vertical profiling of atmospheric particles

what are the capabilities of commercial Jen-Optik ceilometers?

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and the Hamburg Lidar group

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Facts

- the Jen-Optik company has developed new cloud ceilometers with higher sensitivity than standard Vaisala ceilometers
- ca. 40 of these new ceilometers have been purchased by the German Weather Service and are distributed throughout Germany

Questions

- … to what degree can the new generation of Jen-Optik ceilometers provide reliable information on aerosol profiling ?
- … can Jen-Optik ceilometers data extend accurate samples at Lidar sites for spatial and temporaly more complete monitoring ?

experimental setup

Hamburg Raman-LIDAR

CEILOMETER

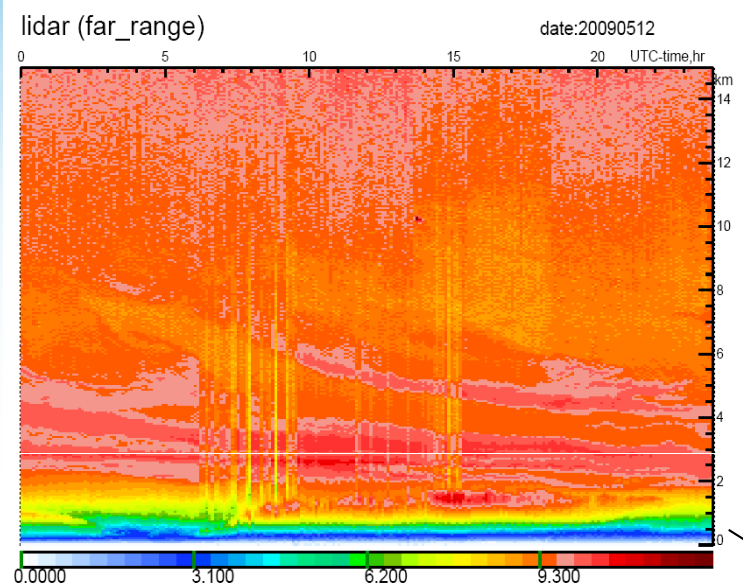
- side-by-side deployment of the Hamburg Aerosol Raman LIDAR and the Jen-OptiK ceilometer at the University of Hamburg
- continuous sampling … at the same 1.024 μm wavelength
- explore sampling at selected days
- harmonize averaging, compare profiles and explore correlations

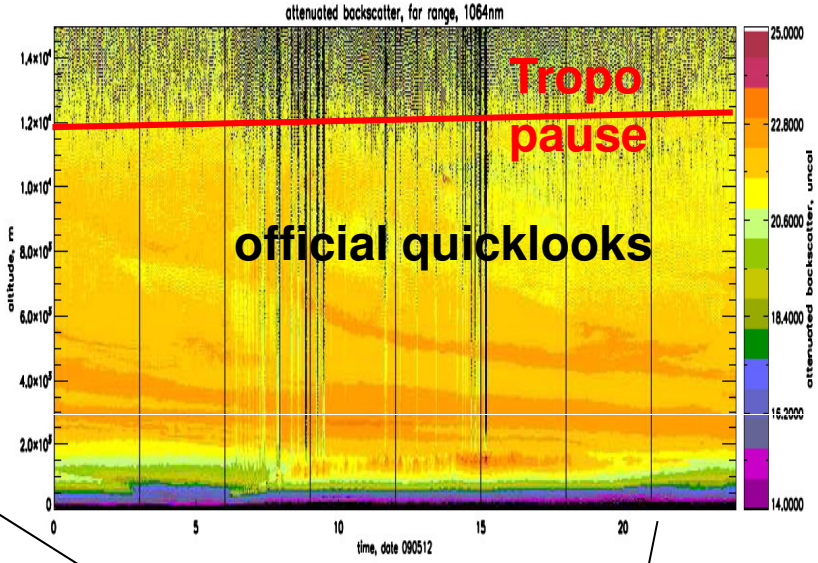
	LIDAR (analog channel)	CHM 15k Ceilometer
Centre wavelength	**1064 nm**	**1064 nm**
Range	**15 km**	**15 km**
Range resolution	**7,5 m**	**15 m**
Time resolution	**10 sec**	**30 sec**
Time per file	**3 h**	**24 h**
Size of file	**≈ 150 MB**	**≈ 12 MB**

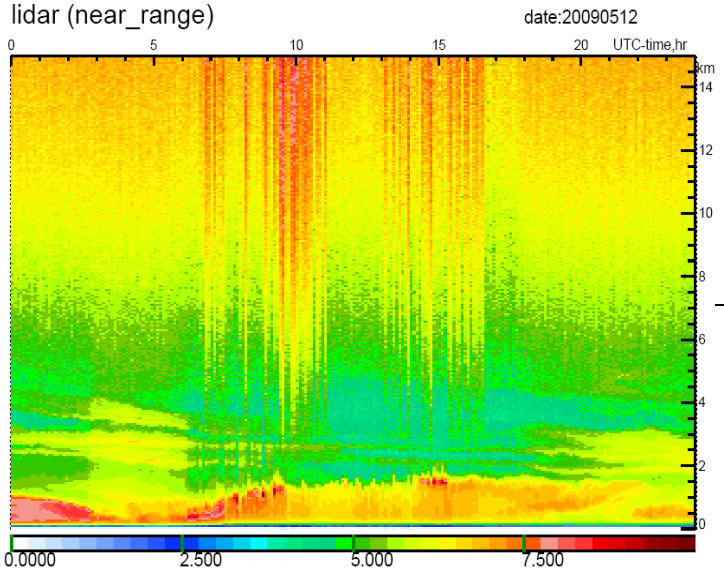
unified data averaging	
Total time	**24 h**
Altitude-step	**60 m**
Time-step	**6 min**

