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Urban boundary layer profiling using ground-based lidars in Rotterdam City Centre

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Royal Netherlands Meteorological Institute (KNMI)



Ruisdael Urban-Atmosphere Interactions Intensive Trace- gas and Aerosol Measurement Campaign

Rotterdam 2022 (Aug.-Sept.) (RITA2022)

KNMI contributions:

...

automatic lidar ceilometer (ALC)

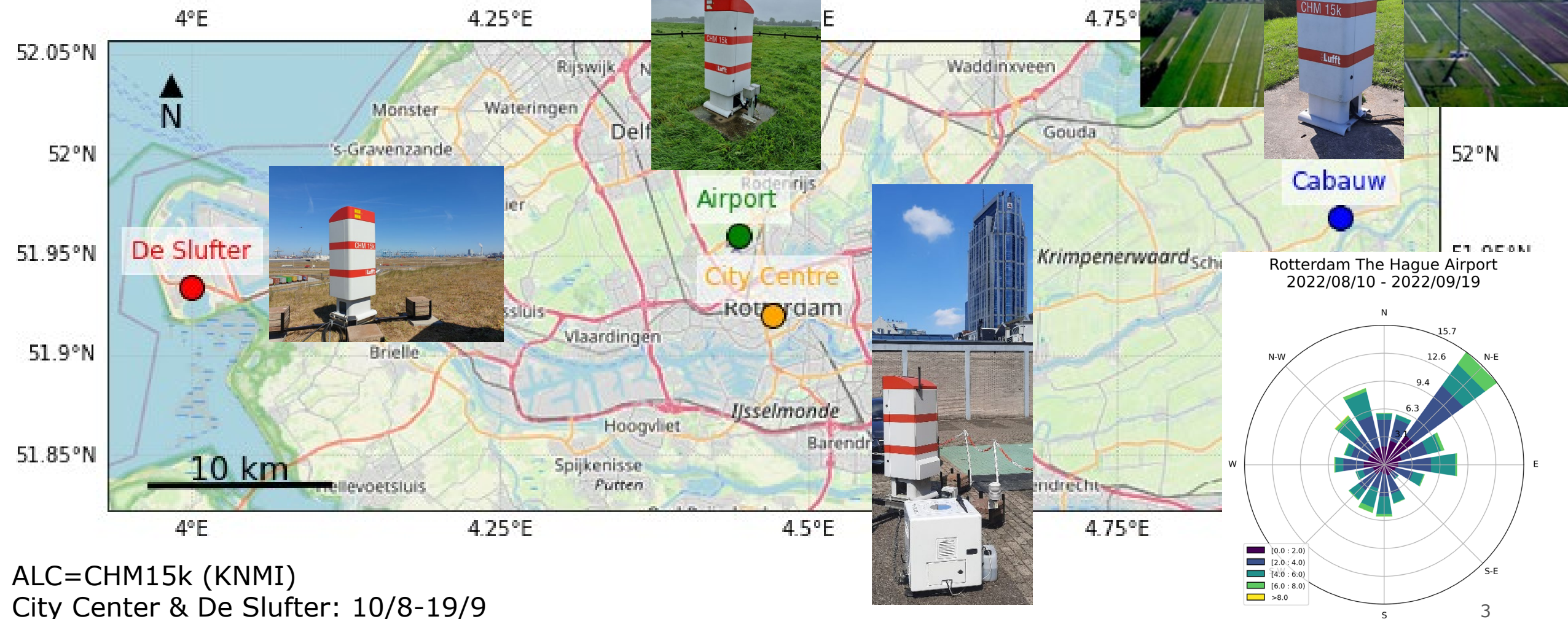
Clouds, aerosol profiles, ...

Doppler wind lidar (DWL)

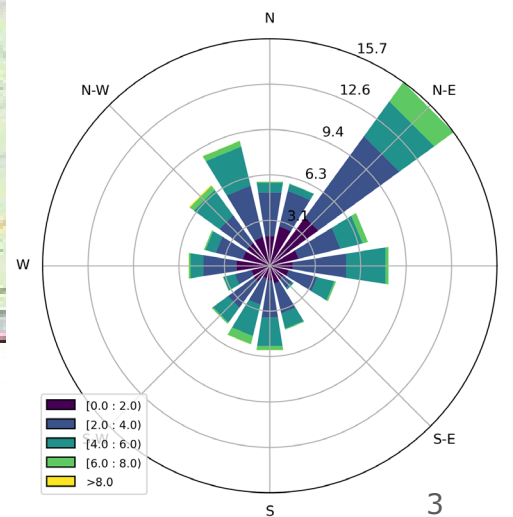
Wind profiles, turbulence, ...



Automatic lidar ceilometers (ALC)

