Detecting Aerosol Layer Heights with Lufft CHM8k/ CHM15k Ceilometer

Speakers:

Guillermo Esquivel

- Lufft USA, Carpinteria, CA (Sales Manager North America)
- Meteorology and Renewable Energy

Holger Wille

- Business Unit Manager Lufft Berlin Optical Sensors
- Product Management

Source: Max-Planck-Institut für Meteorologie, Hamburg, Installation: Caribbean Institute for Meteorology & Hydrology, Barbados

Lufft

Data & Sky Condition Algorithm – CHM8k and CHM 15k

Data

- CHM15k: Unique sensitivity in the ceilometer class: detect cirrus clouds with optical densities <0.003 @ 500 m thickness within 1 min in day time background light conditions at 10 km altitude.

- CHM8k: Performance at night similar to CHM15k, at day limited to 8 km

- Data as attenuated backscatter coefficient profiles $\beta_{att}(x)$

SCA

- Multiple cloud layer detection (number programmable)

- Integrated wavelet algorithms for real time calculations of
  - aerosol layer heights/ mixing layer height

- Cloud amount due to WMO code 2700

- Sky condition index: precipitation, fog,…

- Vertical visibility (VOR)


Lufft
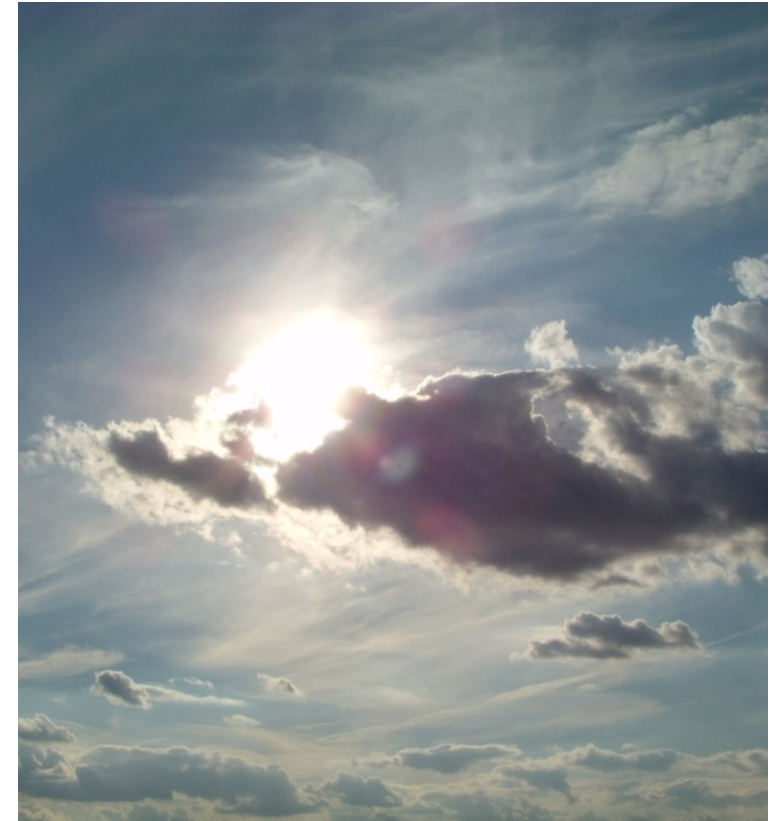
CHM8k / CHM15k General Specifications

Main specifications	CHM8k and CHM15k
Hardware communication interfaces	RS485, LAN
Communication RS485	ASCII commands for configuration Up to 9 different data telegrams with or without raw data, transfer in automatic or polling mode
Communication LAN	Web-interface (configuration and daily NetCDF file request) AFD / (s)ftp NetCDF file transfer mode Polling commands to get data telegrams via LAN port ssh port (Lufft remote service only)
Internal data storage	SD-HC Card (up to 32 GB), single daily file with 15 s, 15m resolution takes 24 MB
System status transmitted	Hardware errors, hardware warnings, signal quality, laser status, window status, temperature values, …
System characteristics	Double shielded aluminium housing, strongly inclined window, hood to decrease scattered light, keep window as clean as possible
Power consumption	15 W (min), 800 W (max - full heating mode)
Weight (heaviest spare part, unit)	10 kg, 70 kg
Laser Class	1M, eye-safe operation

CHM8k/ CHM15k technical data comparison

Specs Laser Optical System	CHM15k	CHM8k
technique laser emitter	Micro-chip Nd:YAG Laser	Laser diode based ceilometer
Wavelength	1064 nm	910 nm
laser divergence	< 0.3 mrad	< 0.5 mrad
energy per pulse, average power, pulse length	8 µJ, < 50 mW 1ns	< 3 µJ, < 24mW 100 ns
receiver FOV	0.5 mrad	1,1 mrad
receiver bandwidth	1 nm	25 nm
detection system	photon counting detection	analog detection with 16 Bit resolution
range resolution	5 m	5 m
Range	5 m … 15 km	5 m … 8 km

