Combined wind lidar and cloud radar for wind profiling

WindCube

Cabauw: 13.09 - 03.1<u>0 2021</u>



sheep

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W-band + KaW-band

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Objective

To study convective momentum transport using observations





Concept

To use Doppler velocities from LIDAR and RADAR to derive continuous profiles of wind









Dual Ka-W-Band Radar: Operated performing continuous PPI scans

WindCube Lidar: operated using the 6 beam strategy (Sathe et al. 2015)

Azm: 0°, 72°, 144°, 216°, 288° Elv: 90°, 75°

Range resolution: 50 m Scan period: 27 s Mobile W-Band Radar: Operated vertically pointing

Range resolution: 22 - 40 m Temp. resolution: 1 s PPI(a): Azm 0 - 360° PPI(b): Azm 360 - 0° Elv (1): 75°

Range resolution: 22 - 40 m Scan period: 72 s

Data processing

Two level processing

Level 1: removal of artifacts and derivation of wind properties

Level 2: volume correction and resample



Data evaluation

Comparing to 1 radiosonde



Comparing to 34 radiosondes

	WindC	ube	Clara	
metrics	wind direction	wind speed	wind direction	wind speed
bias	0.37	0.52	-0.24	-0.34
RMSE	12.62	1.98	14.03	2.35
correlation	0.98	0.92	0.96	0.94



	CLARA x WindCube			
metrics	wind direction	wind speed		
bias	0.24	-0.16		
RMSE	12.85	0.93		
correlation	0.98	0.99		

Additional information

ESSD Preprint

Combined Wind Lidar and Cloud Radar for Wind Profiling https://doi.org/10.5194/essd-2022-268

Preprint



Data:

Level 1: https://doi.org/10.5281/zenodo.6926482 Level 2: https://doi.org/10.5281/zenodo.6926604 Data L2



Example case Continuous profiles

Occluded front passage followed by a convective period

Possible applications:

Model validation Data assimilation Validation of momentum transport in models



Contribution of (subgrid) scales to momentum transport in ten-day EUREC4A DALES runs (150 km x 150 km domain)

Zonal momentum flux Meridional momentum flux * Subtropical B oceans 1.0 0.8 0.6 0.4 0.2 @200 m @200 m 0.0 10-1 100 101 10^{-1} 100 101 C 1.0 0.8 0.6 0.2 @650 m @650 m 0.0 10^{-1} 100 101 10-1 100 101

Savazzi, Nuijens, Siebesma, de Rooy (in prep)

50 % of flux carried by motion up to a scale equivalent to the BL height

Contribution of different time scales to meridional wind variance





Conclusions

Radar and Lidar can be combined to create continuous wind profiles.

The data is publicly available and can be used for different applications.

The initial analyses suggest a correlation between the zonal and vertical wind variance.

additional slides

Different scale processes: low pass filter (larger than 10 min)

Looking at the convective period

Periodic slowdown and speedup of horizontal winds

Periodic upward and downward motion

Observations suggest a correlation between slow wind and upward motion





Different scale processes: high pass filter (smaller than 10 min)

Data also contains information from smaller scales

Turbulence

Derivation of momentum flux profiles





Predominant scales

Region between 500 and 1000 m, period between 09:00 and 17:00