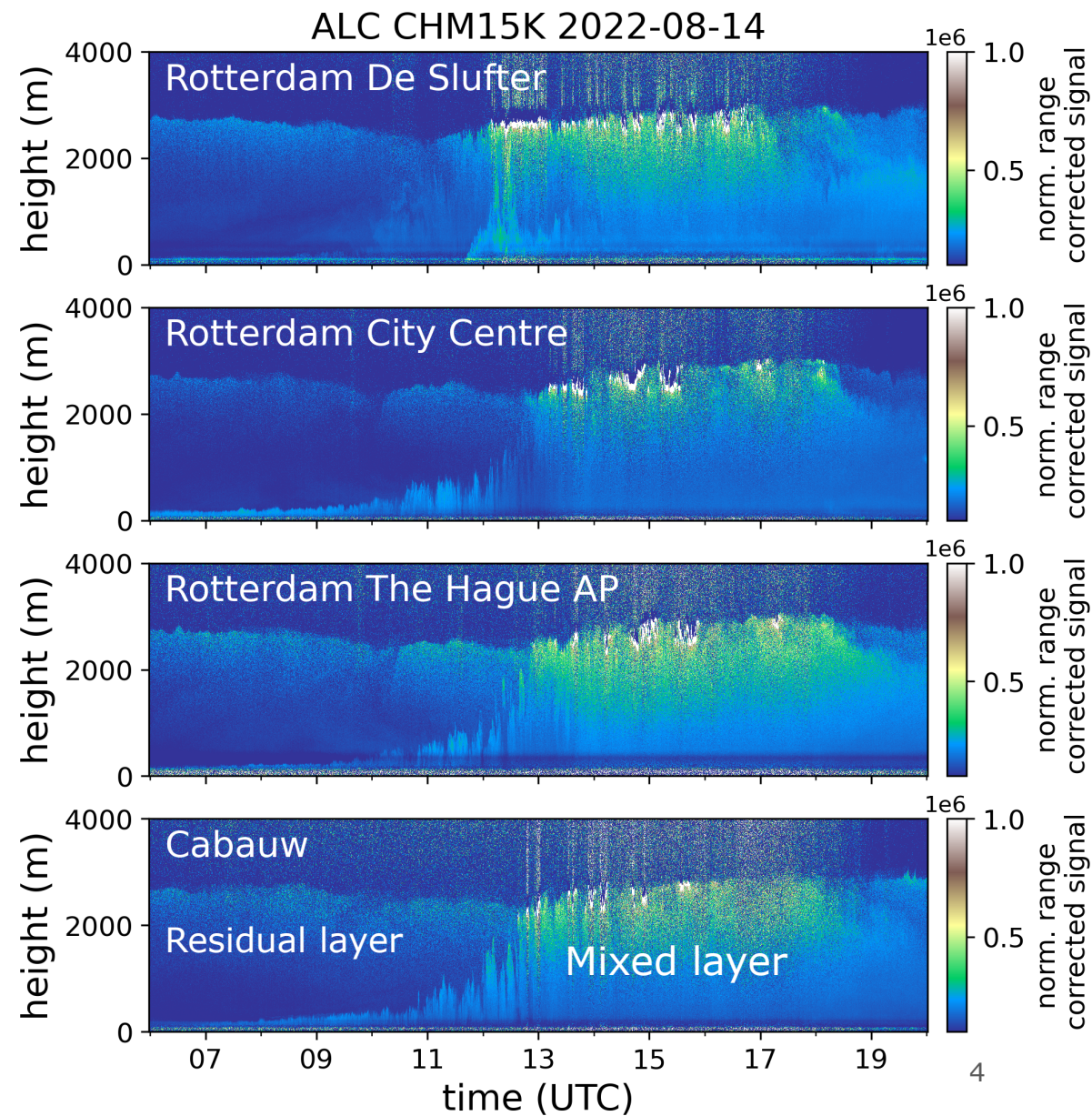
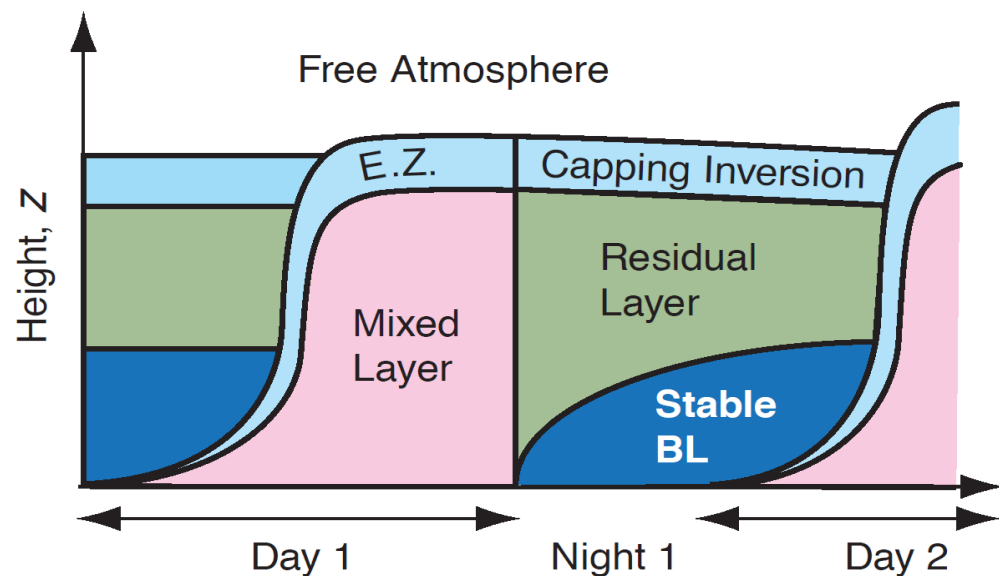
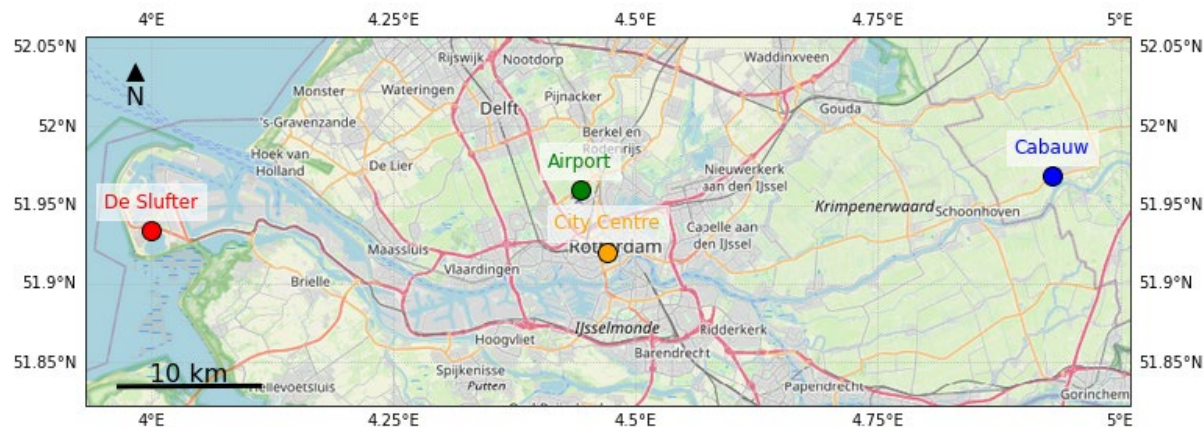


Rotterdam The Hague Airport
2022/08/10 - 2022/09/19



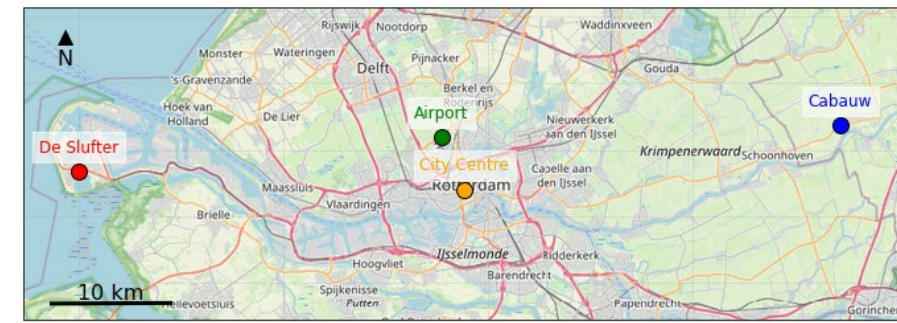
Cabauw & Rotterdam The Hague Airport: permanent stations [\[https://e-profile.eu\]](https://e-profile.eu) & [\[https://dataplatform.knmi.nl\]](https://dataplatform.knmi.nl)

Automatic lidar ceilometers (ALC)

