# Atmospheric Boundary Layer Wind Structure Measured by the Doppler Wind Lidar near CCT, Ny-Ålesund

March 11, 2025

Sang-Jong Park

KOPRI
극지연구소
Korea Polar Research Institute

# Objective

- RIS-ID: 10247 (Title)
- Objectives:

✓ By measuring vertical profile of wind in Ny-Alesund year-round

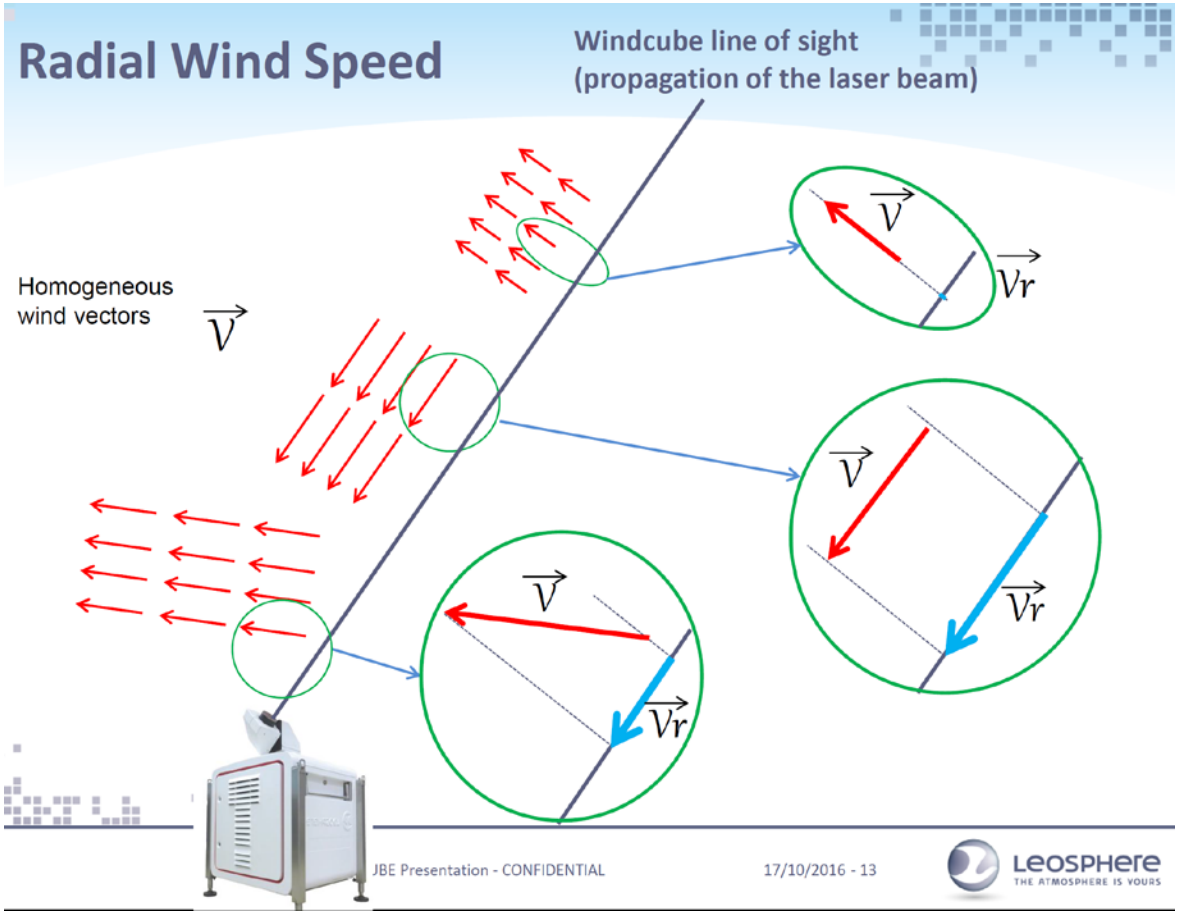
✓ To understand turbulent structure in the Arctic boundary layer under various environmental conditions: surface, stability etc

✓ To understand entrainment below Arctic cloud

✓ To help other researches requiring wind distribution in Ny-Alesund

# Instrument - principle

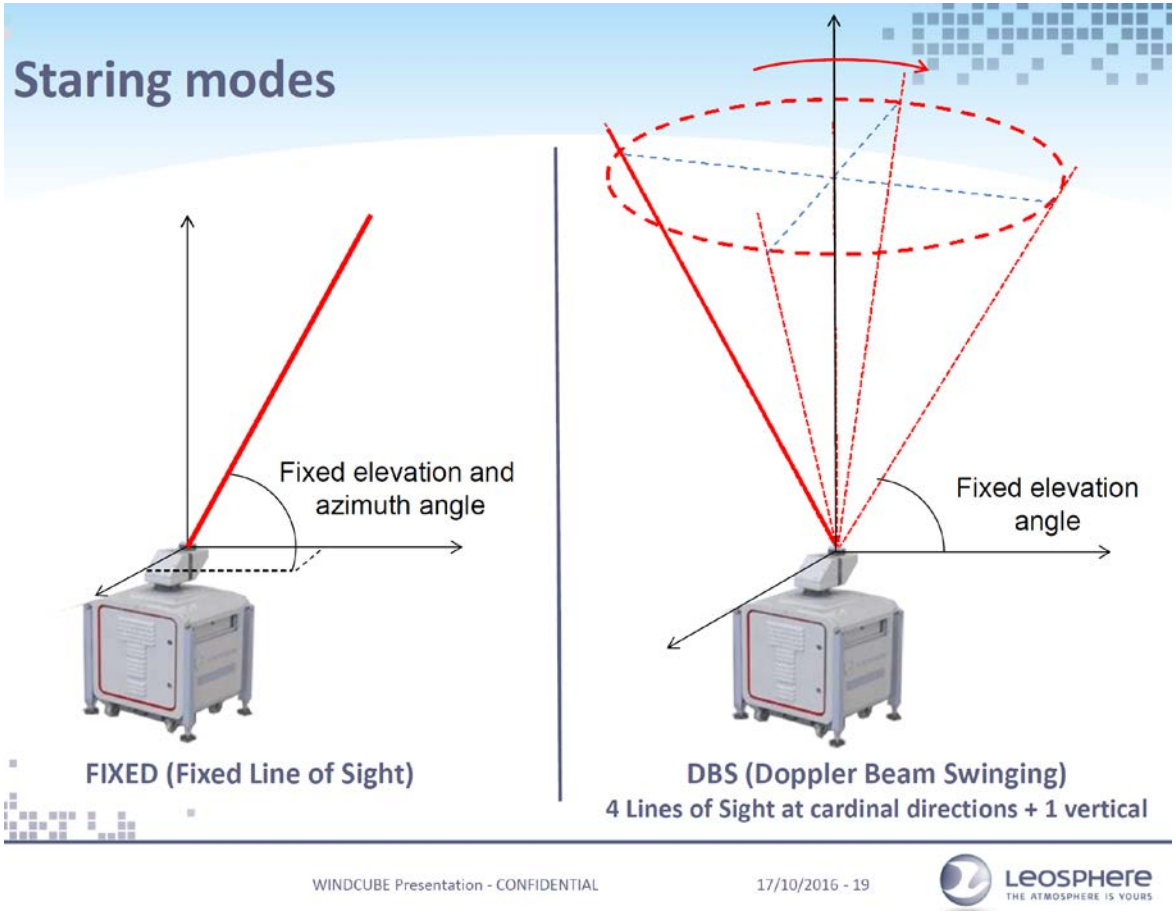
- Model: Doppler wind lidar (Windcube-100S, Leosphere)
- Principle: obtain radial velocity by measuring doppler effect by particles in the air