Comparison - CHM15k vs other manufacturers

CHM 15k performance at the Ceilinex campaign: http://ceilinex2015.de/measurements_folder/03-july-2015
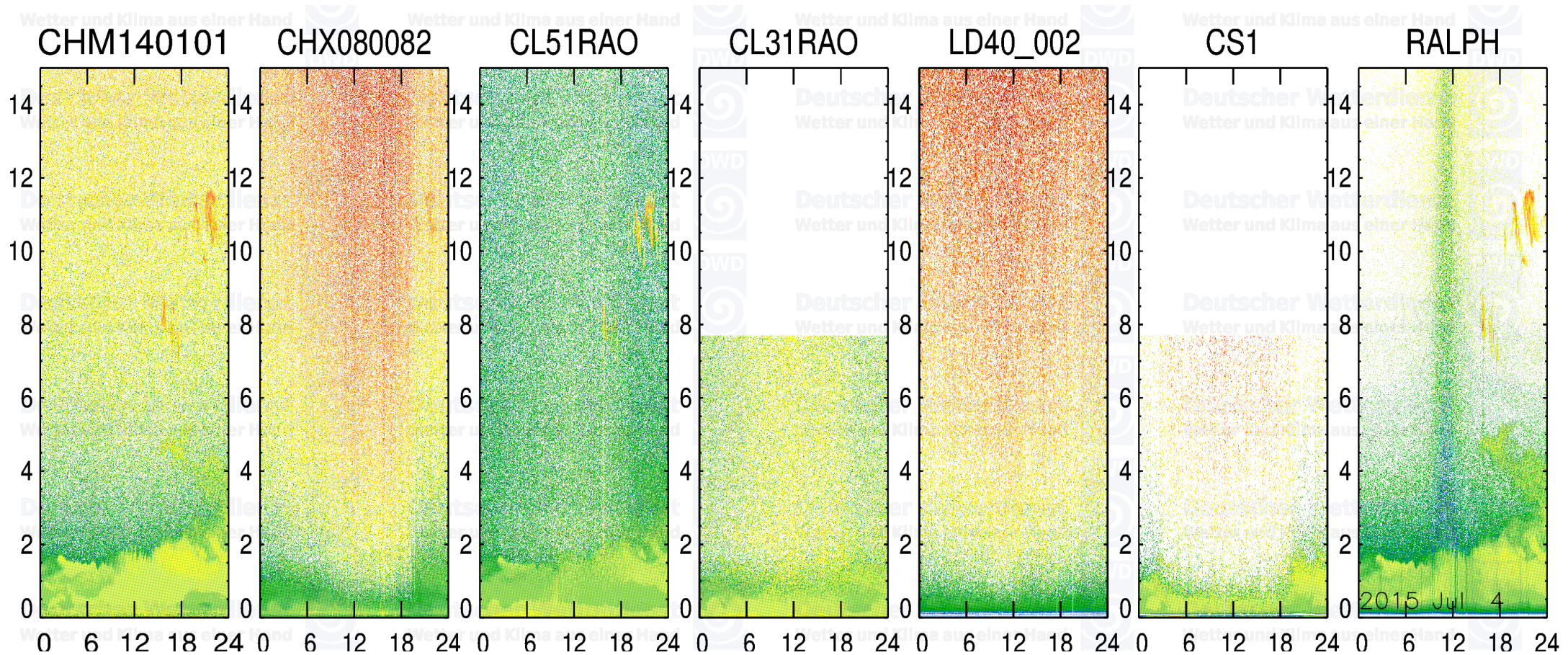
CHM15k – CHM8k comparison
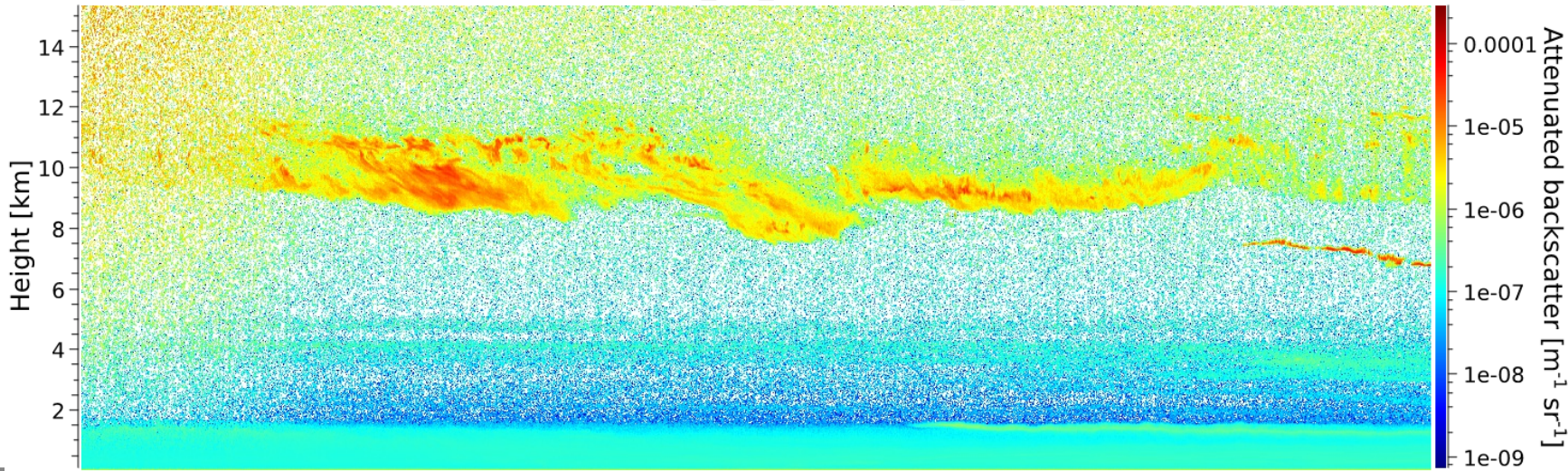
20170825_Berlin_CHM15kd01_000
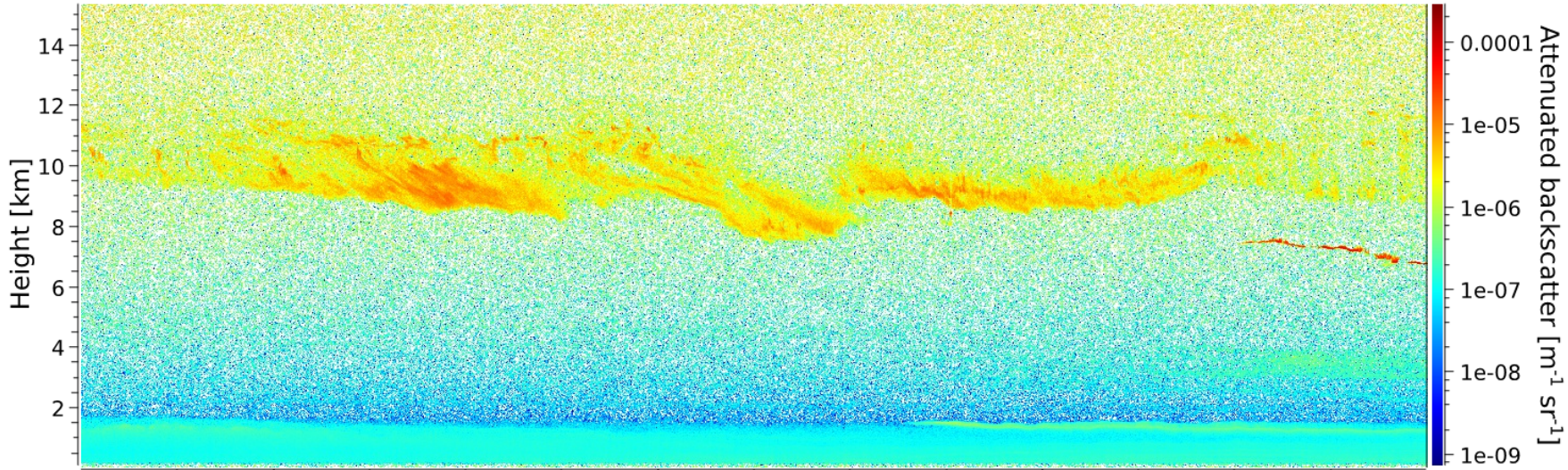
Cirrus Cloud comparison