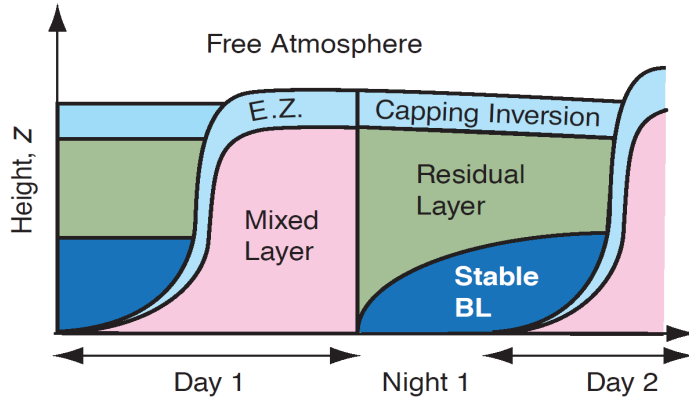




ALC boundary-layer heights

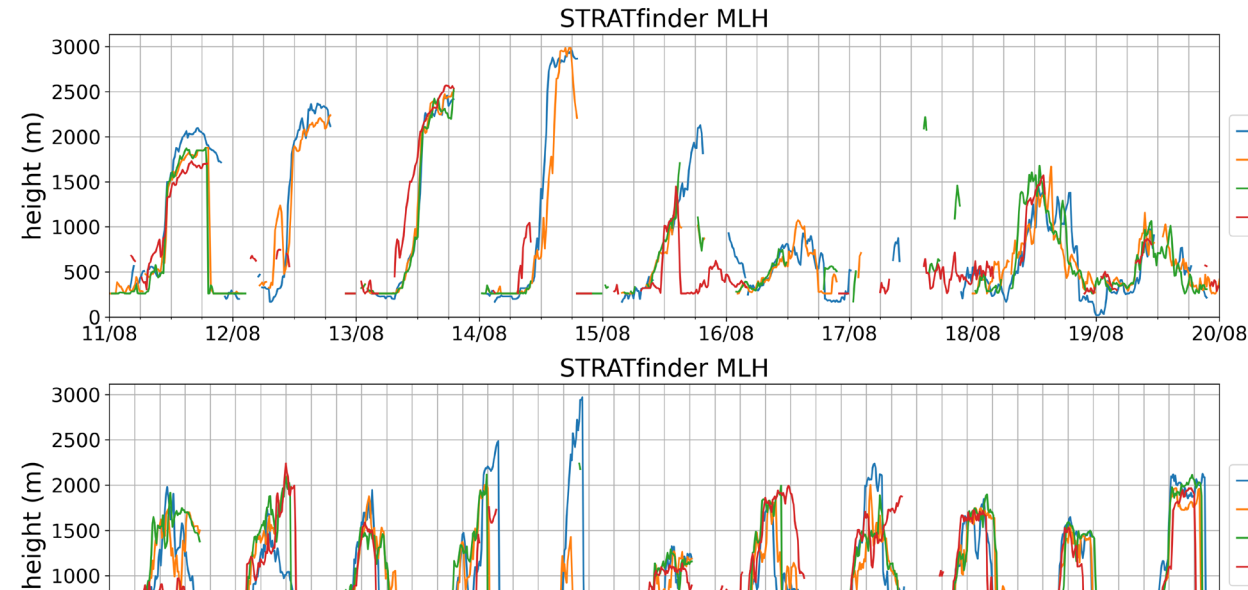


MLH:
mixed layer
height



STRATfinder algorithm
(aerosol-based layer height
detection)

Melania Van Hove
Simone Kotthaus
ablh.aeris-data.fr

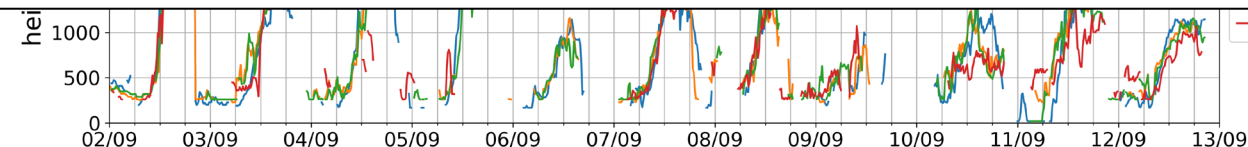


ICUC12-903 | Orals | [PM2](#) ★

[Variations in urban boundary layer height at regional and European scales from lidar network observations](#) ▶

Melania Van Hove, Simone Kotthaus, Mariana Adam, Arnoud Apituley, Jonnathan Cespedes, Sophie Bouffies-Cloche, Marijn De Haij, Marc-Charles Dupont, Aurélien Fauchaux, Diego Gouveia, Matthias Hersent, Clément Laplace, Linda Miladi, Ewan O'Connor, Raphael Ollier, Razvan Trules, and Martial Haeffelin

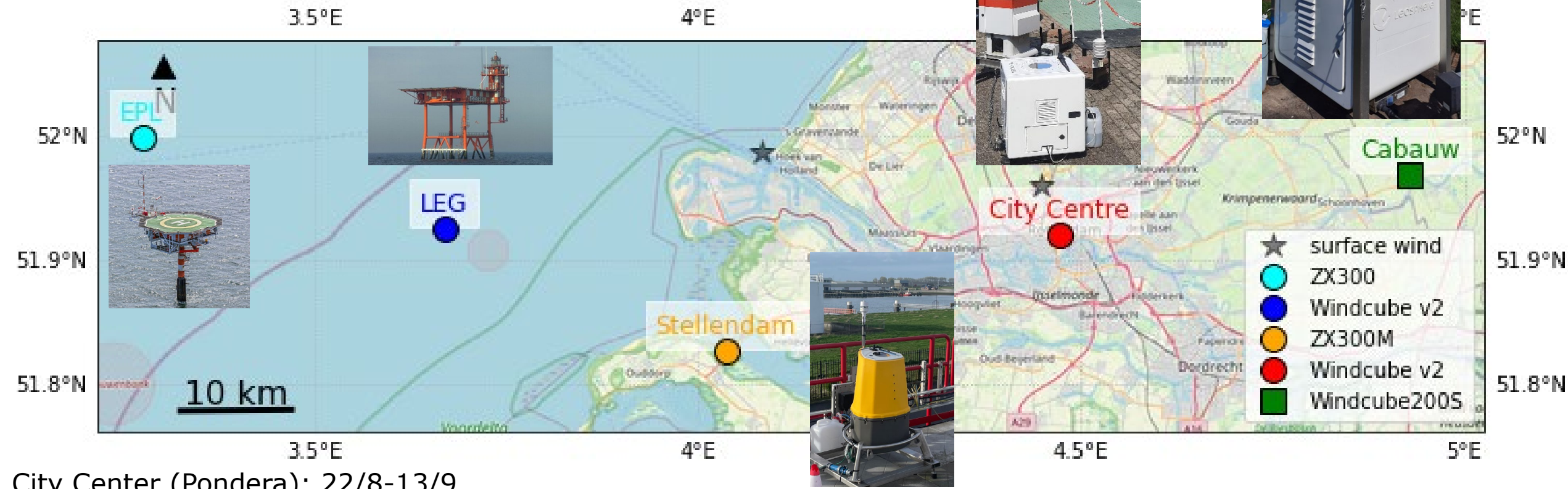
Thu, 10 Jul, 16:45–17:00 (CEST) | Room Mees 2





