

Royal Netherlands Meteorological Institute Ministry of Infrastructure and Water Management

## Doppler wind lidar activities at Cabauw

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#### 1. Two-year measurement campaign short-range wind lidar (2018-2020)

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#### A 2-year intercomparison of continuous-wave focusing wind lidar and tall mast wind measurements at Cabauw

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region









#### Meteo mast Cabauw

- 213 m
- cup anemometers / wind vanes
  - 10, 20, 40, 80, 140, 200m
- Many other meteorological instruments
  - Cloud base, visibility, precipitation, ...

### Data quality and availability

- 10-minute QC data of ZephIR 300M
- Effect of fog, low clouds and precipitation

#### Period

• 2 years (Feb. 2018 – Feb. 2020)





# Data availability

- Precipitation >1mm/h
- Low clouds <100m</li>



(much more in Atmos. Meas. Tech. article)



# Data quality

- Mean bias wind speed<0.1 m/s
- (larger bias for fog, low clouds or high wind speeds)
- Mean bias wind direction  $\leq 2^{\circ}$
- (sometimes 180° off)



(much more in Atmos. Meas. Tech. article)



# Firmware intercomparison

- ZP ("old") vs. ZX ("new")
- 3½ months (20-2-2020 to 7-6-2020)
- Data availability: ZX more QC data at lower levels, but less at higher levels
- Data quality:
  - Wind speed: ZX smaller bias at high wind speeds
  - Wind direction: ZX less often 180° off

Knoop, ZephIR 300M wind lidar firmware intercomparison, KNMI Internal report IR-2021-01







Deployment within offshore wind farm Dutch North Sea





### 2. Scanning long-range wind lidar (2021-)

- Task: measure 3D wind field around Cabauw & wind profiles up to the boundary layer
- Measuring program: Alternating between different scan patterns (DBS, vertical staring, PPI/RHI)





# **Scanning Doppler wind lidar @ Cabauw**

- > Leosphere Windcube 200S
- > Pulsed lidar @ 1.5  $\mu$ m
- > Long-range (max. 14 km, but typically 6 km)
- > 3D-scanning (full semi-hemisphere)
- > Possible scans: DBS, PPI, RHI, (vertical) staring
- Data: radial wind speed, horizontal wind speed & wind direction (with DBS), CNR, attenuated backscatter coefficient
- > Installed at Cabauw: April 6, 2021





DBS (Digital Beam Swing): wind profiling





Parameters: resolution, accumulation time, elevation angle

Range is limited by the number of range gates (and therefore resolution)



## Mast comparison @ 200m

2021-05-25 - 2021-06-29, resolution 100m



2021-05-25 - 2021-06-29, resolution 100m





# Vertical velocity

- > From DBS scan (one of the 5 beams)
- > From vertical staring scan ("continuous")





# Range Height Indicator (RHI) scans





# Plan Position Indicator (PPI) scans





Single scan 2 minutes (full PPI, 1 sec, 3°)



# Range ambiguity issues Windcube

- The unambiguous range is given by the pulse repetition frequency (PRF) via c/(2\*PRF). Strong backscatter occurring beyond the unambiguous range can lead to a signal at a smaller range, leading to range ambiguity.
- > In the Windcube the pulse repetition frequency (PRF) cannot be set by the user, but is linked to the chosen resolution.
- > For Windcube 200S:
- > For 75m and 100m PRF=10 kHz -> unambiguous range 15 km.
- > For 50m PRF=20 kHz -> unambiguous range 7.5 km.
- > For 25m PRF=40 kHz -> unambiguous range 3.25 km.