CHM 15k
+ full day high performance

20170825_NN_CHM178002_001

CHM 8k
+ twilight/ night time
comparable performance,
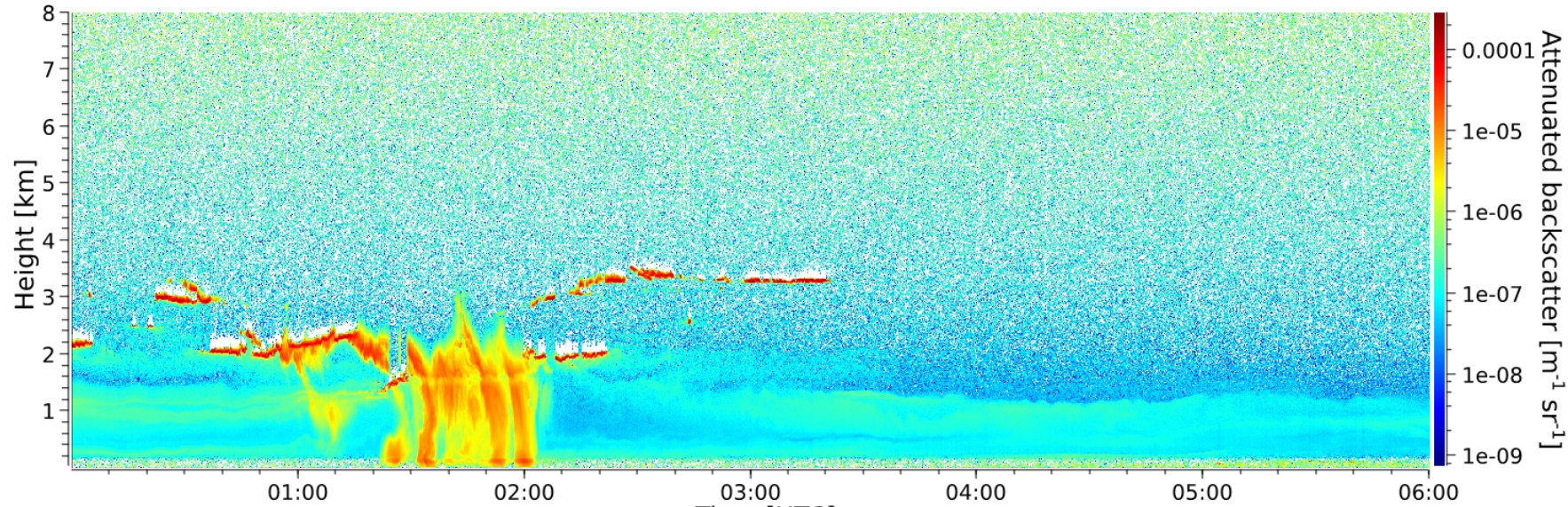analogue technique has a
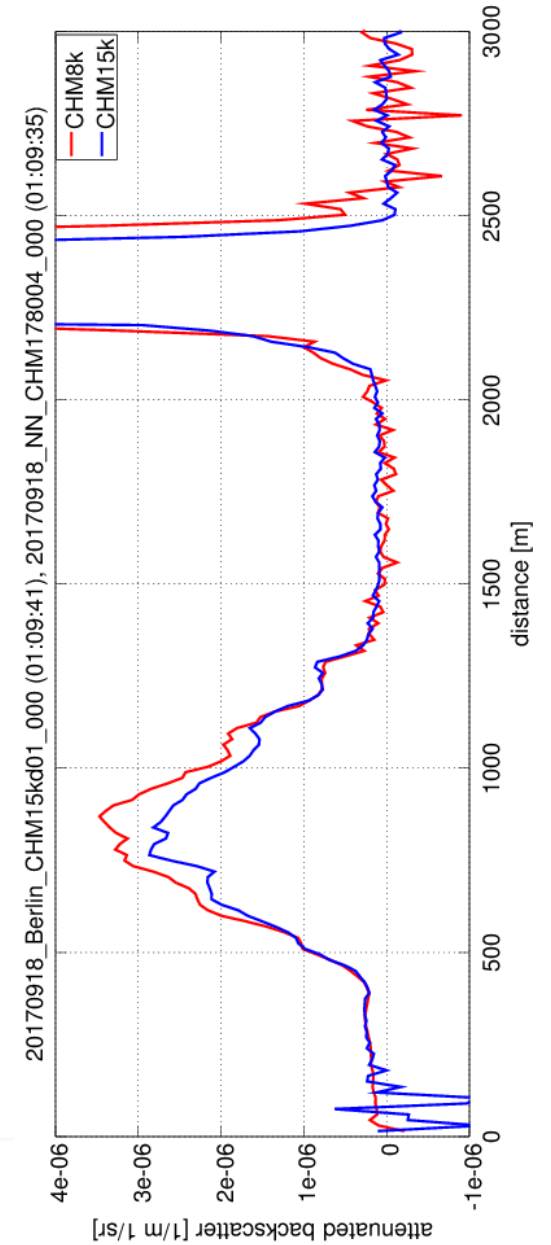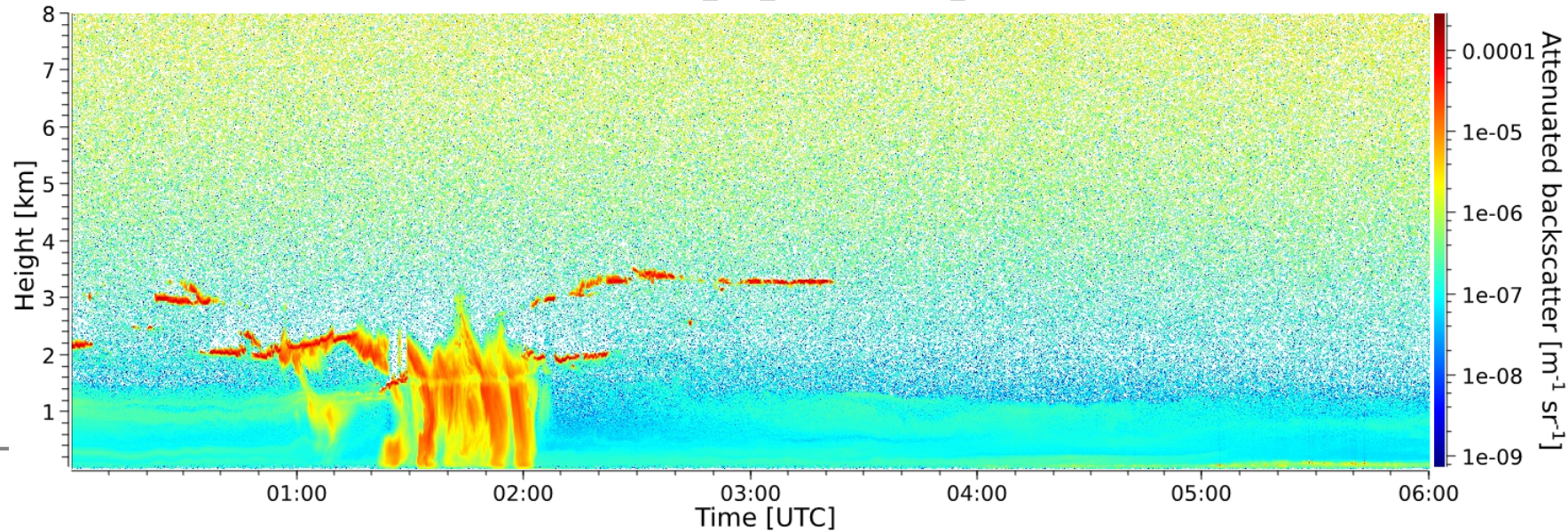higher dynamic range