LIDAR range corrected backscatter

May,5 2009







15 km

0 km

far-range telescope data

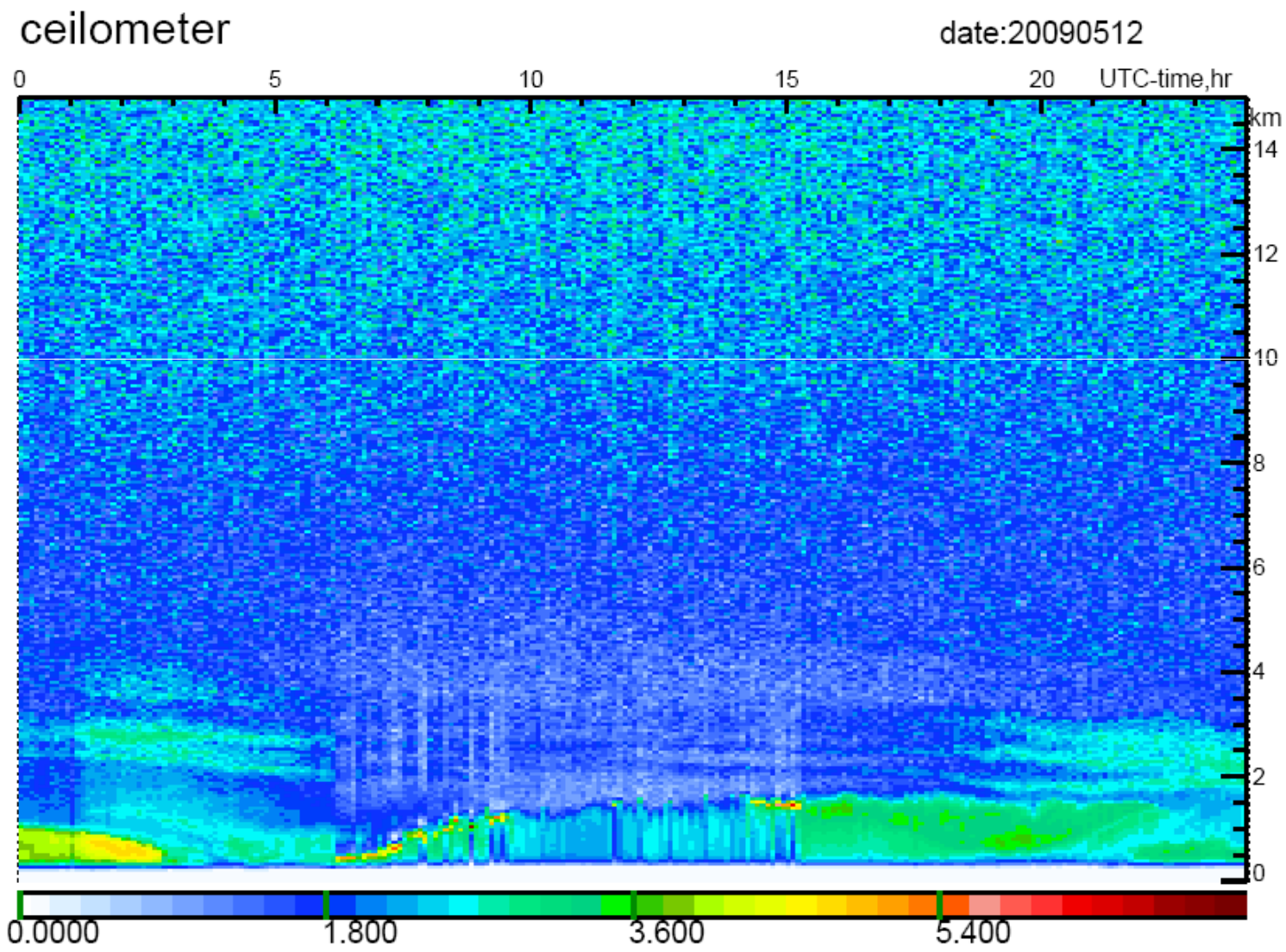
near-range telescope data

0 UTC

24 UTC

CEILOMETER range corr. backscatter

May,5 2009



CEILOMETER range corr. backscatter