Doppler wind lidars (DWL)

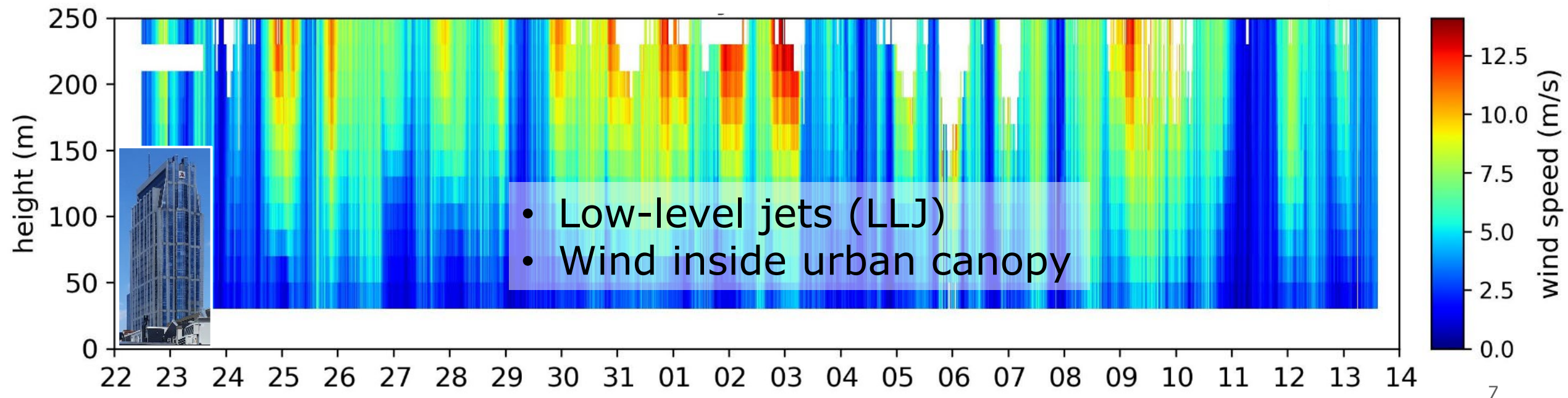
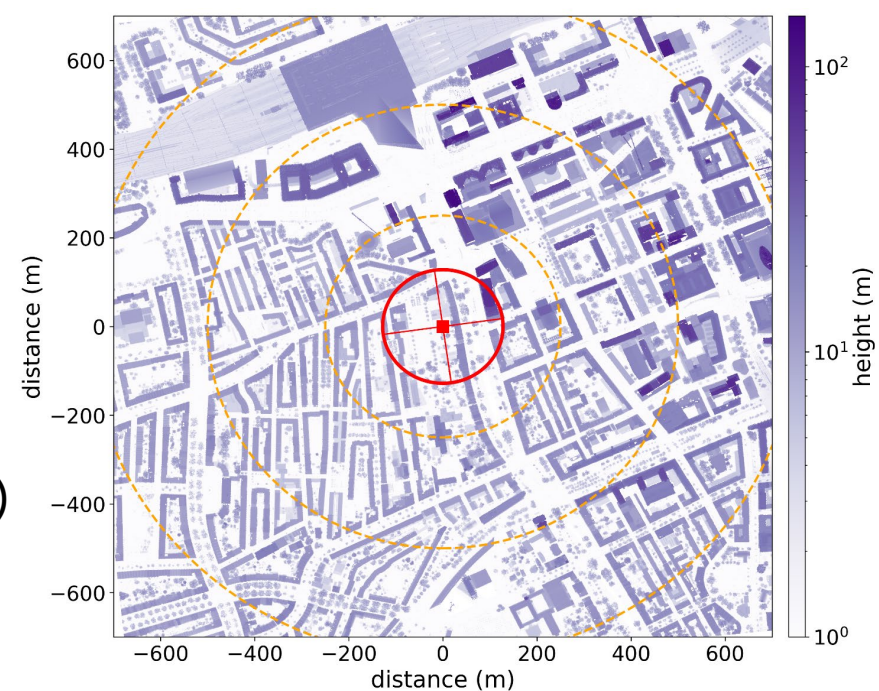
offshore – coastal – urban - rural



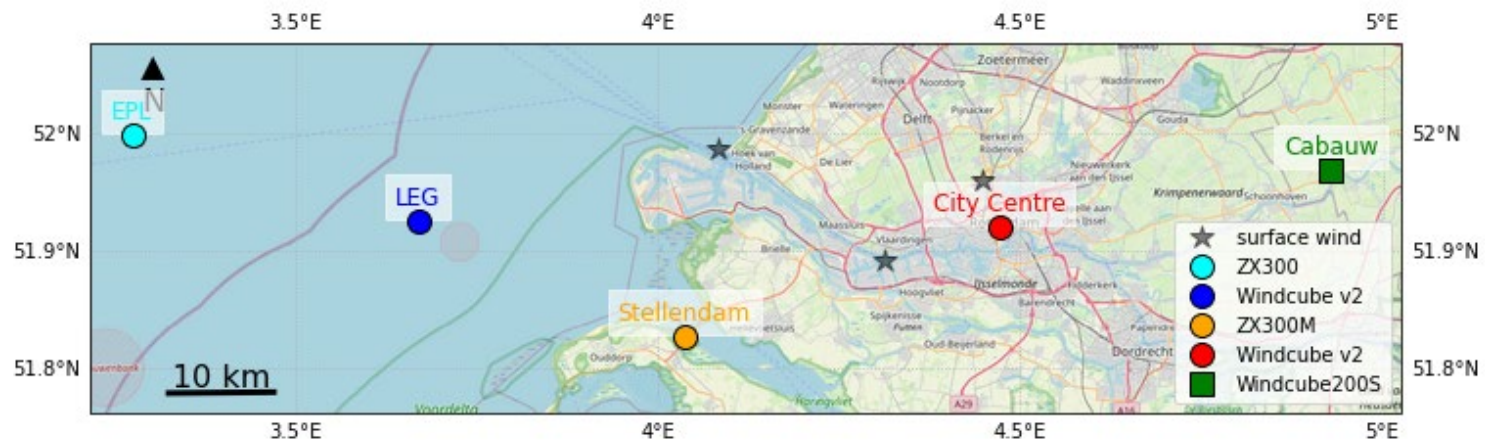
City Center (Pondera): 22/8-13/9
Stellendam (RWS/KNMI): 22/8-16/11
Cabauw (Ruisdael/KNMI): permanent [<https://e-profile.eu> & <https://cloudnet.fmi.fi>]
EPL & LEG (TNO): permanent [<https://offshorewind-measurements.tno.nl>]