OTT Hydromet EU Sales Meeting

CHM15k – CHM8k comparison

20170918_Berlin_CHM15kd01_000

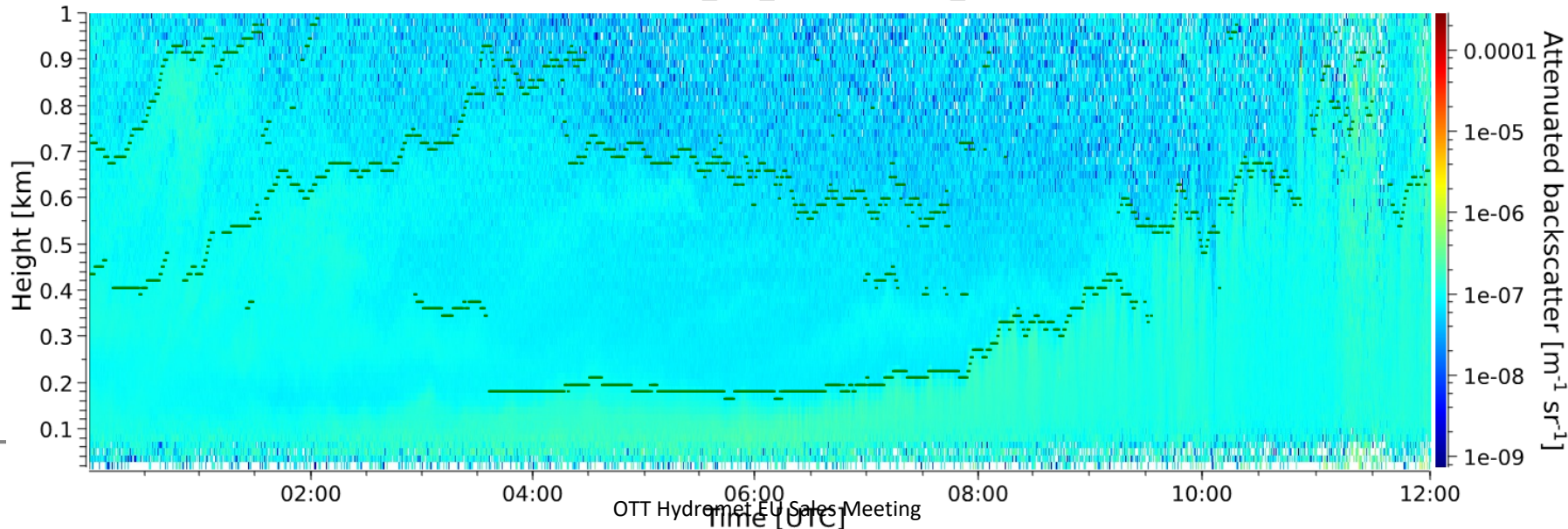20170918_NN_CHM178004_000

CHM15k – CHM8k comparison

20170916_Berlin_CHM15kd01_000

20170916_NN_CHM178004_000