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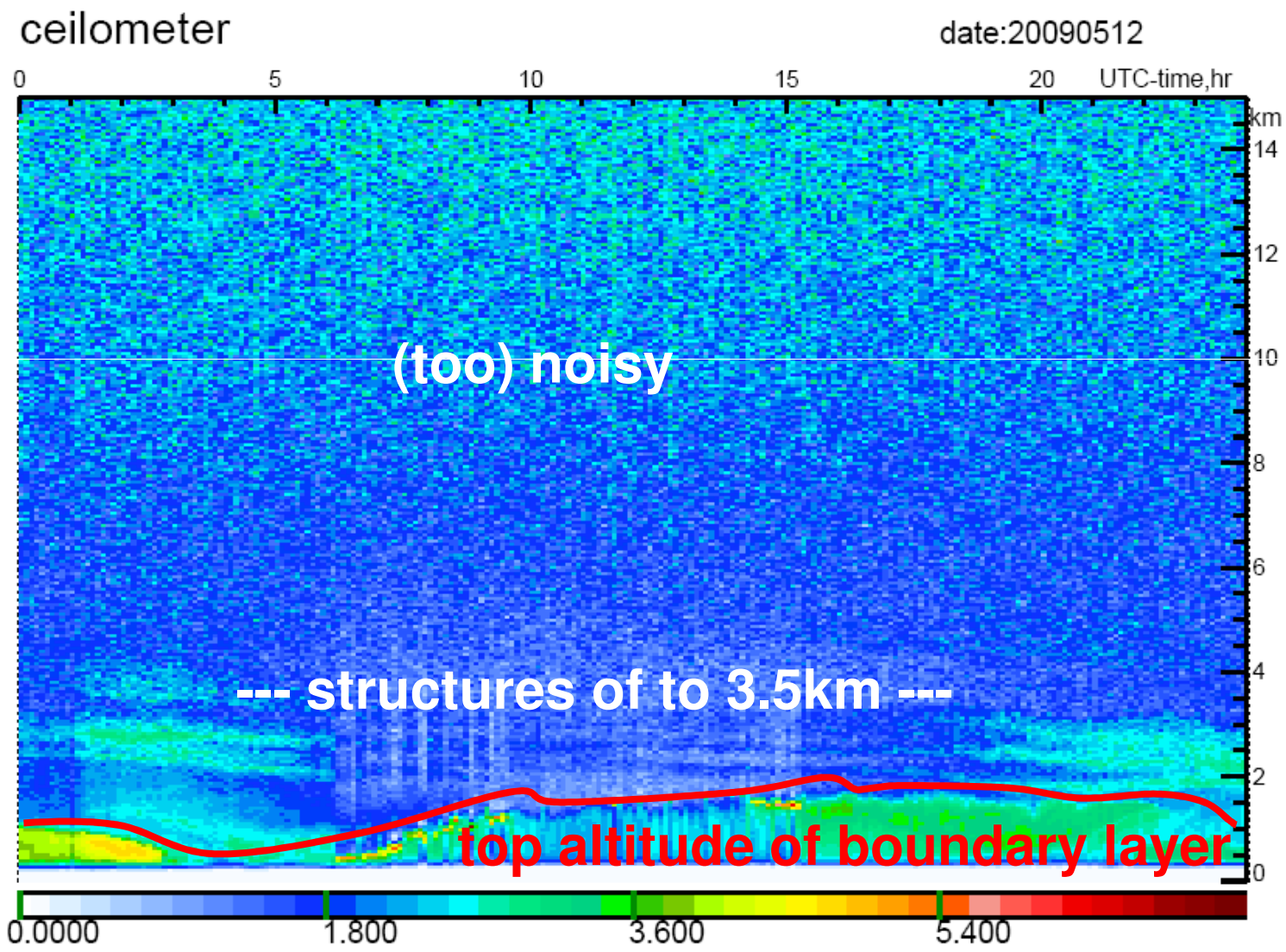
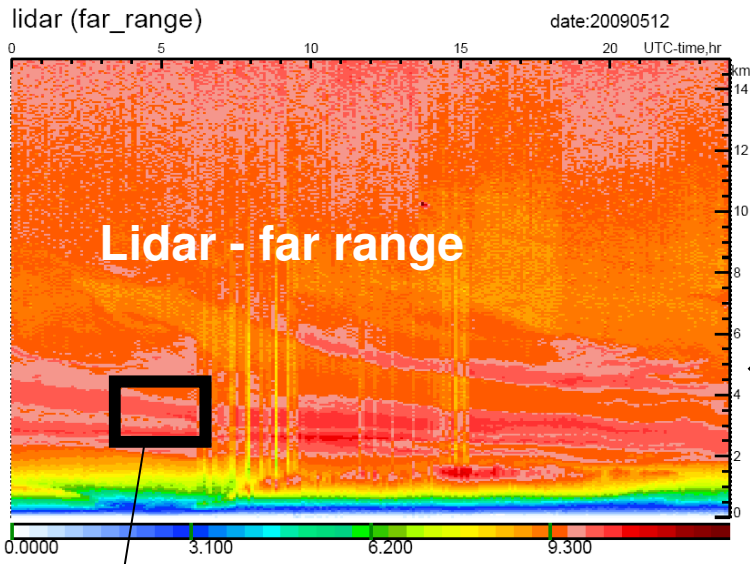
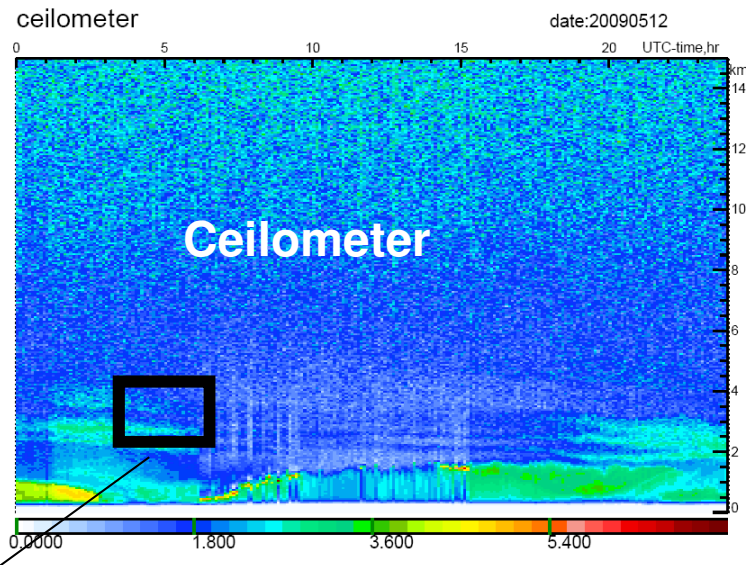
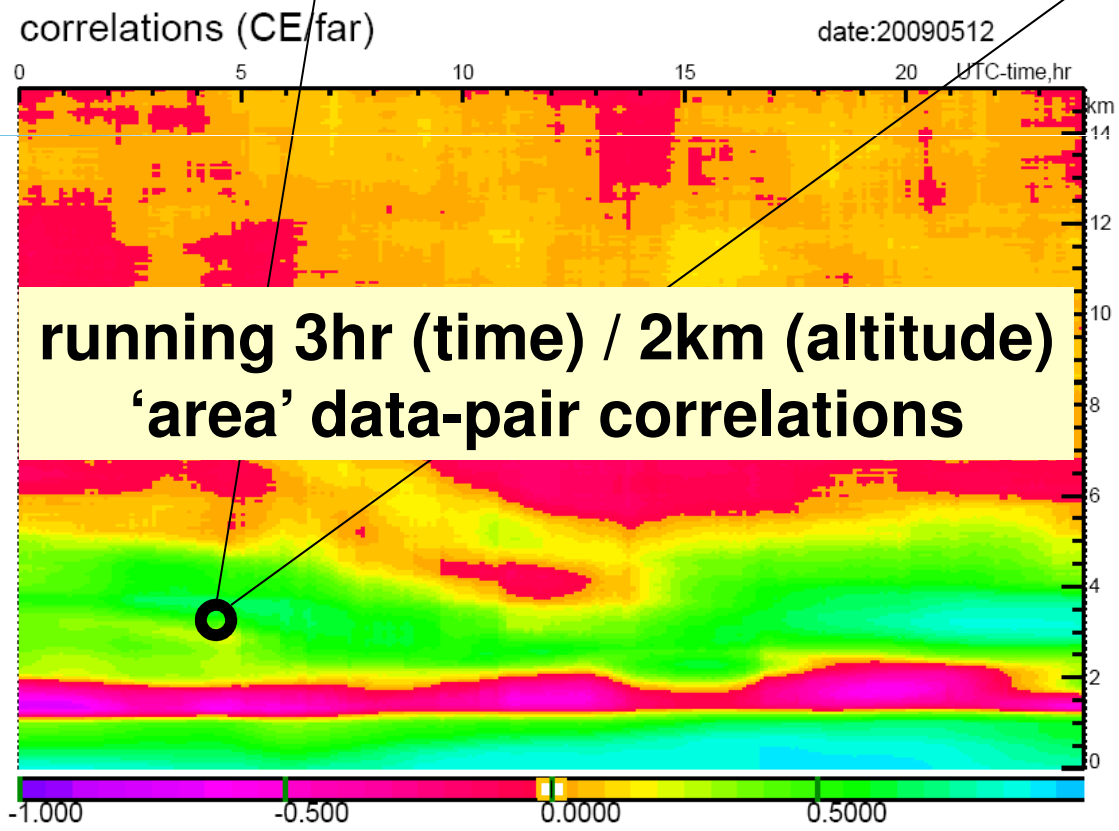
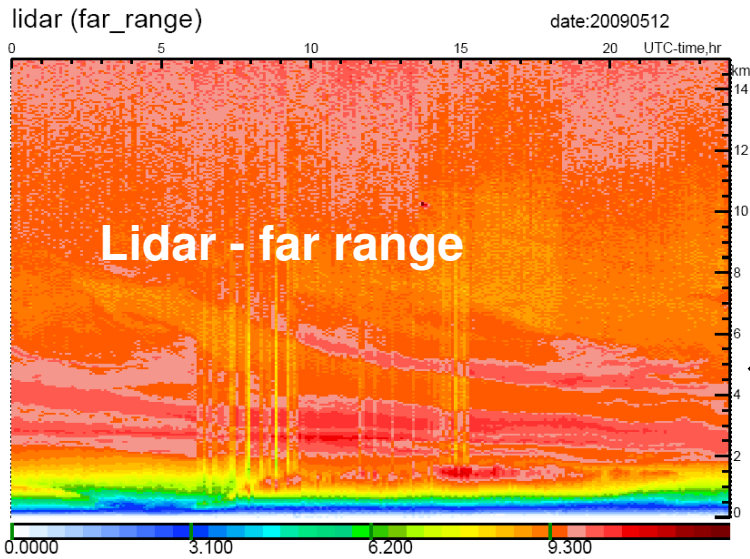


