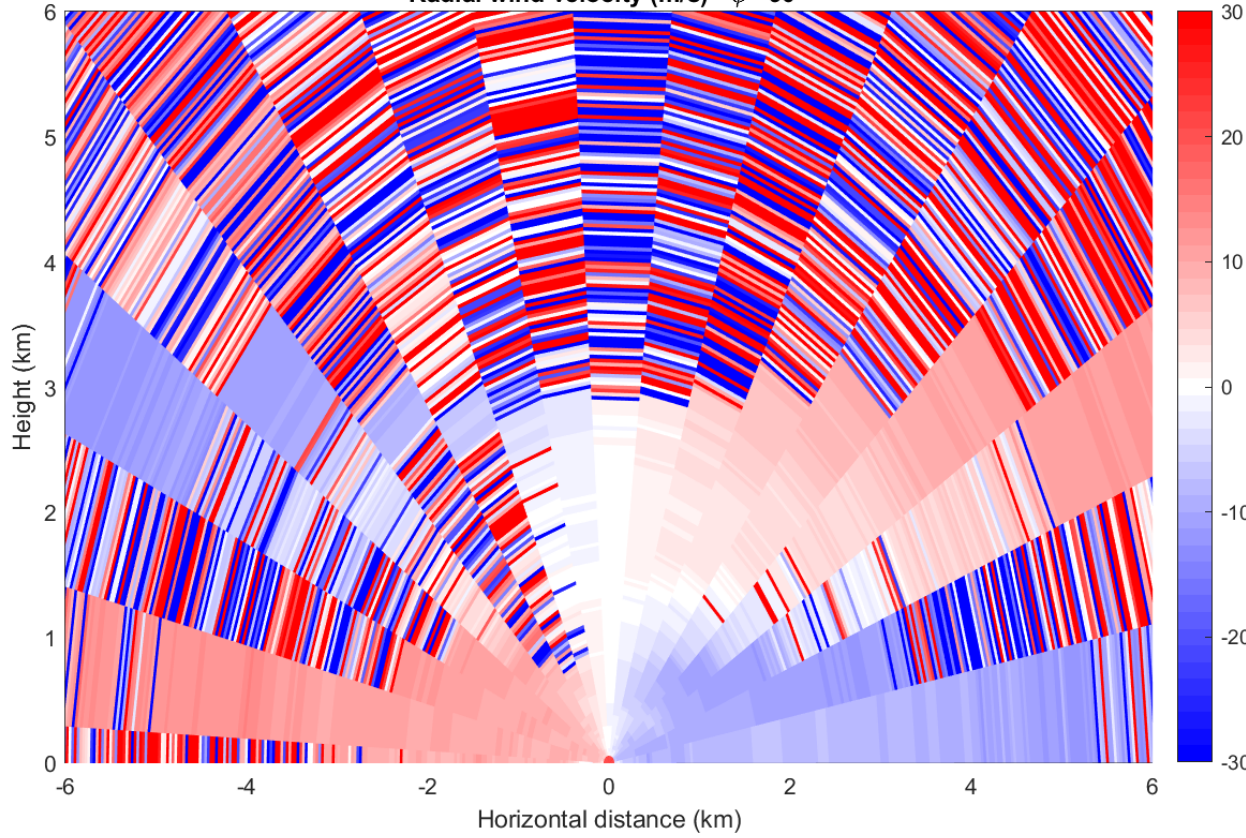
Date: 2025.03.28 - 04.02



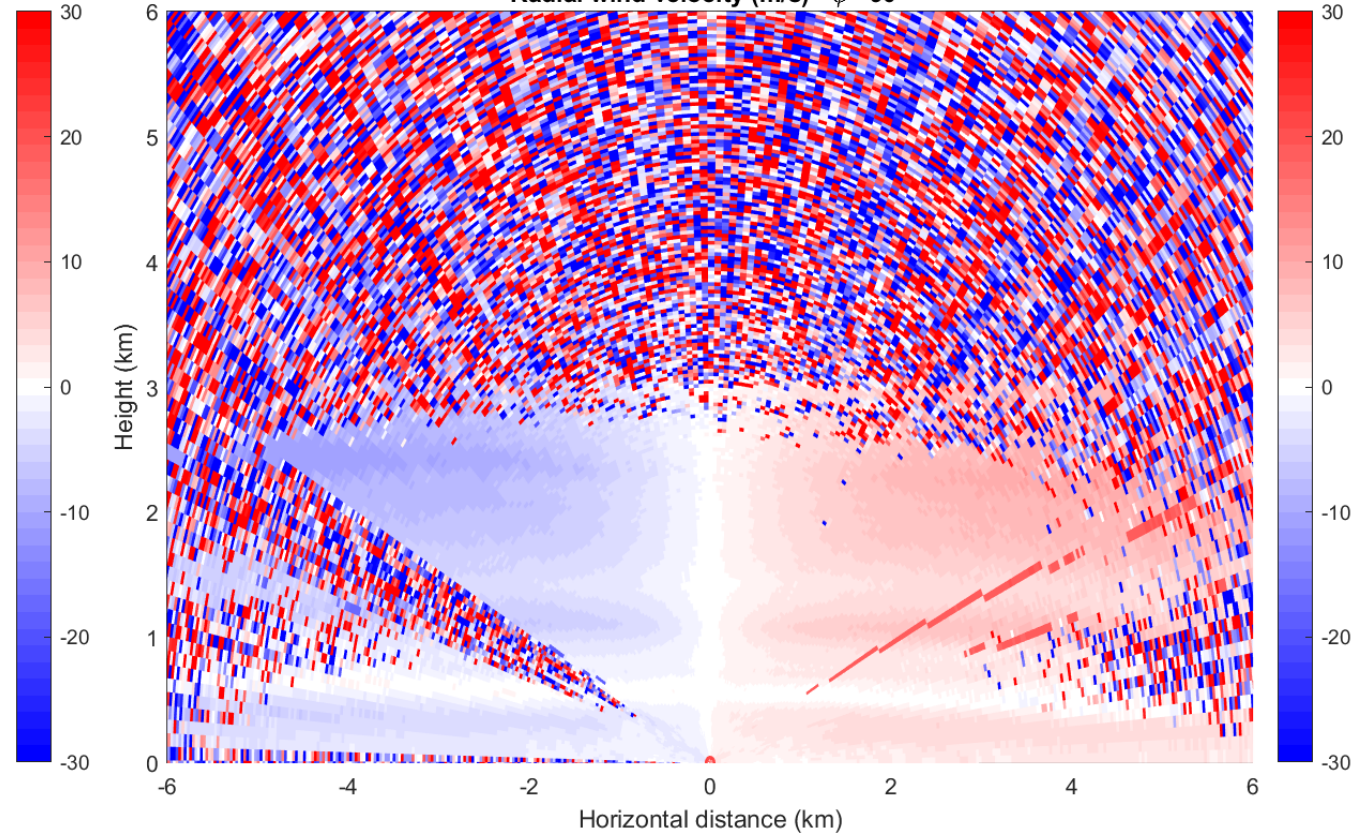
RHI Scanning

under Northeast Monsoon

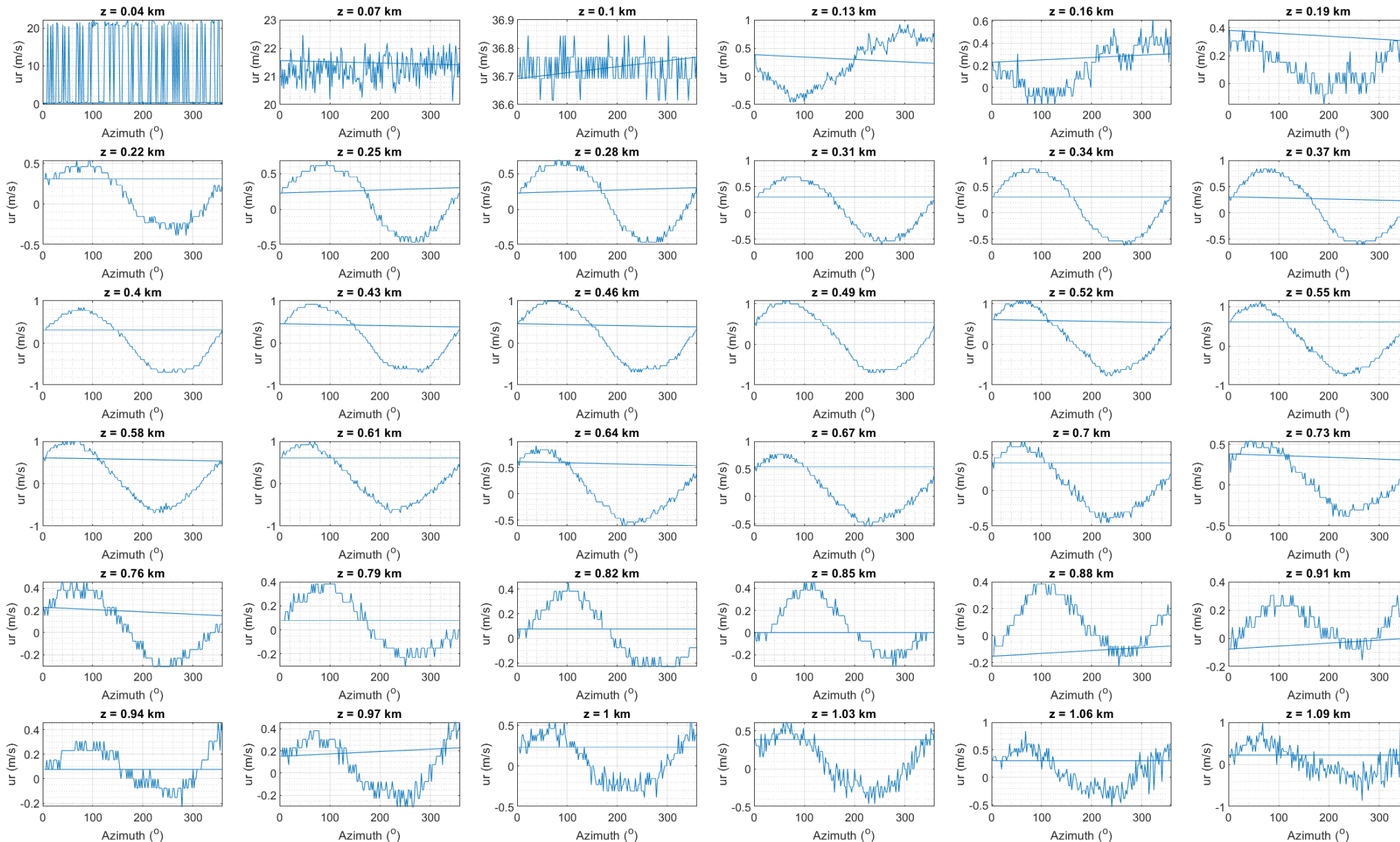
RHI Scanning at 20250208, 000903
Radial wind velocity (m/s) - $\phi = 90^\circ$



RHI Scanning at 20250420, 043611
Radial wind velocity (m/s) - $\phi = 90^\circ$



VAD180 Scanning at 20250627, 012253



Acknowledgement



NCKU
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The research gratefully acknowledge the Central Weather Administration for the LIDAR support, the BSMI for Taichung Port wind data, and Smartech Inc. for assistance with equipment installation.



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Thanks for your attention !

Block Diagram

VAD Scanning Analysis