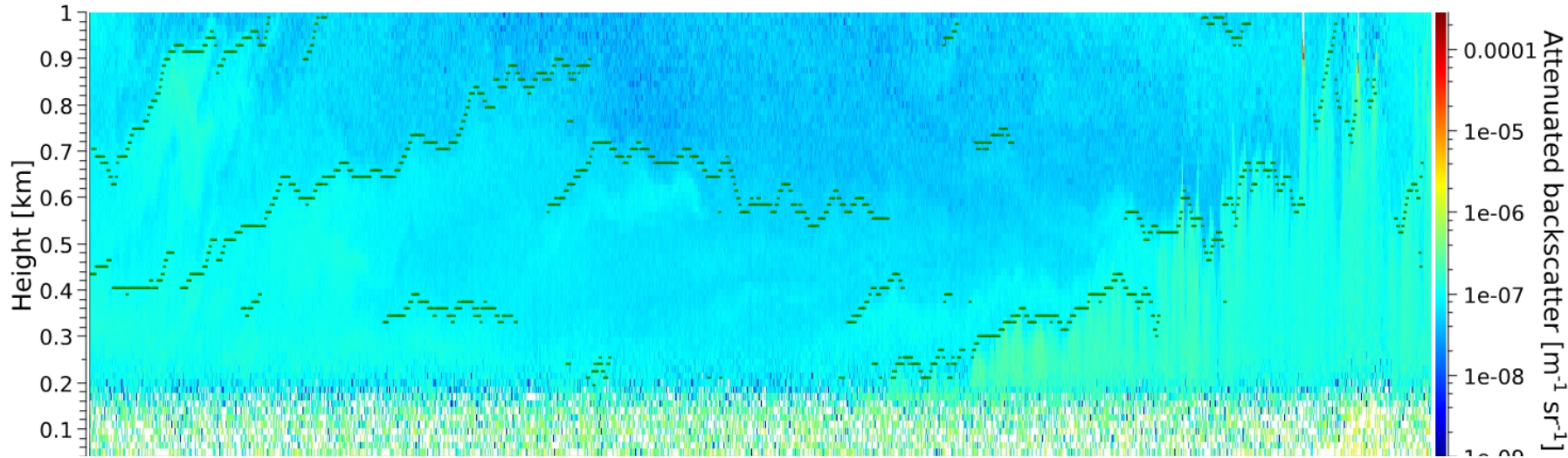
Aerosol layer/
mixing layer comparison

CHM 15k
+ full day high performance,
lower noise level
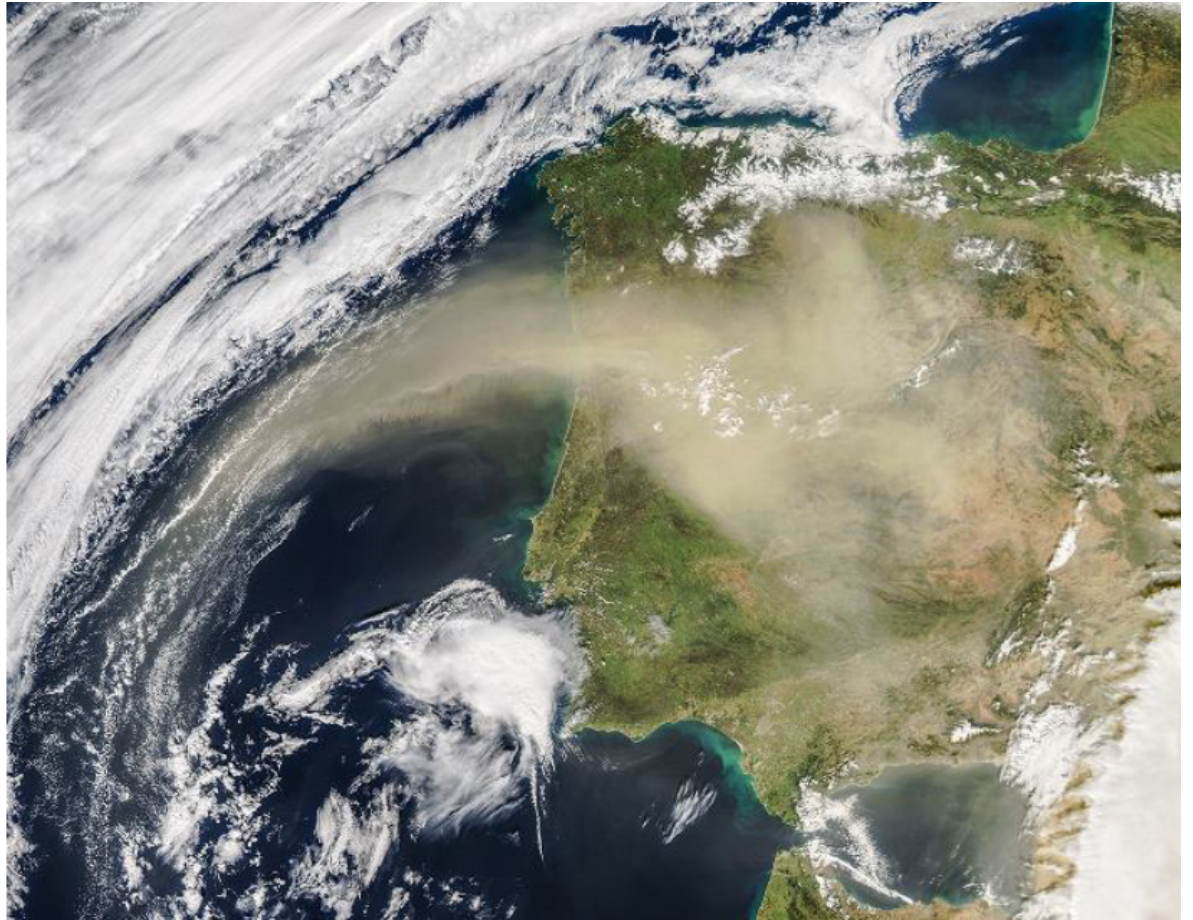
CHM 8k
+ low overlap for single
scattering measurements
(50 m)