Ref) WLS-100S HW manual rev.7

# Instrument - modes

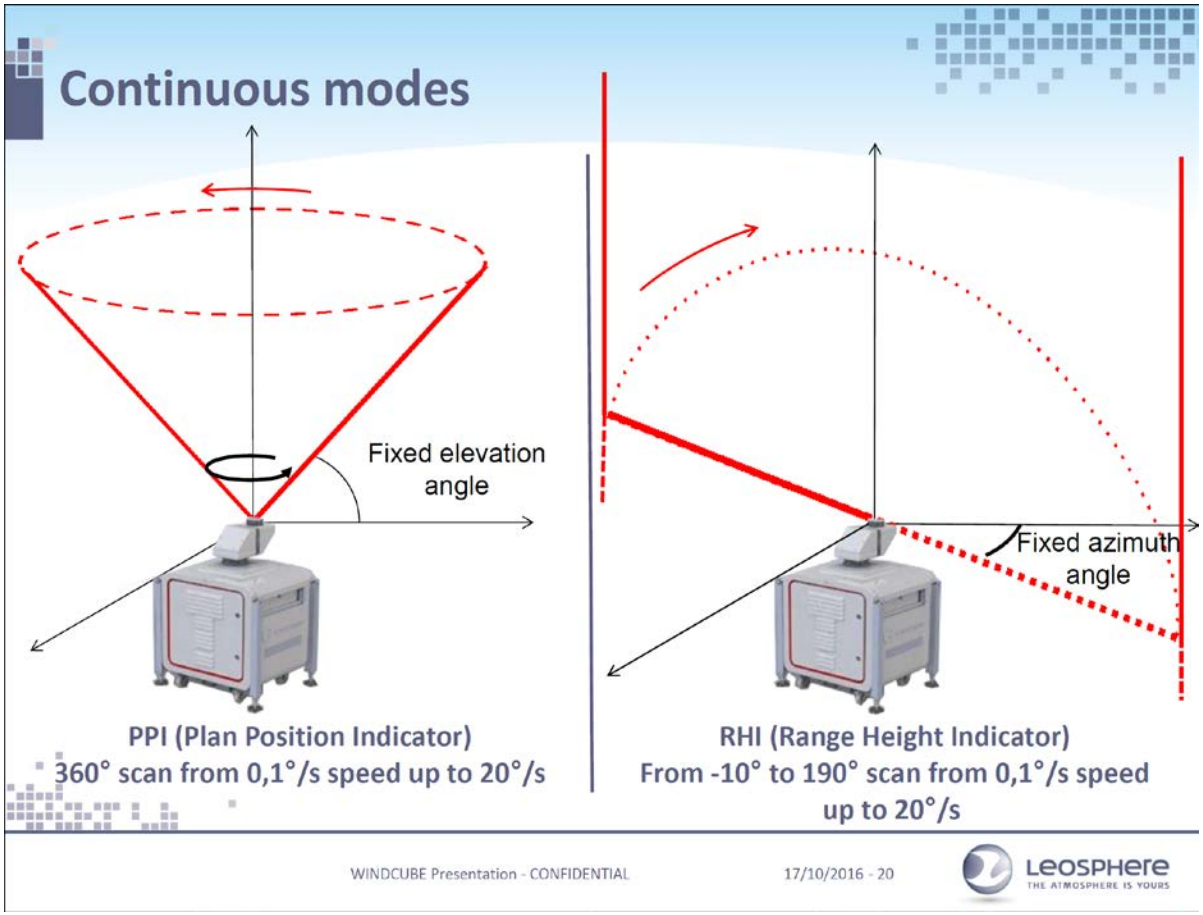
- Modes: LOS and DBS




Ref) WLS-100S HW manual rev.7

# Instrument - modes

- Modes: PPI and RHI




Ref) WLS-100S HW manual rev.7

→ Radial velocity (LOS, RHI, PPI), Wind vector (DBS)