DWL City Centre

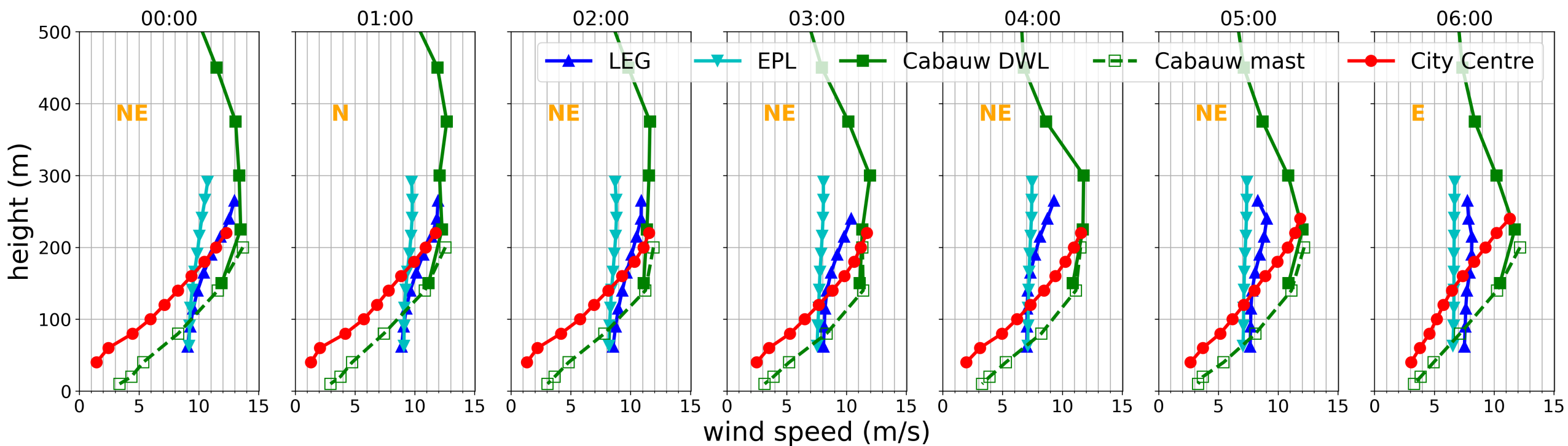
- Windcube v2 @ parking lot MRDH (Westersingel 12)
- 2022/08/22 12:00 – 2022/09/13 15:00 UTC (22 days)
- DBS (4 beams + 1 vertical beam), 4s per cycle
- wind speed & direction, vertical velocity @ 40-240m