Network Spain: Dust event on 21/02/2016

- Status 2016: 7 Spanish Research facilities

- Status 2017: 9+

- Time frame: Network started 2012

- Each ceilometer is combined with a Sun Photometer

- Discriminating the PBL internal layering by synergic monitoring of ceilometers and microwave radiometers

Courtesy of Modis Aqua

# Network Spain: Determine dust layer with ceilometer data
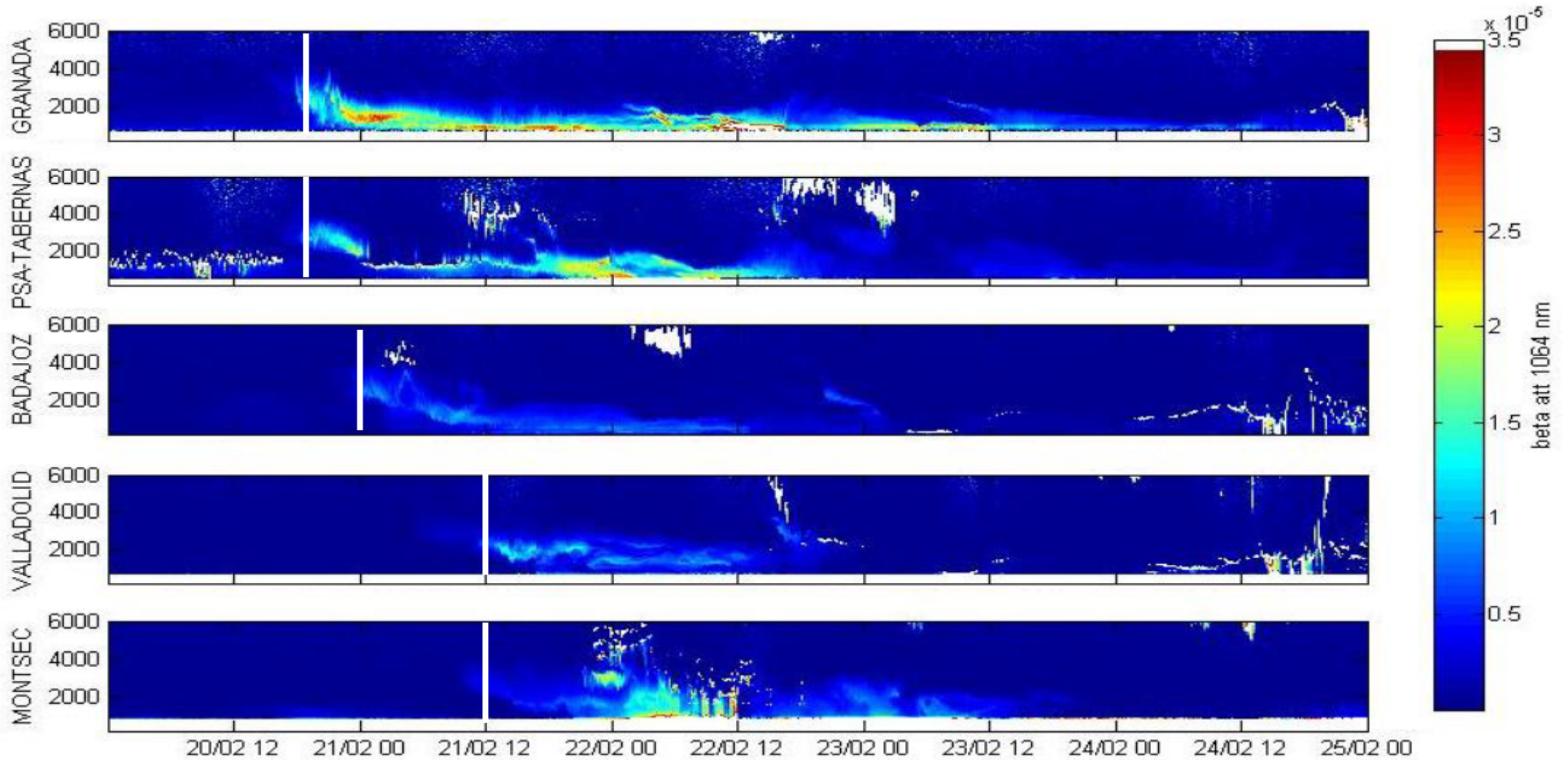
What kind of aerosol layer information does the ceilometer provide?