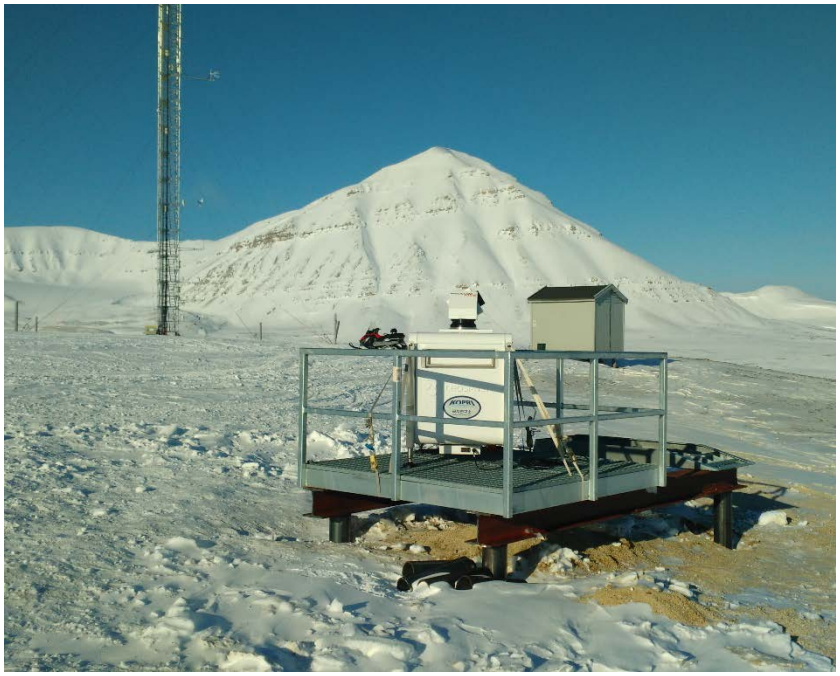
# Instrument – current configuration

- Combination of DBS, RHI, PPI, LOS at ~ 30-min cycle

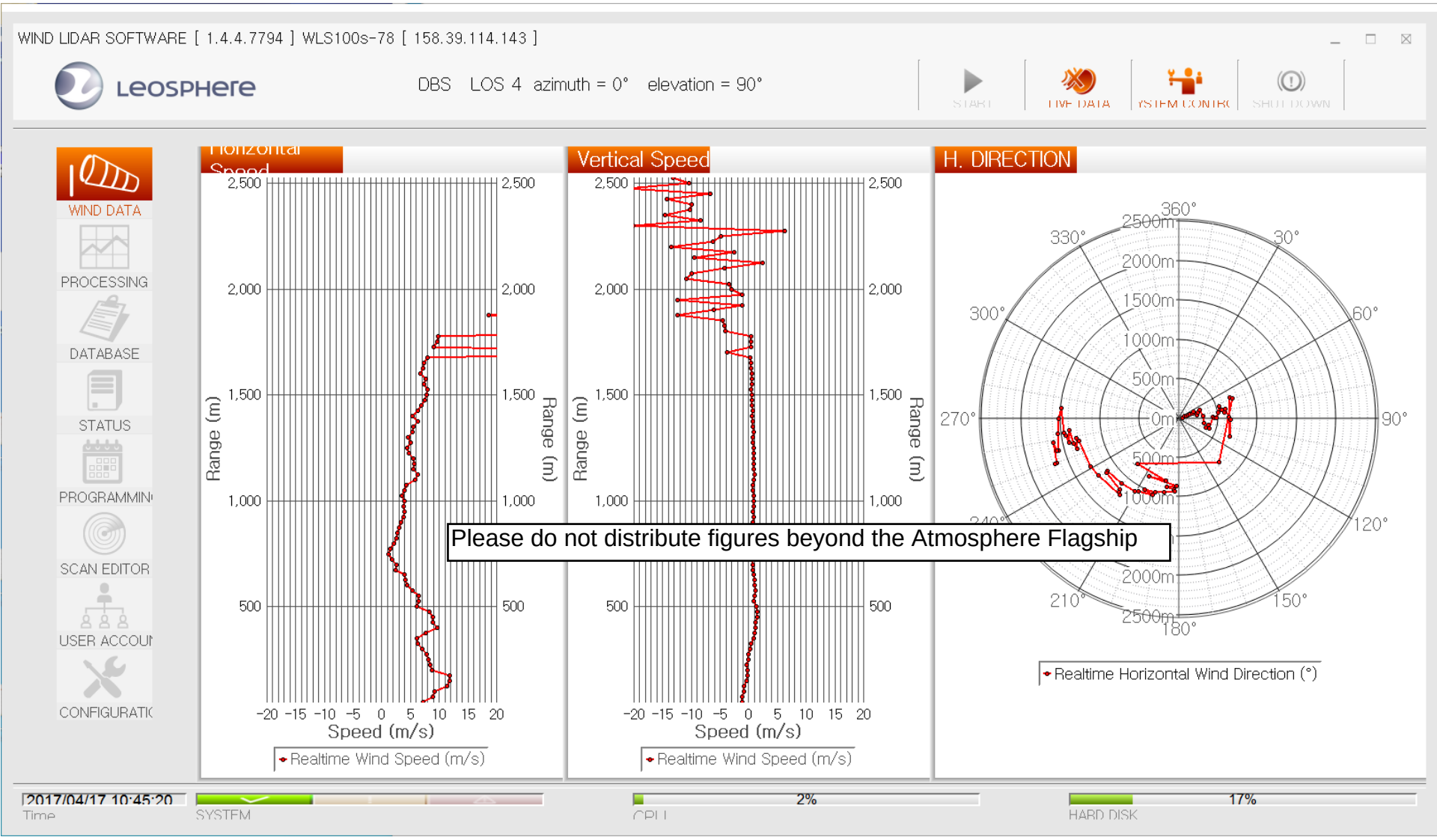
- 25-m interval from 100m AGL
- One cycle
  - DBS * 5 times
  - PPI * 1
  - RHI_East_West * 1
  - RHI_North_South * 1
  - LOS * 1200 sec