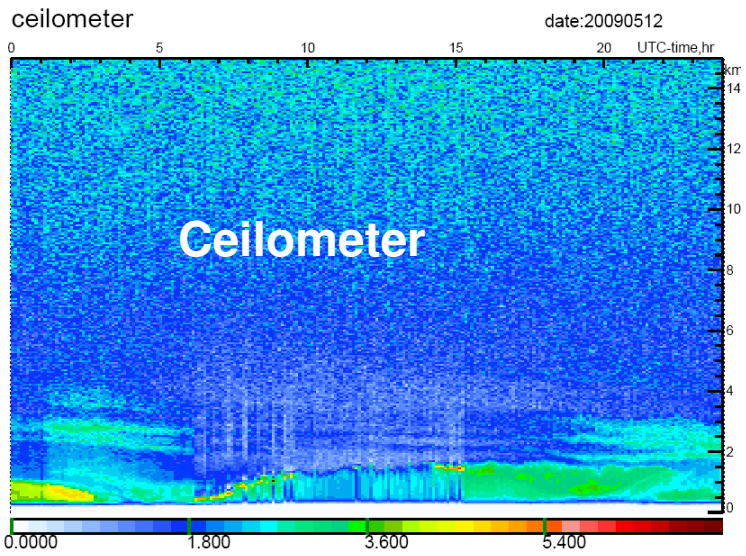


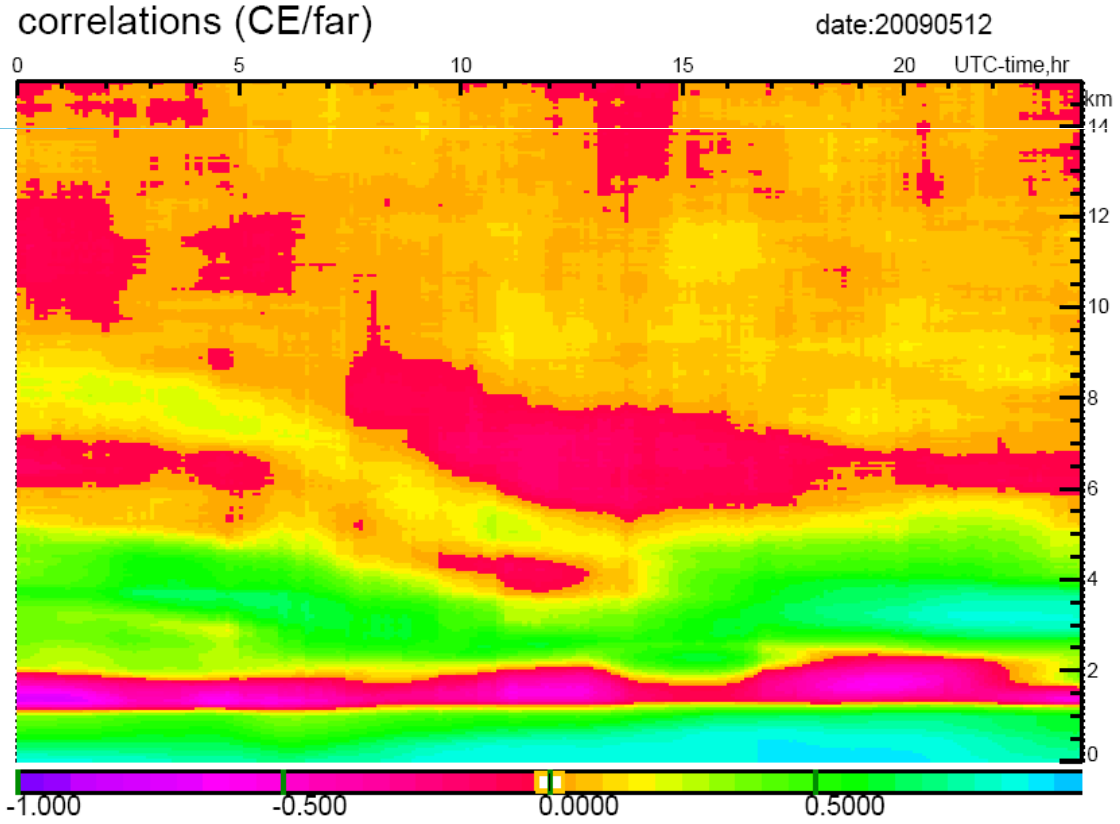




- examine, if atm. structures are reproduced … ⇨ correlations !
- pick time/height regions are corr. data pairs

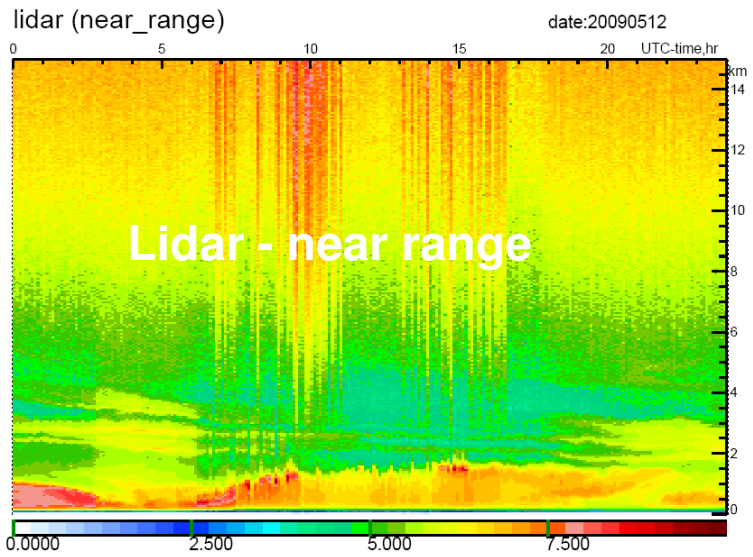


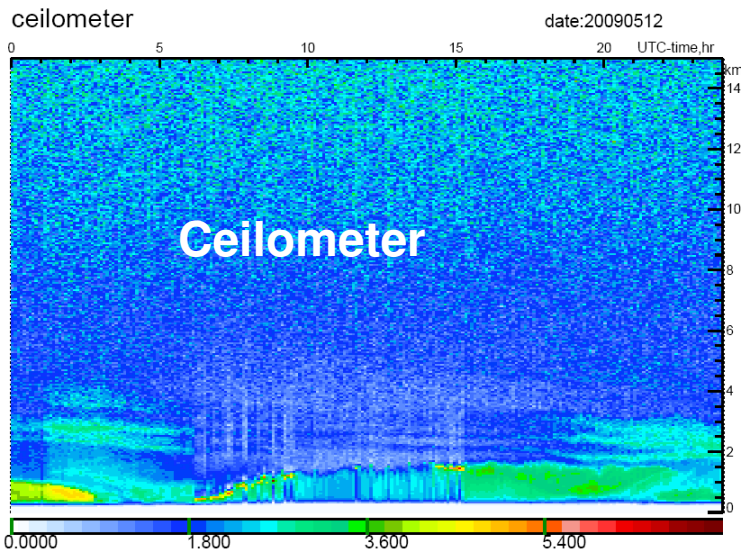


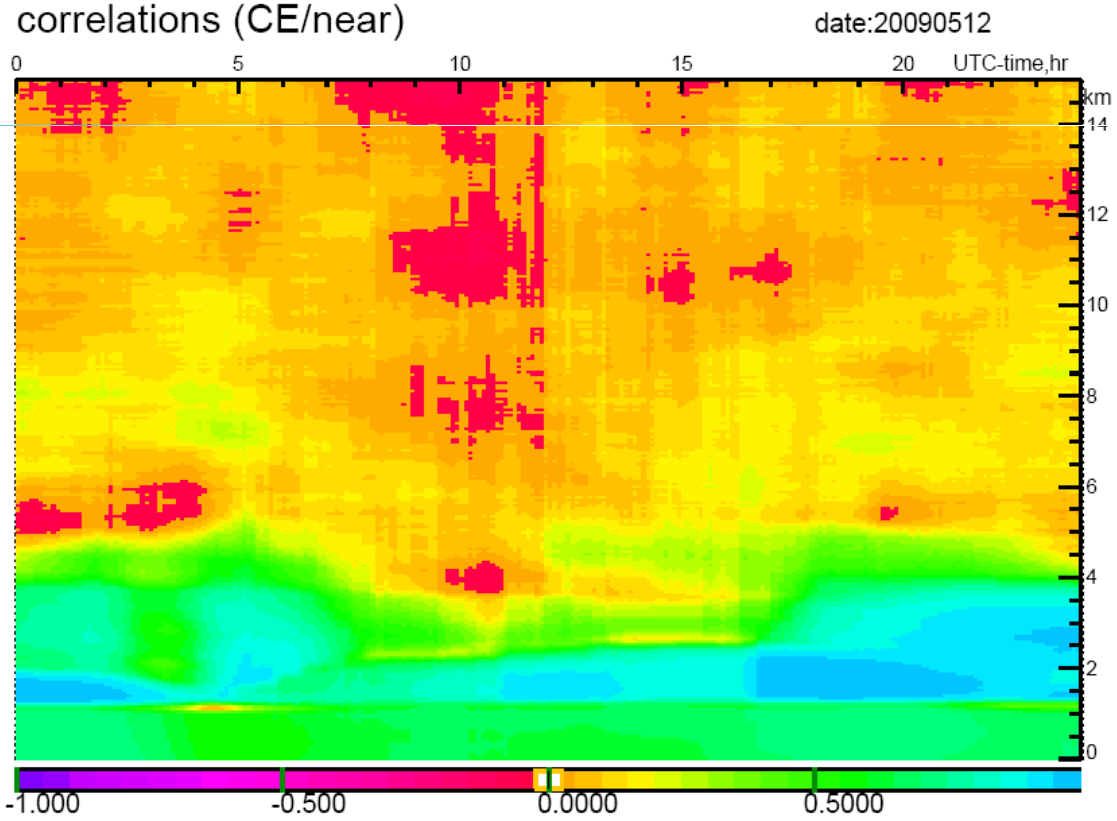


- correlations higher at lower altitudes
- anti-correlation band due to a diff. gradient in the overlap reg.