1) Realtime CHM algorithm analyzing backscatter profiles

2) Wavelength & gradient algorithm as part of SCA identifies in the planetary boundary layer (PBL) aerosol layer structures.

3) Weak aerosol layers (single scattering events) can be identified down to

   1) *190-220 m CHM15k,*

   2) *50-80 m CHM8k*

4) "Number of layer" parameter defines how many layers are transmitted in data telegrams.

5) The lowest determined aerosol layer will be in general characterized as mixing layer height.

Overlap Function CHM

Theoretical lidar signal normalized to 1 - maximum at 200 m.

Overlap function is designed to measure aerosol layers down to 50 m altitude.
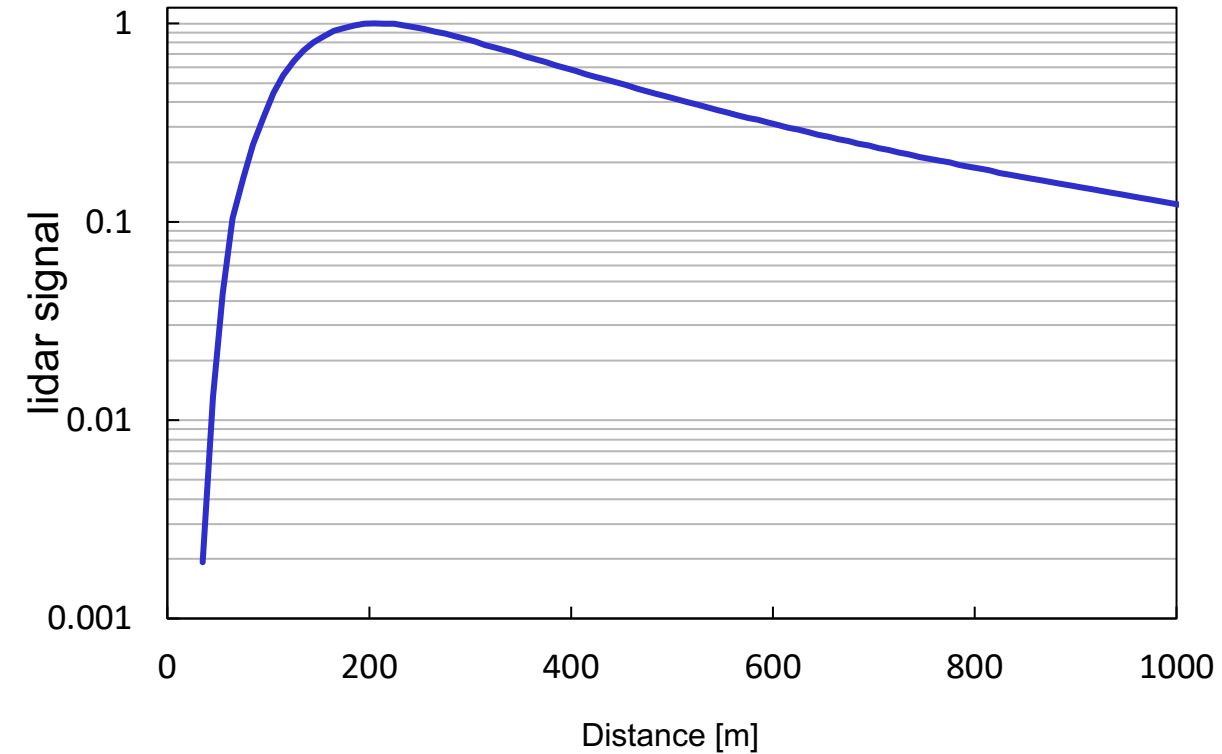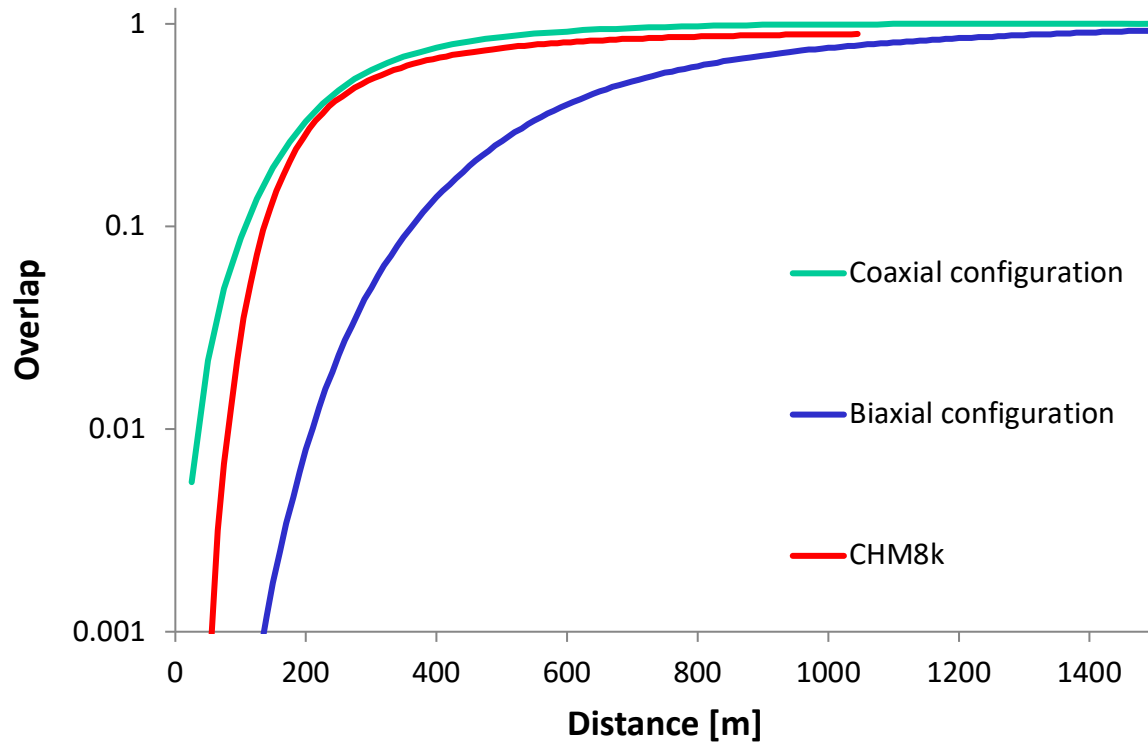
Updates Ceilometer CHM15k 2016/2017