# Instrument - location

- Location: ~50m northeast from the CCT
- Period: year-round since April 2017

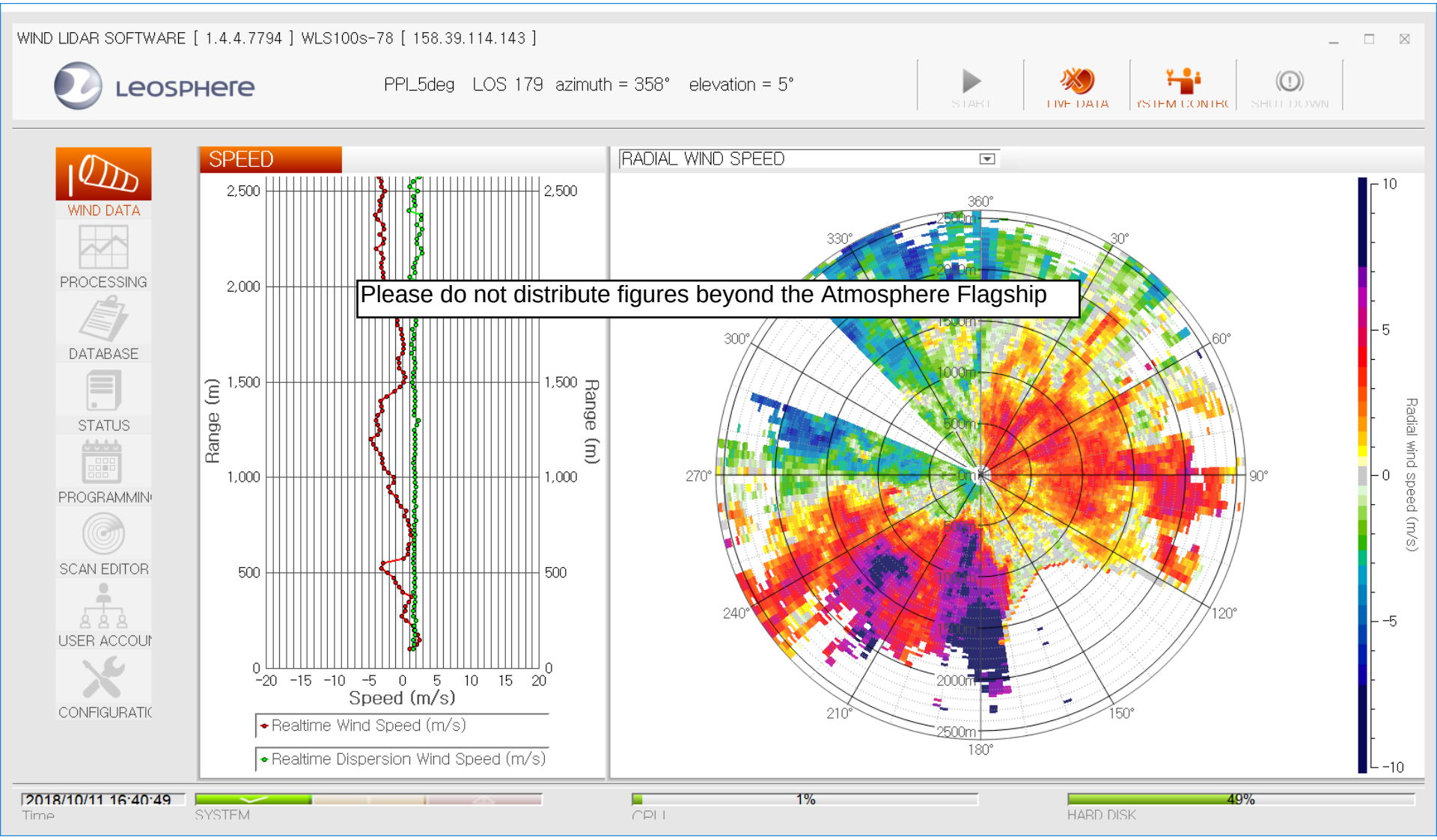


# Example of observations - 1



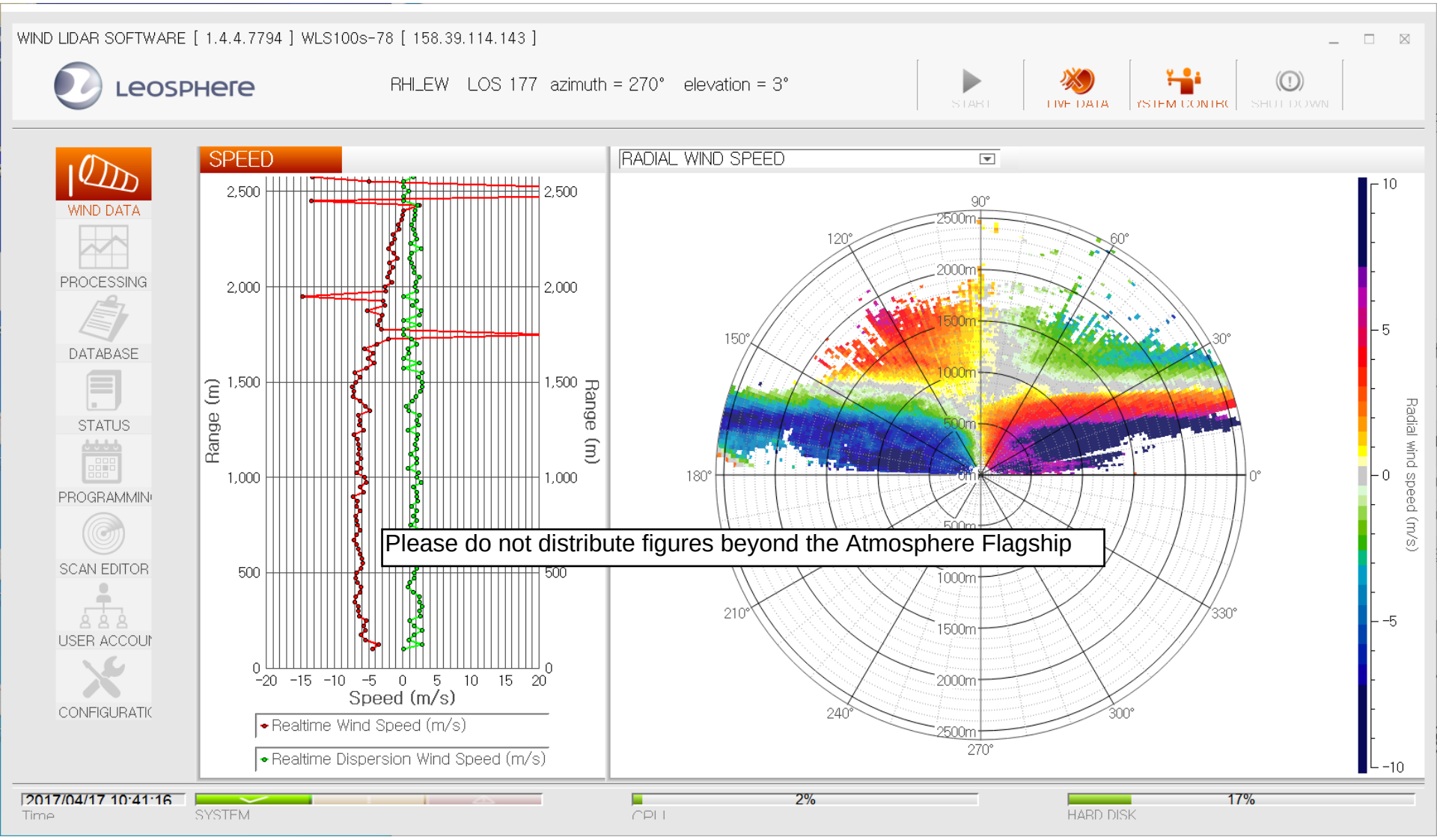