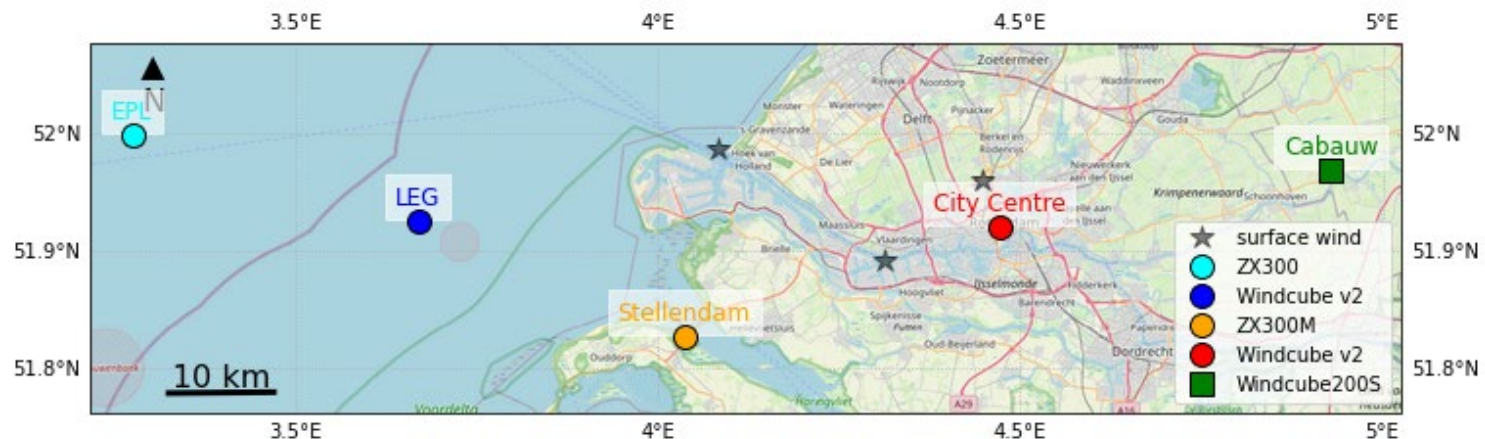
Low-level jet



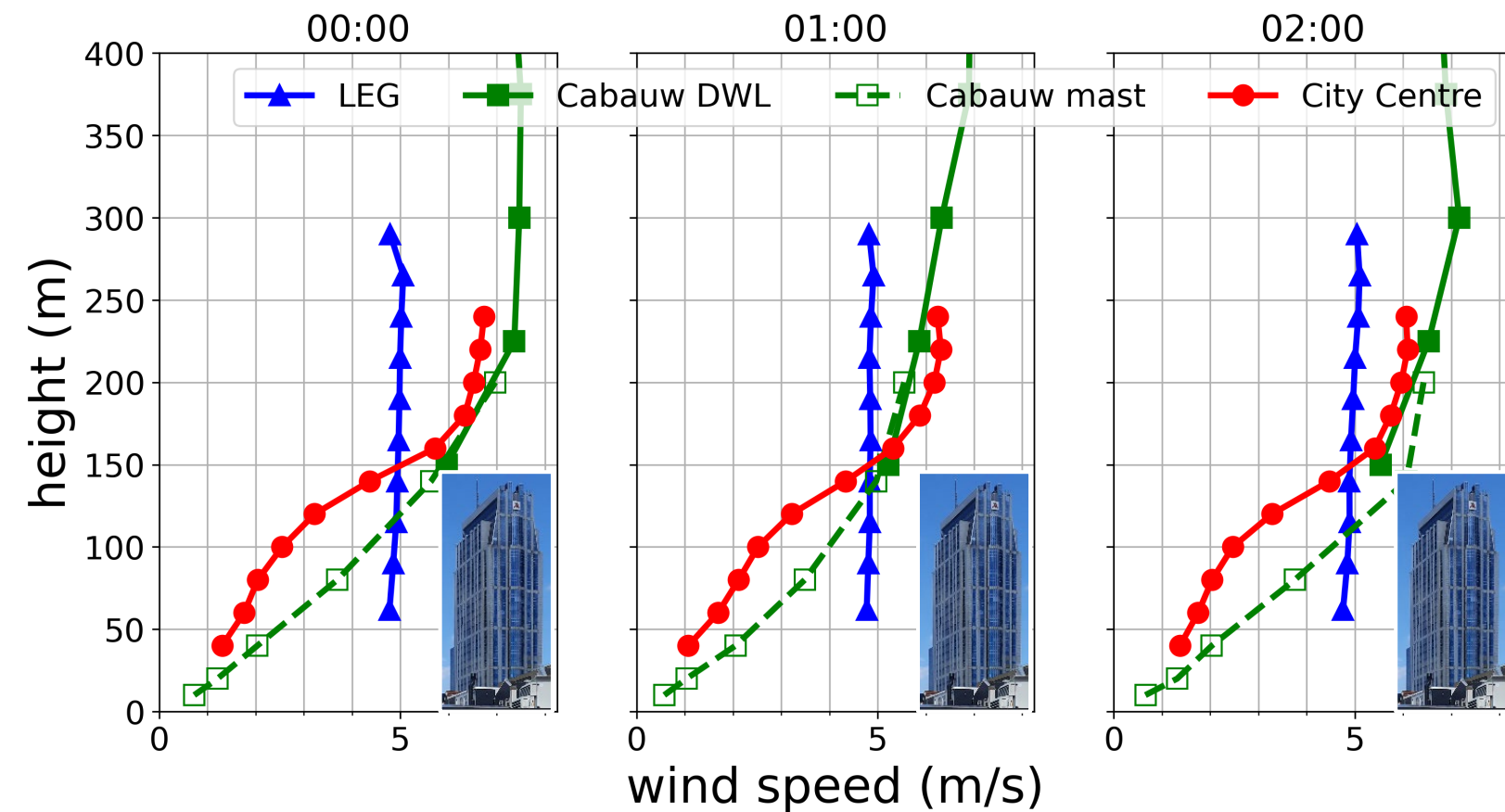
2022-09-02



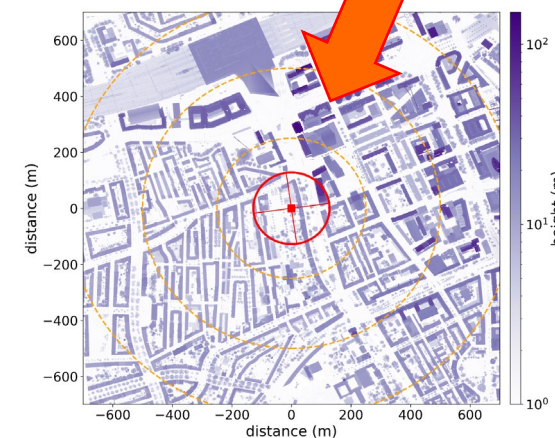
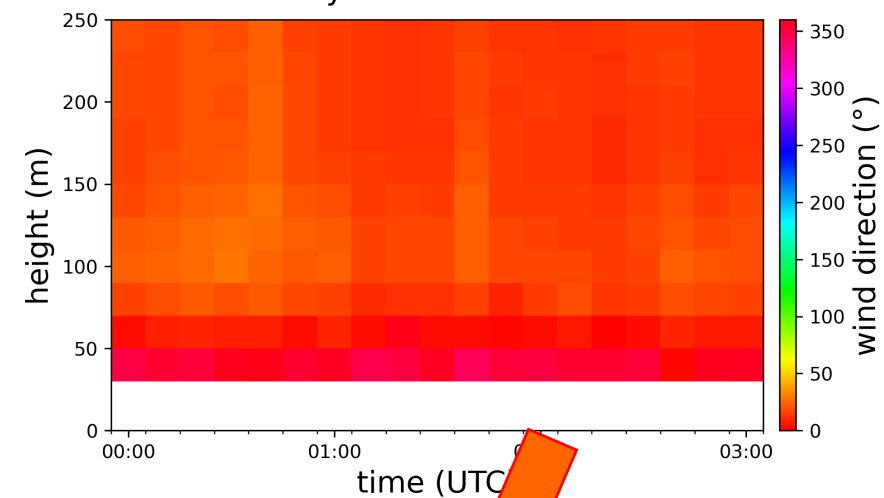
Urban canopy