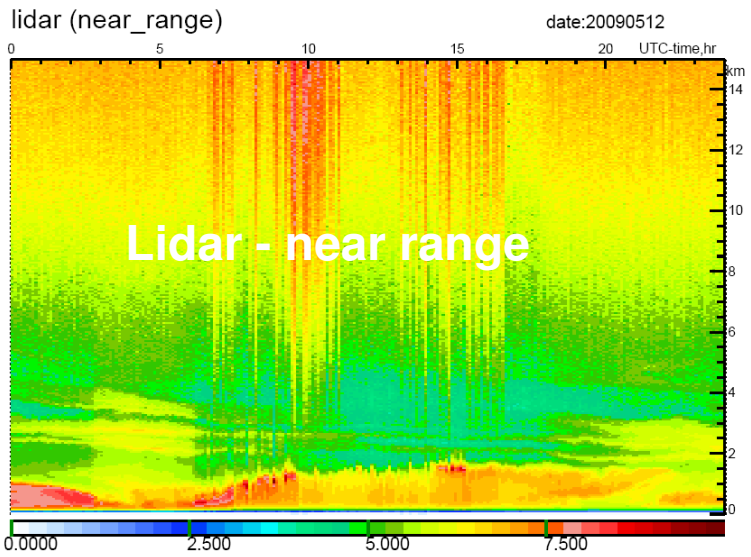
⇨ use near range

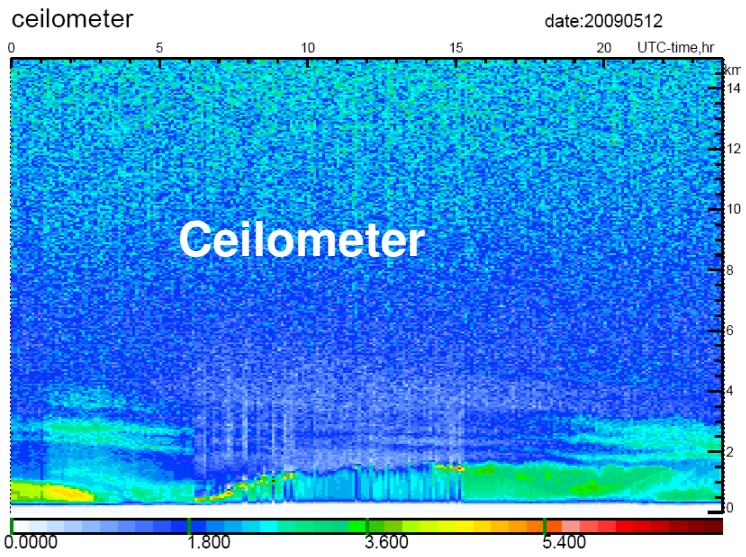


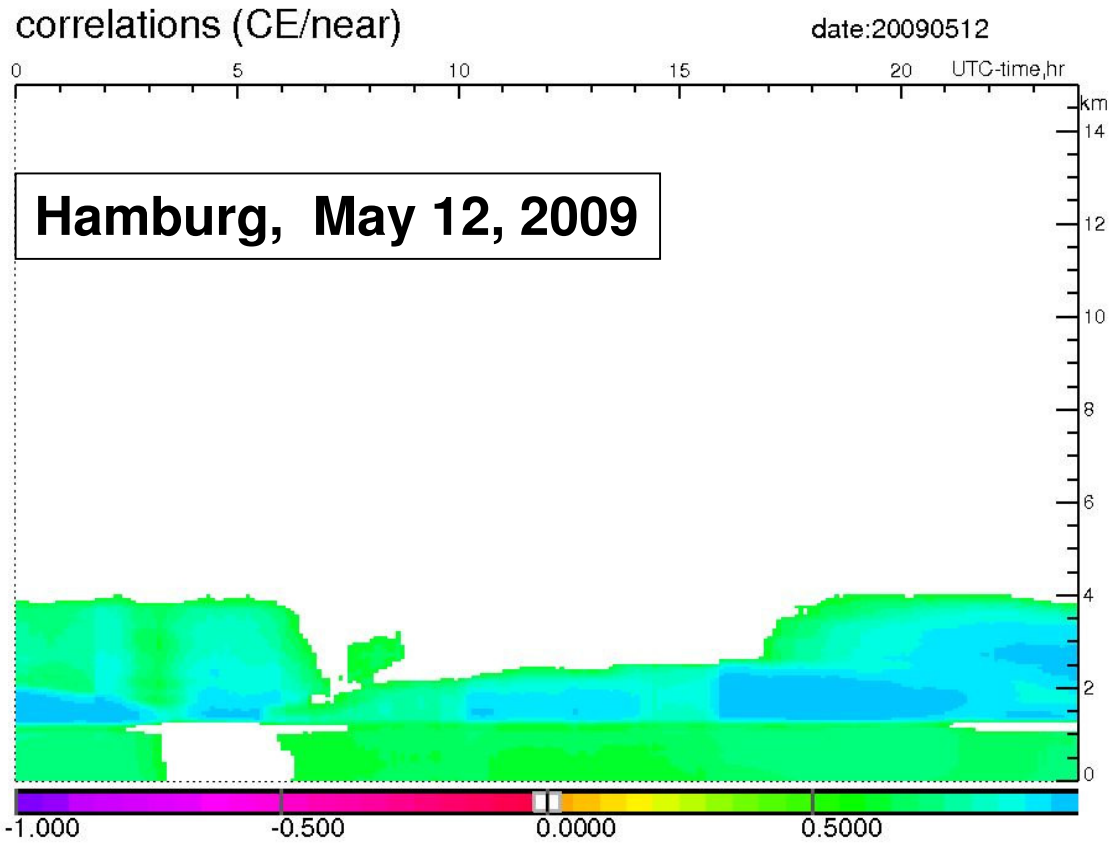




- correlations higher at lower altitudes
- well correlated in the lowest altitudes even above the plan. boundary layer







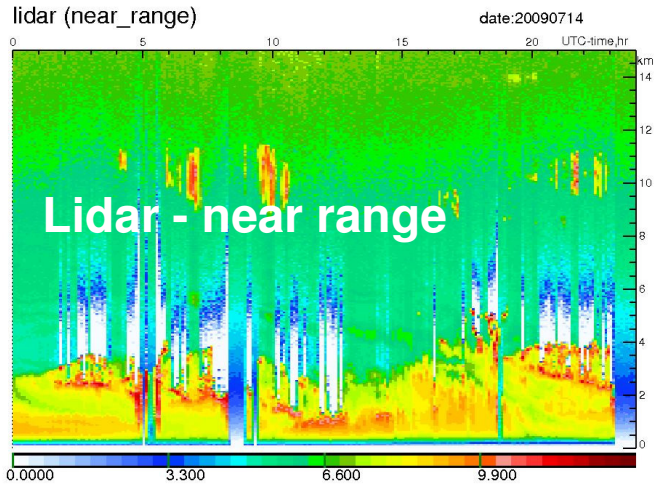
- focus on better correlations … Rs > 0.6