DBS (vertical profile of wind, usually < 1 km)

# Example of observations - 2



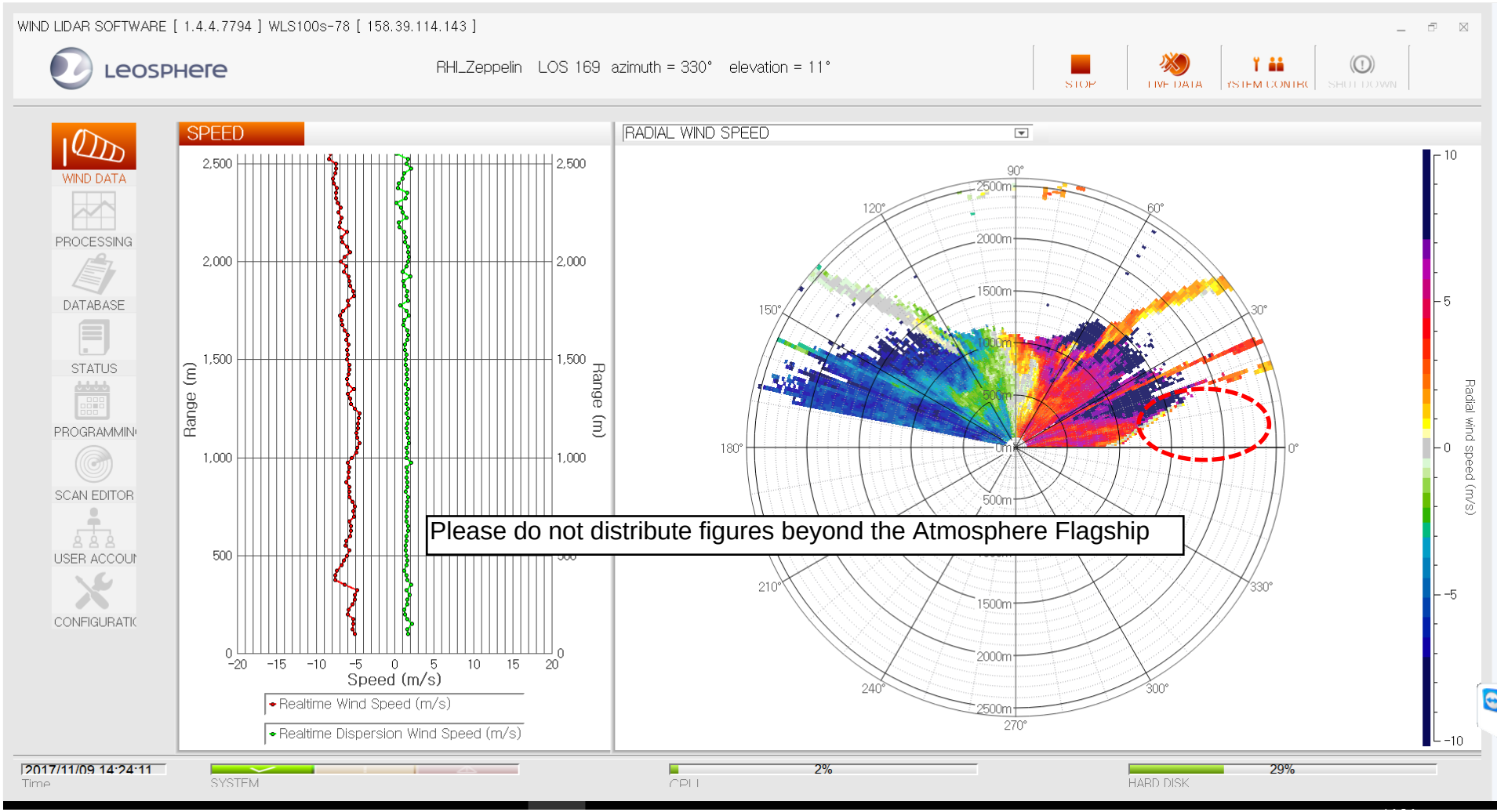

PPI (horizontal distribution of radial velocity, < 2.5km)