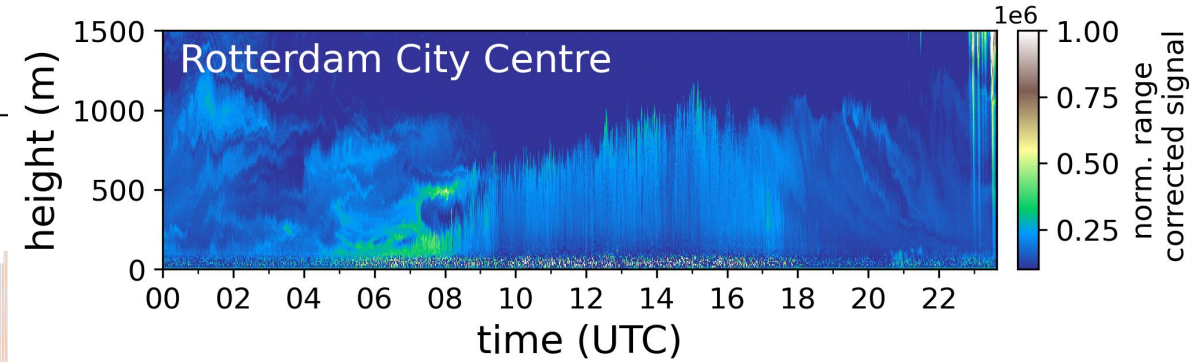
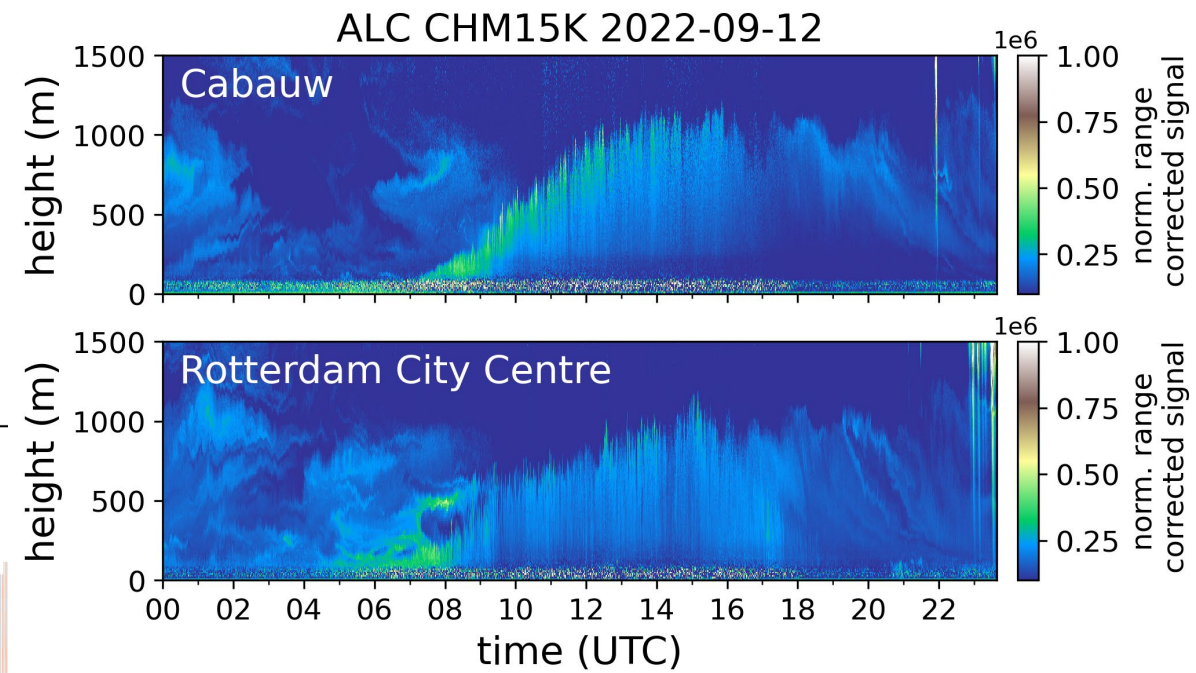
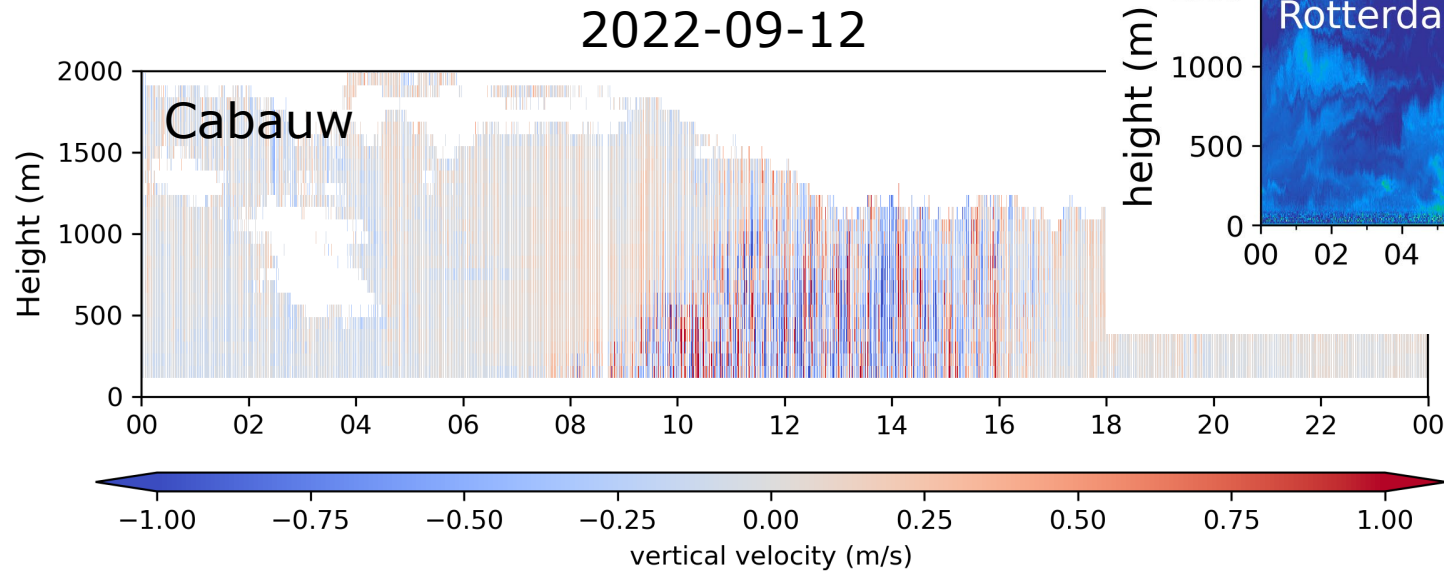
2022-08-27