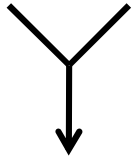
diurnal

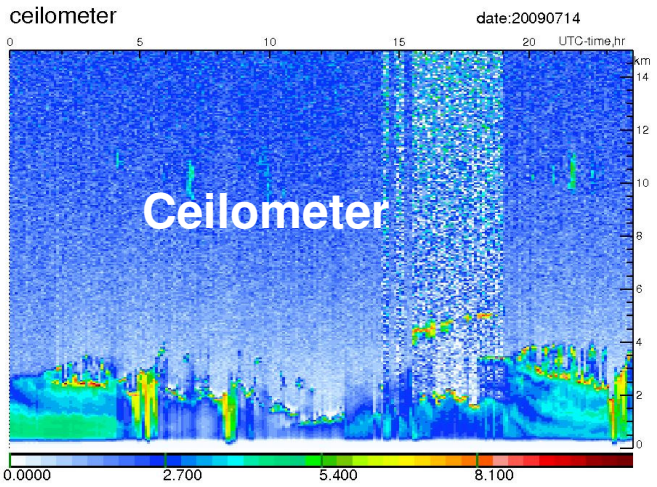
- better at night
- am poorest

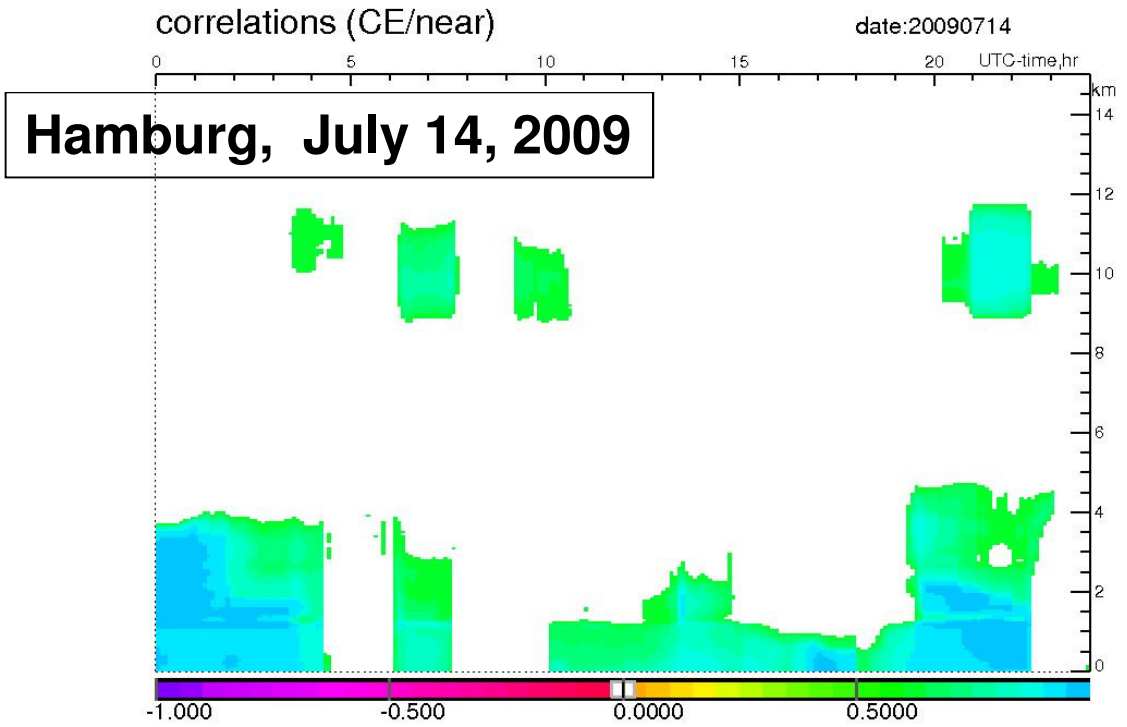
altitude

- up to 4km









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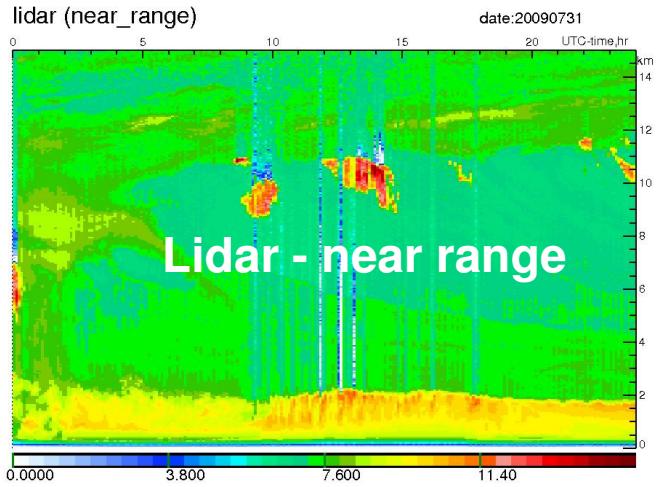
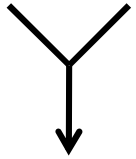
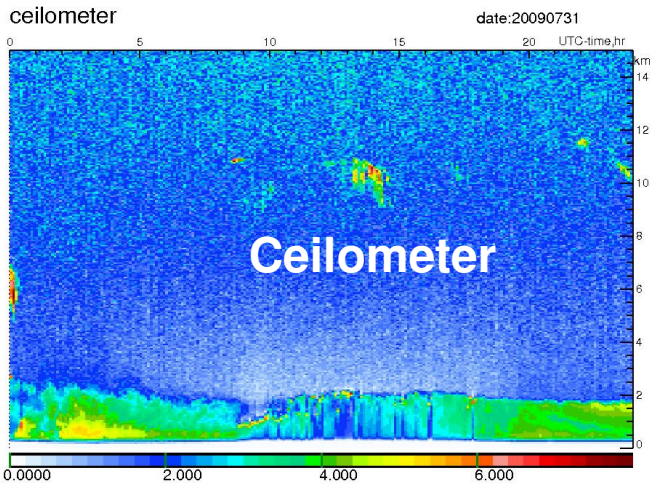
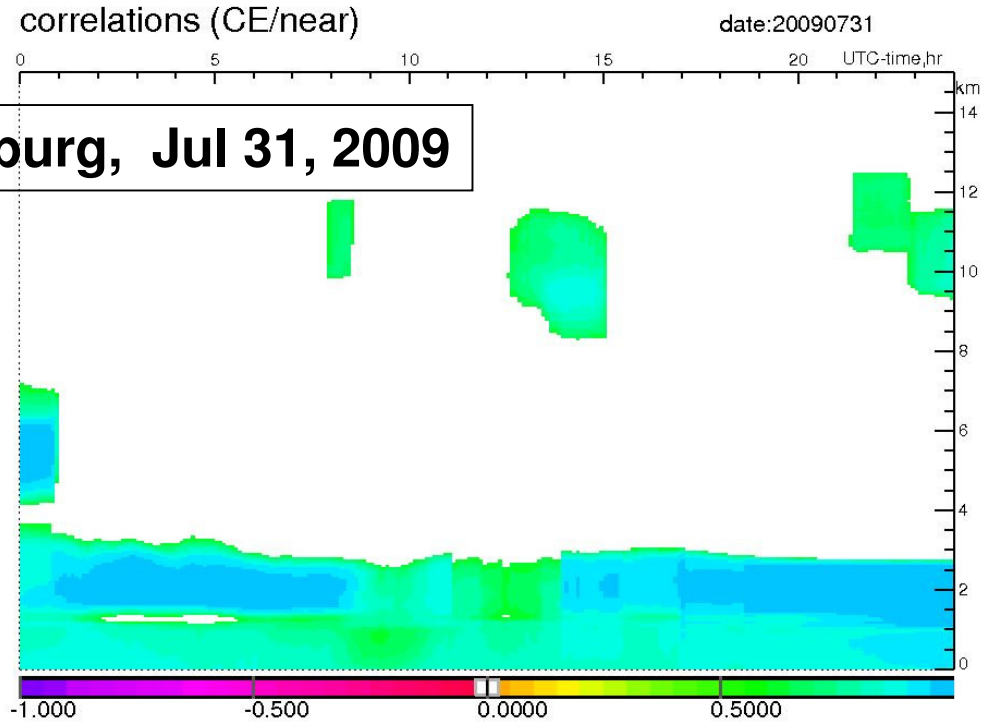