# Example of observations - 3



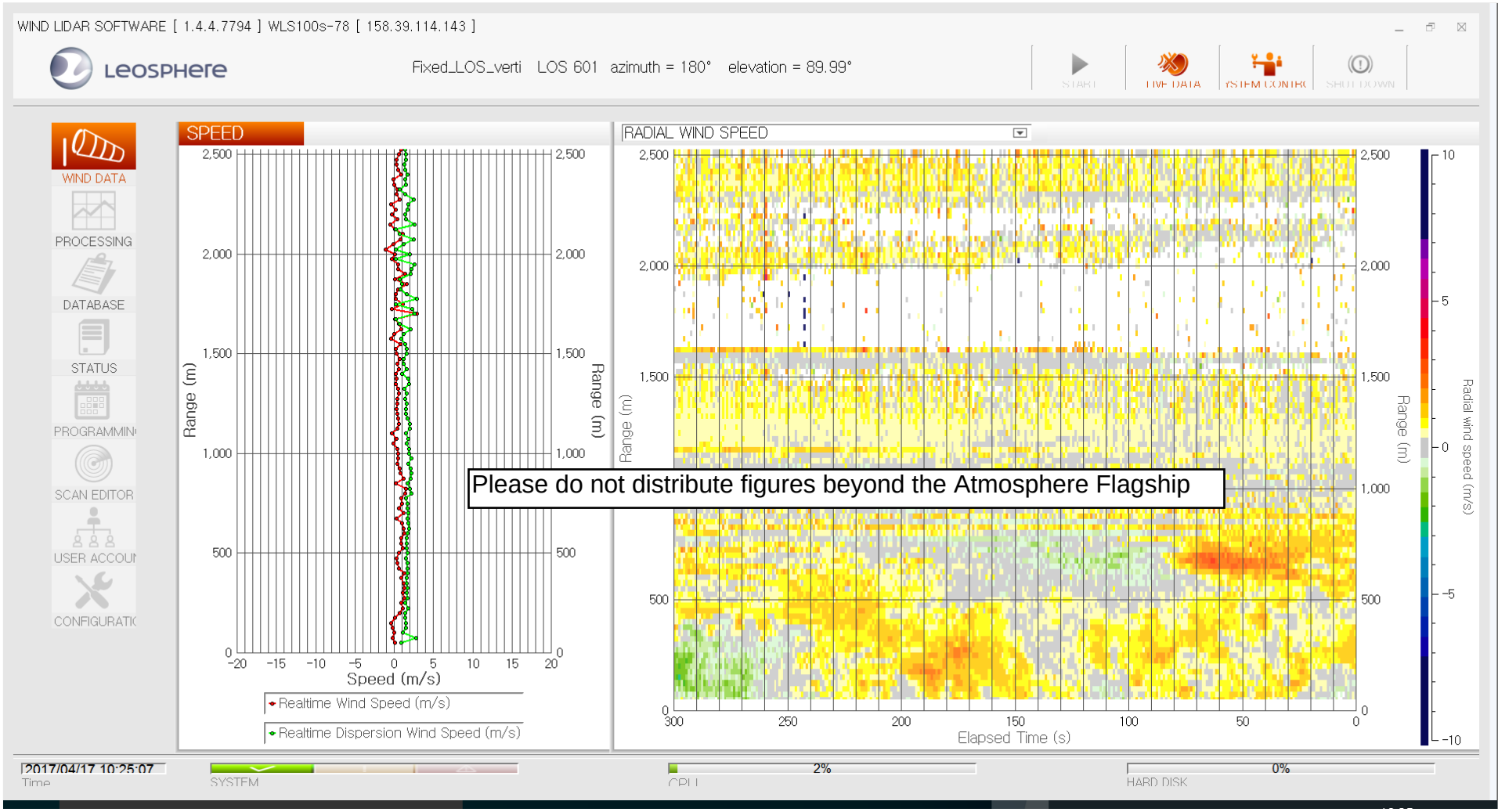

RHI-EW (Cross section in East-West direction)

# Example of observations - 4



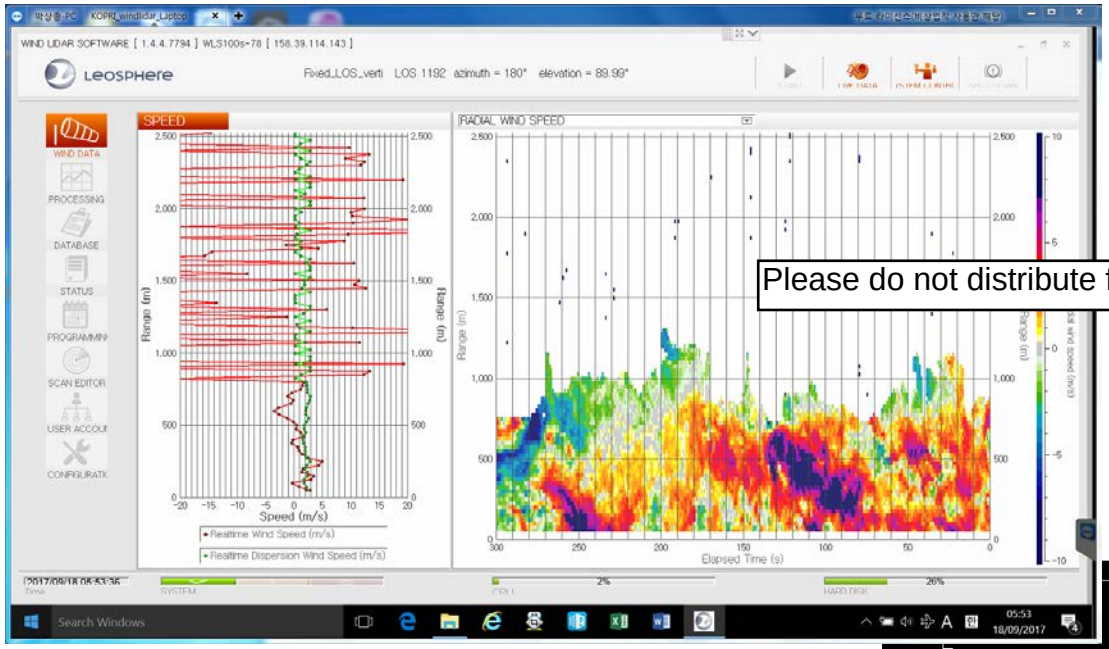

RHI-NS (Cross section in ~ South-North direction, Zeppelin direction)