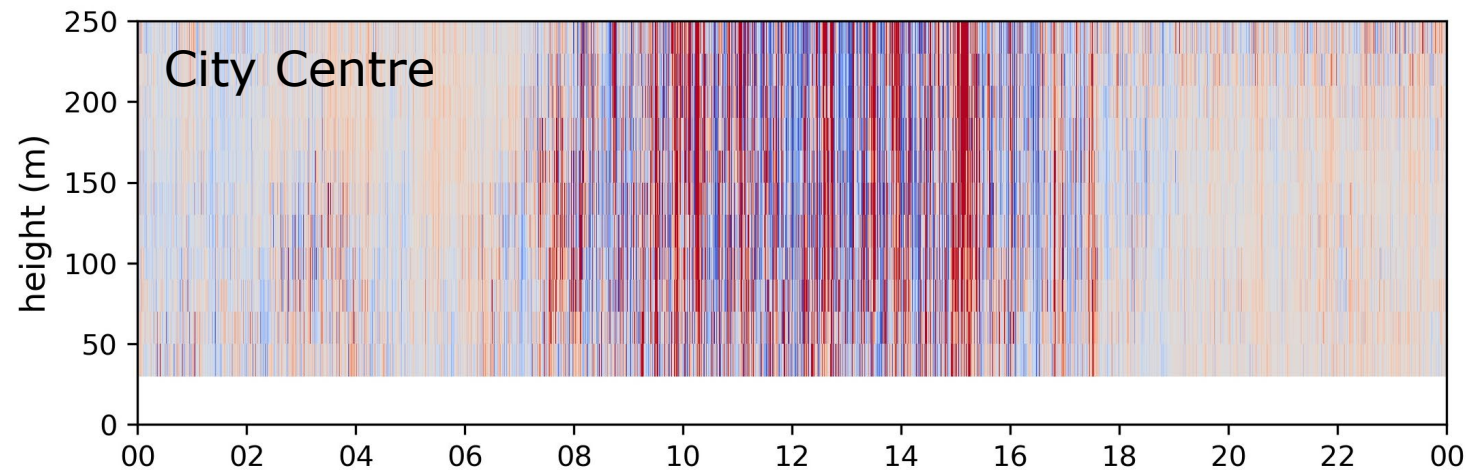
City Centre 2022-08-27



DWL vertical velocity

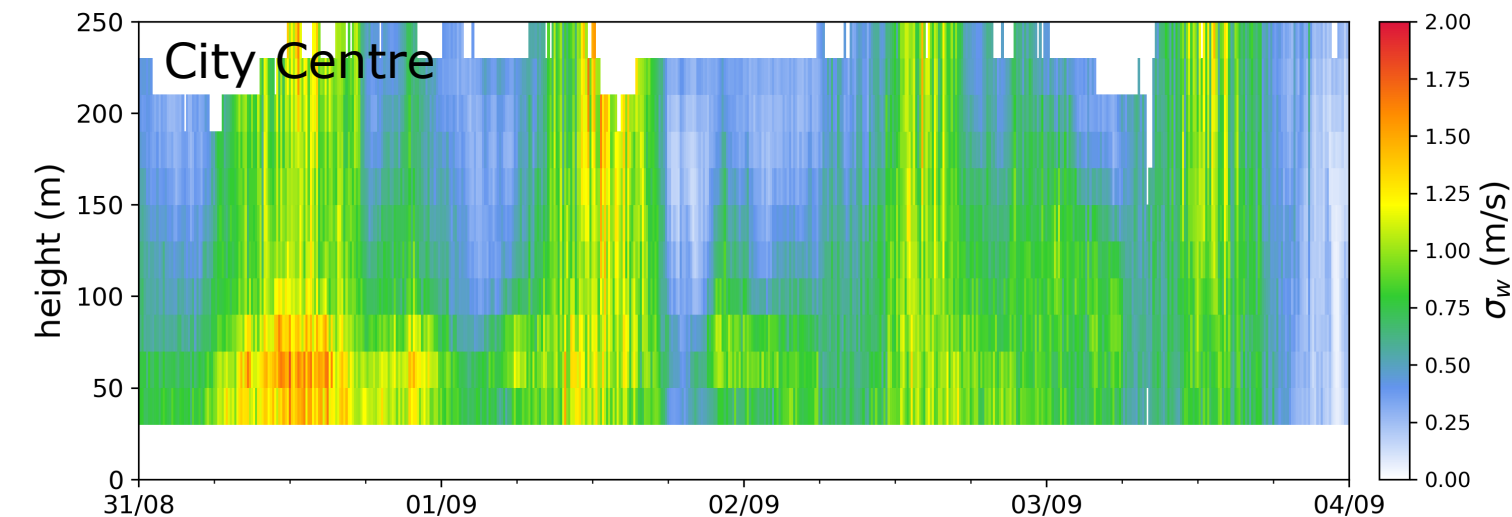
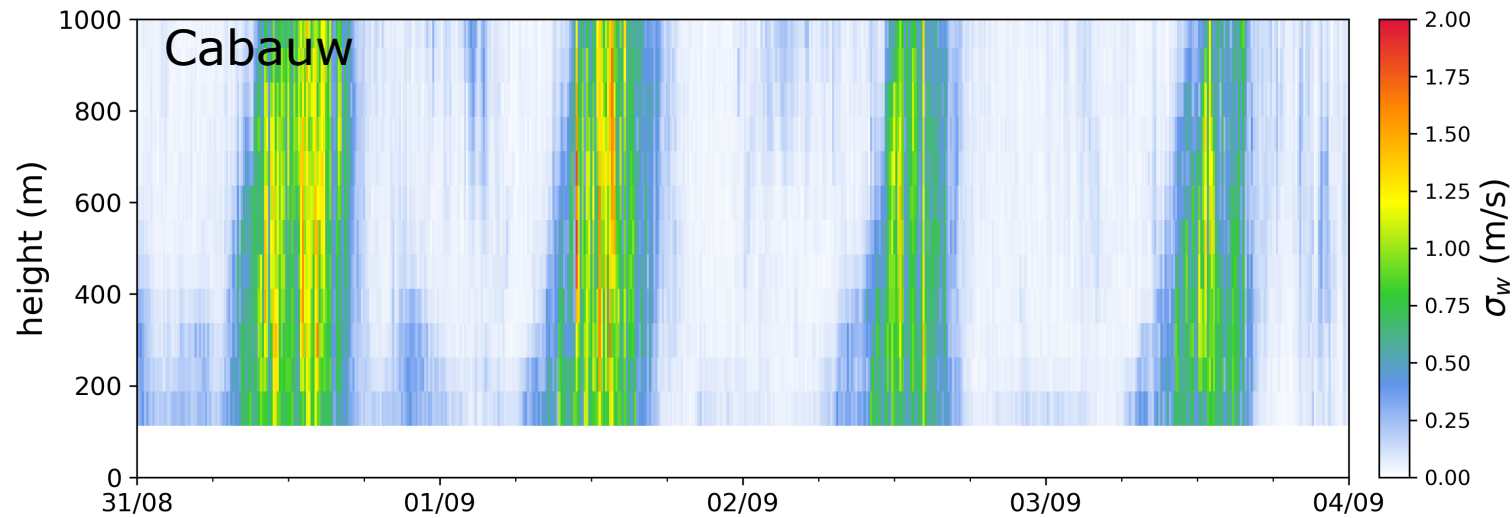
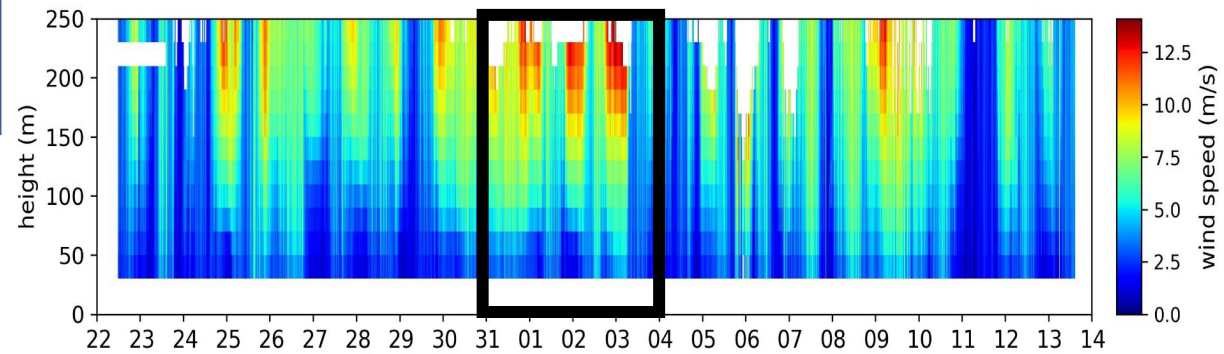


- Up- and downdrafts
- Turbulence
- Variance (or std .dev.)
- Eddy-dissipation rates
- Mixed layer height





DWL vertical velocity variance



- Less clear diurnal cycle in city
- Turbulence in urban canopy
- Buoyancy or shear driven?

Summary & outlook

You are still here

- RITA2022 measurement campaign
- ALCs and DWLs in and around Rotterdam (including Cabauw, offshore platforms)
- ALC
 - clouds, vertical profiles aerosols
 - boundary and mixed layer height
 -
- DWL
 - wind profiles in and above urban canopy
 - vertical velocity profiles
 - *sea breeze case (5/9)*
- *Model development*

ICUC12-616 | Orals | [PM6](#) ★

[Improving numerical weather prediction at urban to neighbourhood scales](#) ▶

Natalie Theeuwes, Andrea Zonato, Wim de Rooy, Humphrey Lean, Steven Knoop, and Valéry Masson

Fri, 11 Jul, 10:15–10:30 (CEST) | Room Mees1

steven.knoop@knmi.nl

Thanks:

Ruisdael
observatory



METROPOOLREGIO
ROTTERDAM DEN HAAG



TNO | Offshore Wind Measurements



Rijkswaterstaat
Ministry of Infrastructure
and Water Management