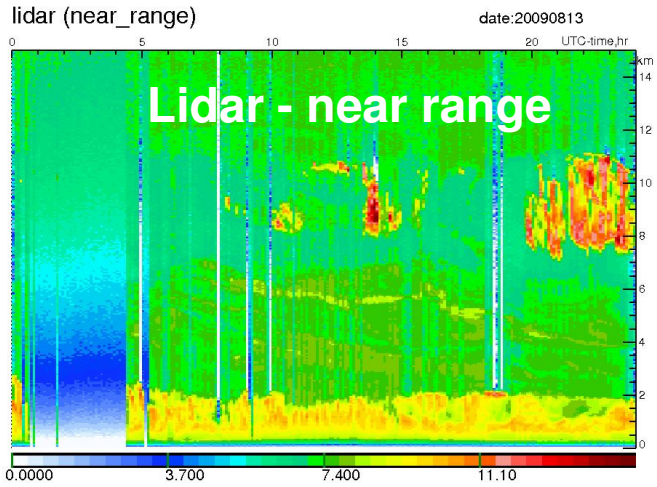


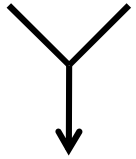


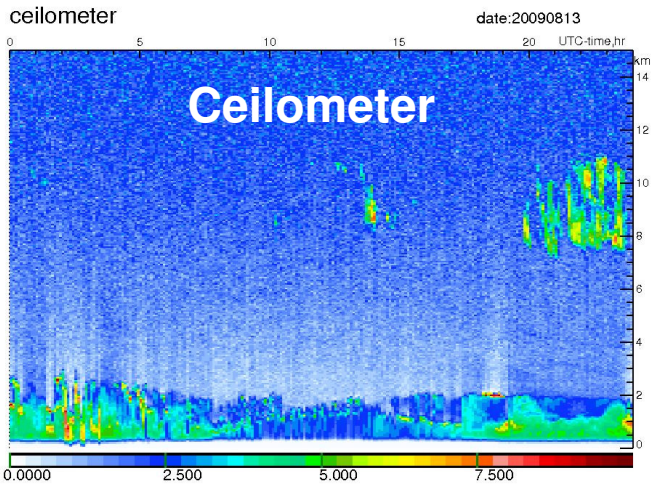


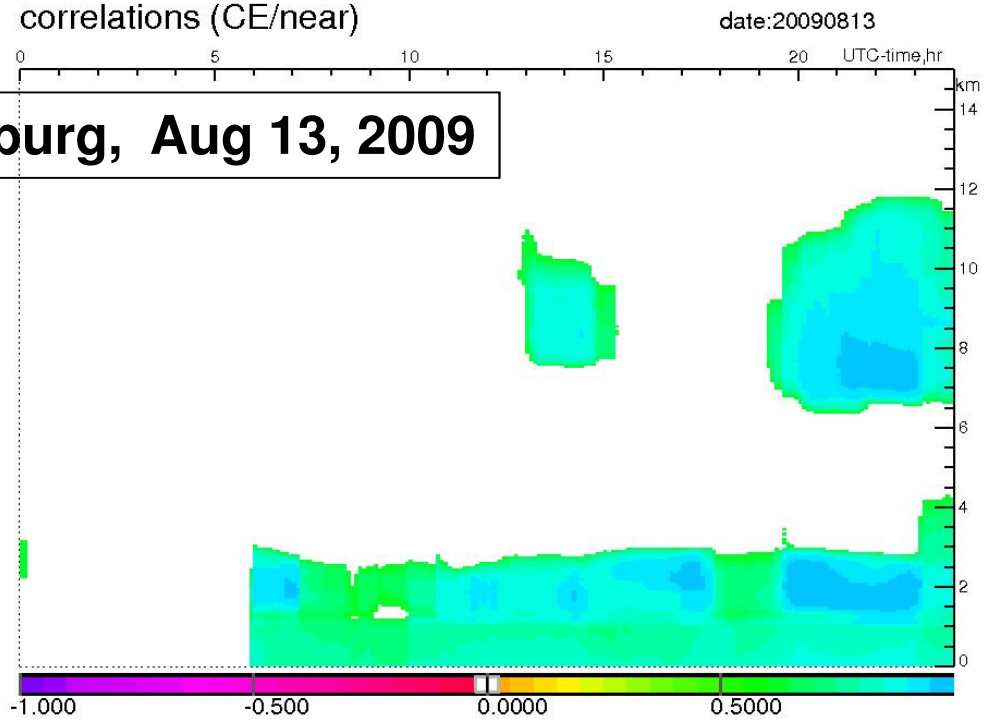
in the noisy regime

- **reliable cirrus detection**
- **many strutures are missed**
- **elevated dust (at 1μm) better seen than elevated biomass aerosol**