# Example of observations - 5




LOS (vertical profile of vertical wind *w* for 20-min at 1-sec interval)

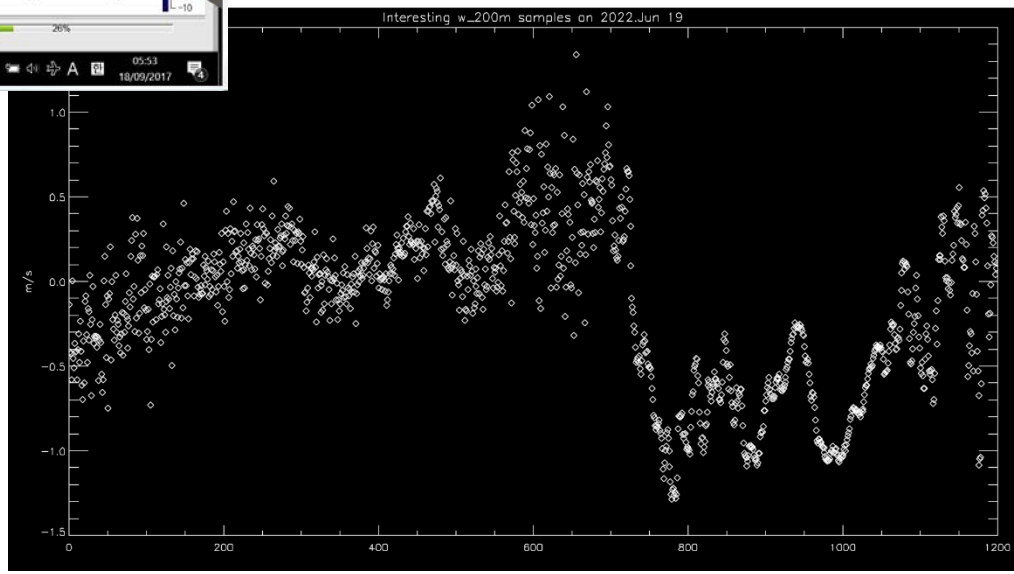
# Example of observations - 6




Please do not distribute figures beyond the Atmosphere Flagship

Dramatic variation of *w* in very strong wind condition

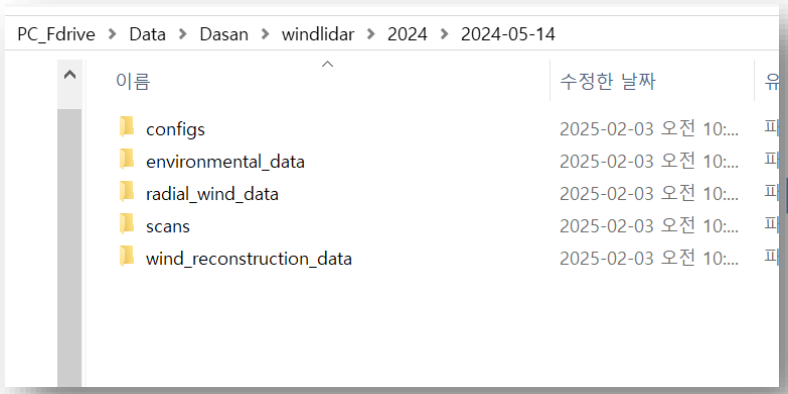
(Sep 18, 2017)



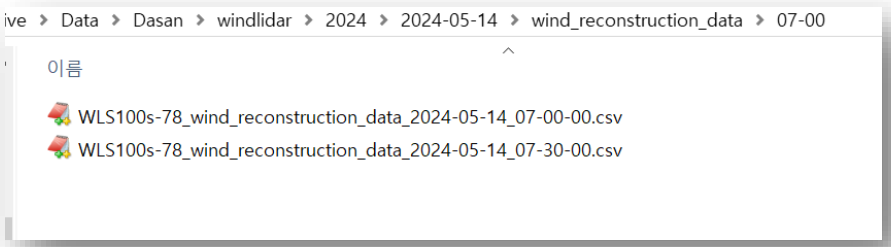

Wave motion in *w* data?

(Jun 19, 2022)

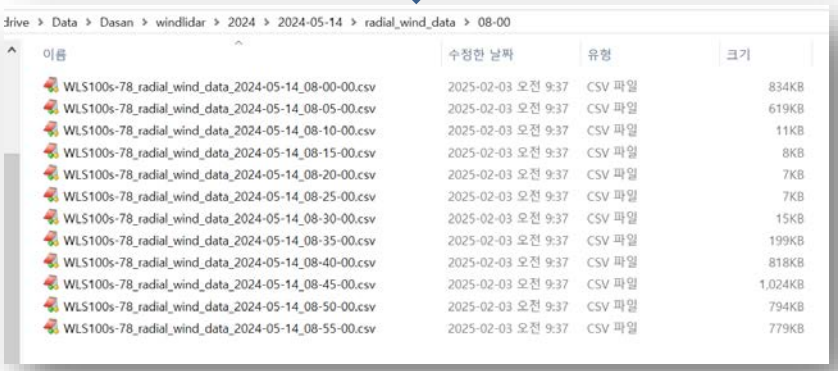
# Data file structure




Data folders each day




Wind reconstruction (DBS) files each hour




Radial wind (all modes) each hour

| TimeStamp | Azimuth [ | Elevation | Range [m] | X-Wind Speed | Y-Wind Spee | Z-Wind Speed | CNR [db] | Confidence index [%] |
|---|---|---|---|---|---|---|---|---|
| 2024-05-14 6:30 | 6.87E-05 | 74.9997 | 900 | -7.06702 | 1.26735 | 0.234779 | -21.7672 | 100 |
| 2024-05-14 6:30 | 6.87E-05 | 74.9997 | 925 | -7.66683 | -2.90199 | 0.532655 | -13.1214 | 100 |
| 2024-05-14 6:30 | 6.87E-05 | 74.9997 | 950 | -7.51827 | -3.16881 | 0.904713 | -13.1924 | 100 |
| 2024-05-14 6:30 | 6.87E-05 | 74.9997 | 975 | -7.7133 | -3.12869 | 1.22075 | -17.0814 | 100 |
| 2024-05-14 6:30 | 6.87E-05 | 74.9997 | 1000 | -7.60641 | -3.26307 | 1.51309 | -25.1365 | 100 |
| 2024-05-14 6:30 | 90.0016 | 75.0031 | 900 | -6.9007 | -2.15502 | 0.030233 | 4.504 | 100 |
| 2024-05-14 6:30 | 90.0016 | 75.0031 | 925 | -7.71579 | -2.08045 | 0.592865 | 9.07768 | 100 |
| 2024-05-14 6:30 | 90.0016 | 75.0031 | 950 | -7.54259 | -2.57586 | 0.934628 | 5.35919 | 100 |
| 2024-05-14 6:30 | 90.0016 | 75.0031 | 975 | -7.67609 | -3.50114 | 1.17499 | -1.98246 | 100 |
| 2024-05-14 6:30 | 90.0016 | 75.0031 | 1000 | -7.54401 | -4.27607 | 1.43635 | -11.3612 | 100 |
| 2024-05-14 6:30 | -179.999 | 75.0031 | 900 | -6.43945 | -2.10191 | -0.0350776 | -7.30335 | 100 |
| 2024-05-14 6:30 | -179.999 | 75.0031 | 925 | -5.24634 | -1.87427 | 0.339307 | 7.34716 | 100 |
| 2024-05-14 6:30 | -179.999 | 75.0031 | 950 | -6.37621 | -2.48878 | 0.827533 | 12.4538 | 100 |
| 2024-05-14 6:30 | -179.999 | 75.0031 | 975 | -7.29677 | -3.48213 | 1.15161 | 12.5927 | 100 |
| 2024-05-14 6:30 | -179.999 | 75.0031 | 1000 | -7.33087 | -4.26343 | 1.42081 | 7.838 | 100 |
| 2024-05-14 6:30 | -90.0021 | 75.0061 | 900 | -6.43945 | -3.12066 | 0.108147 | -15.2925 | 100 |
| 2024-05-14 6:30 | -90.0021 | 75.0061 | 925 | -5.24634 | -1.94562 | 0.327948 | -1.65877 | 100 |
| 2024-05-14 6:30 | -90.0021 | 75.0061 | 950 | -6.37621 | -2.4648 | 0.803769 | 10.6135 | 100 |
| 2024-05-14 6:30 | -90.0021 | 75.0061 | 975 | -7.29677 | -3.79997 | 1.16403 | 9.17764 | 100 |

DBS data contents (30-min interval)

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Timestamp | Configuration ID | Scan ID | LOS ID | Azimuth [째] | Elevation [째] | Range [m] | RWS [m/s] | DRWS [m/s] | CNR [db] | |
| 2 | 2024-05-14 8:40:00 | 31 | 91 | 142 | -90.0001 | 38.0173 | 300 | -4.07128 | 1.89604 | -26.031 | |
| 3 | 2024-05-14 8:40:00 | 31 | 91 | 142 | -90.0001 | 38.0173 | 325 | -4.36363 | 1.13776 | -25.7112 | |
| 4 | 2024-05-14 8:40:00 | 31 | 91 | 142 | -90.0001 | 38.0173 | 350 | -3.69281 | 2.11028 | -25.0134 | |
| 5 | 2024-05-14 8:40:00 | 31 | 91 | 142 | -90.0001 | 38.0173 | 400 | -3.99156 | 0.899542 | -25.7229 | |
| 6 | 2024-05-14 8:40:00 | 31 | 91 | 142 | -90.0001 | 38.0173 | 425 | -3.19191 | 2.54138 | -25.0361 | |
| 7 | 2024-05-14 8:40:00 | 31 | 91 | 142 | -90.0001 | 38.0173 | 450 | -2.3545 | 2.24541 | -24.4447 | |
| 8 | 2024-05-14 8:40:00 | 31 | 91 | 142 | -90.0001 | 38.0173 | 475 | -2.78038 | 2.31065 | -24.7881 | |
| 9 | 2024-05-14 8:40:00 | 31 | 91 | 142 | -90.0001 | 38.0173 | 500 | -2.59021 | 2.82376 | -24.8466 | |
| 10 | 2024-05-14 8:40:00 | 31 | 91 | 142 | -90.0001 | 38.0173 | 525 | -2.70014 | 1.41923 | -24.7267 | |
| 11 | 2024-05-14 8:40:00 | 31 | 91 | 142 | -90.0001 | 38.0173 | 550 | -2.68544 | 2.2377 | -24.8889 | |
| 12 | 2024-05-14 8:40:00 | 31 | 91 | 142 | -90.0001 | 38.0173 | 575 | -1.61294 | 2.92113 | -24.9726 | |
| 13 | 2024-05-14 8:40:00 | 31 | 91 | 142 | -90.0001 | 38.0173 | 600 | -1.74633 | 2.85622 | -23.8403 | |
| 14 | 2024-05-14 8:40:00 | 31 | 91 | 142 | -90.0001 | 38.0173 | 625 | -0.93584 | 1.79443 | -24.6668 | |

Radial wind data contents (5-min interval)

# Possible applications

- Vertical profile of horizontal wind depending on atmospheric stability
- Vertical profile of turbulence intensity
- Seasonal variations of the vertical profiles
- Interaction between the surface and ABL
- ABL-cloud interaction (entrainment)
- Horizontal distribution of wind over NyAlesund

# Issues

- Too clean air lowers data retrieval sometimes
- Frequent upward wind
- Quality control of the data and producing user-friendly output to increase data usage in the NyA community
- HW Maintenance in need (probably in 2026)

# Acknowledments


- Thanks to AWI (Christopher Ritter), ISP-CNR (Mauro M. and Angelo V.) for their support since 2016
- The BL measurement has been supported by PE25010 (KOPRI) project.

Thank you for attention.
Welcome questions and comments.