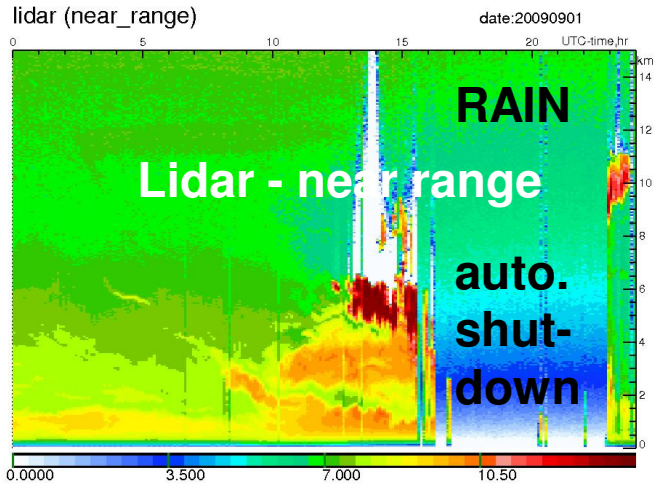


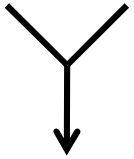


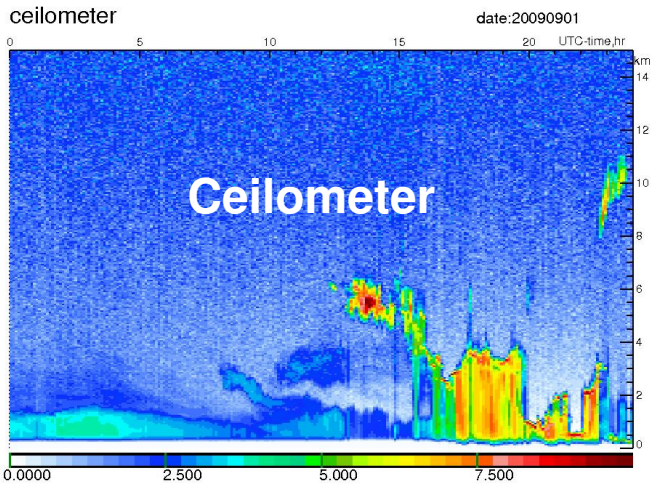


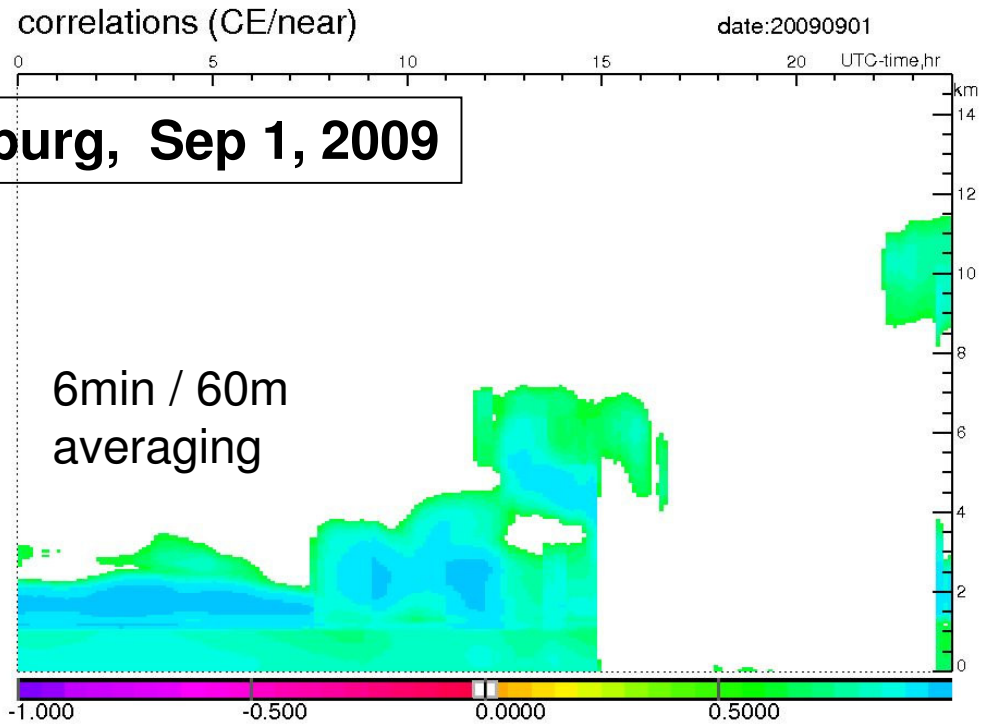
during precip.

- **ceilometer keeps on ticking**



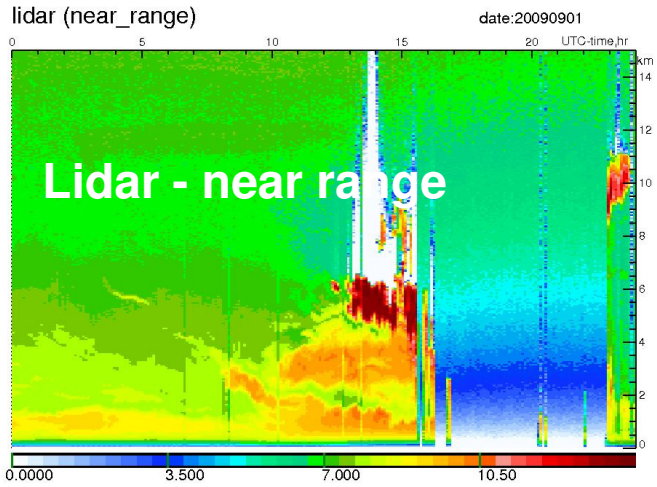


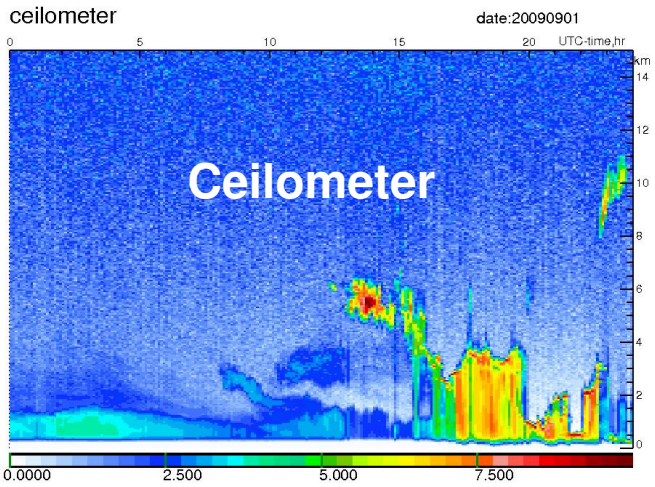


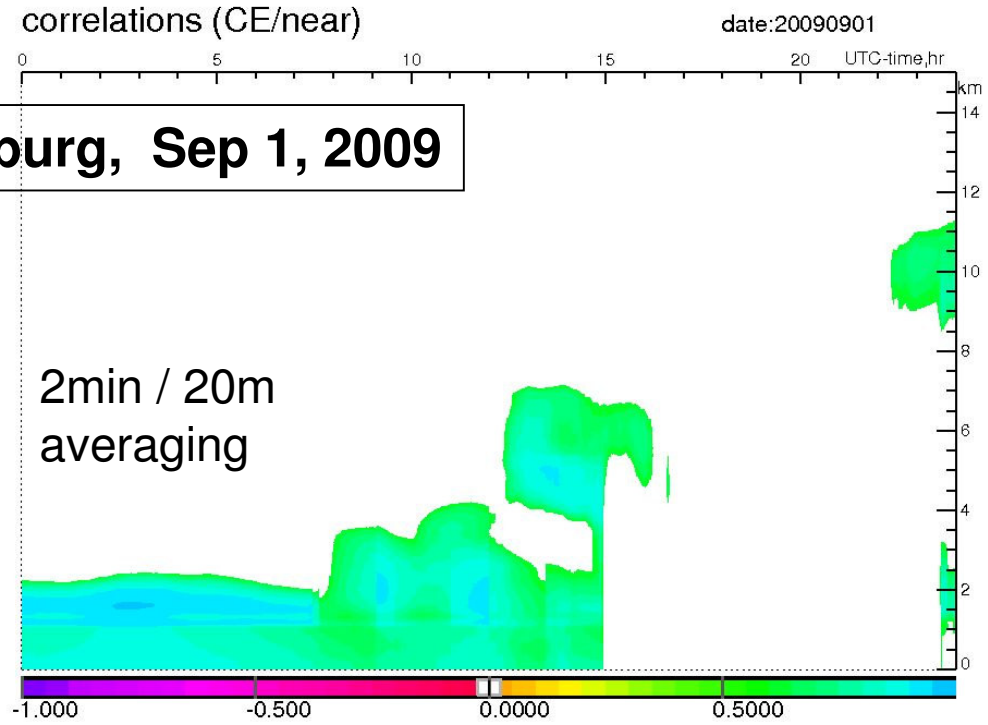


below clouds

- **ceilometer sensitivity fades**







shorter averaging

- **reduced correlation coefficients**

Conclusions

the Jen-Optik ceilometer can sense

- aerosol layers up to 4km (if they are no clouds)
- optically thin cloud structures (e.g. cirrus)
- responses are identical of side by side ceilometers
- averaging (time/space) should increase with height
- quantitative assessments (though) remain an issue

- it is definitely worth to consider and explore data of the 40 ceilometers of the German Weather Service for an improved temporal and spatial extension of EARLINET LIDAR data

- … again “extension” … and not a “replacement”

Possibilites

Quantitative grid assessments ?

- calibrate the lidar at 1024μm (diff. but possible)
- calibrate ceilometers in side-by-side comparisons
  - determine the instrument constants
- move ceilometers to surrounding satellite positions
- in regular intervals return for re-calibarations

Applications

- boundary layer altitude (daily, seasonal cycle)
- elevated dust frequency
- cirrus cloud statistics

Thank You!