- Firmware changes

- 115 VAC version modified to fulfill latest
  US, CA lightning protection / UL specs

- Modified options: cloud simulator, battery
  backup, additional (DSL) modem supported
  - Photo shows a combination of an industrial DSL
    modem and a battery backup
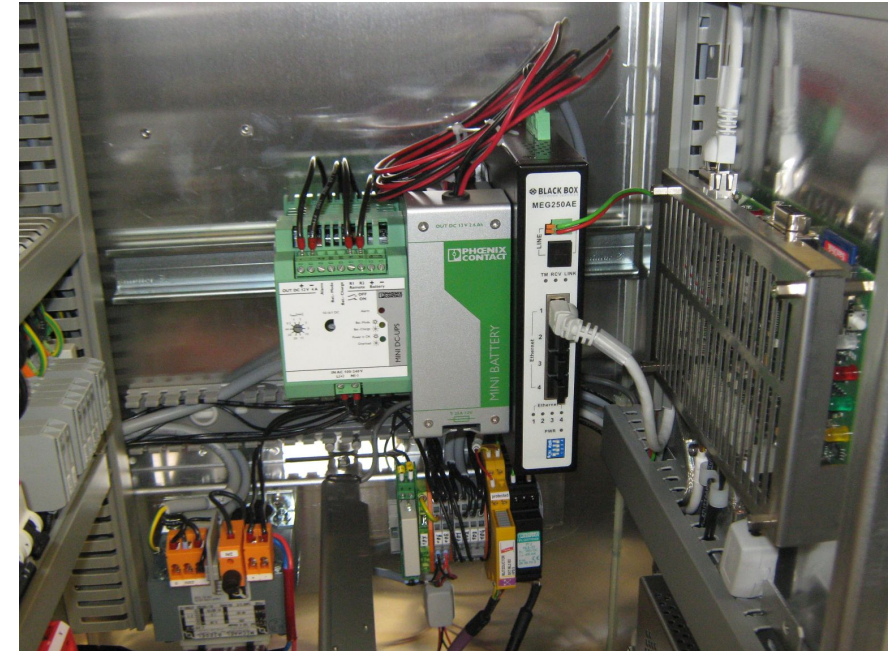
Cloud Simulator CHM

- Field test equipment

- Bluetooth connection - app controlled or RS485 connection
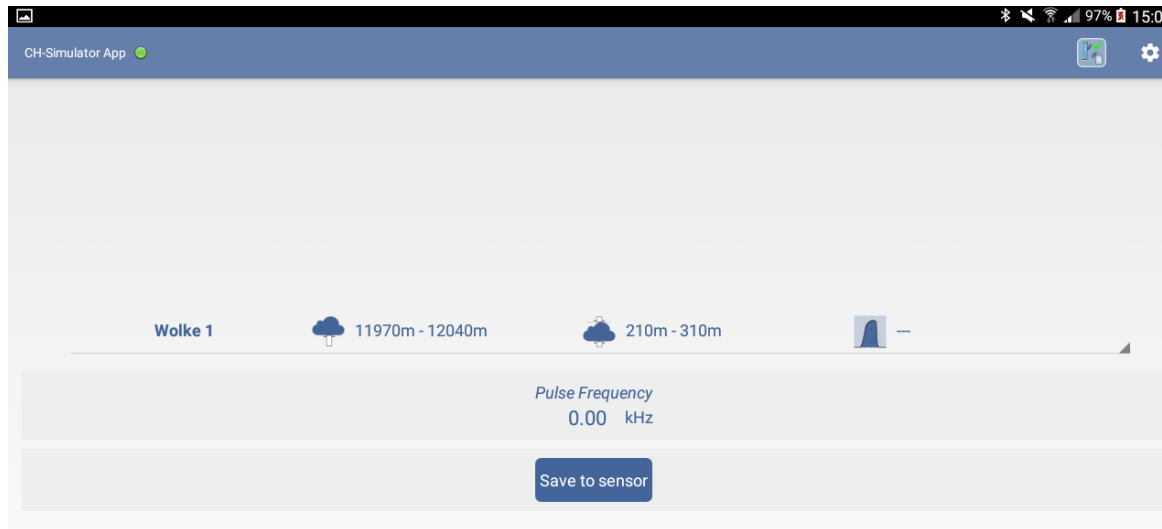
Firmware 0.747 (June 2017)

Aerosol & Cloud Monitoring:

- Cloud detection variant "higher the low clouds" introduced,
  new settings CloudDetectionMode = 1.

- Display no aerosol layers above clouds

- Correction for handling time slots after setting the time
  (now reset)

- Current CloudDetectionMode is displayed in the NetCDF attribute 'software_version' on last
  position:
  example: software_version string = „17.05.1 2.13 0.747 1"

- CHMDataViewer software version 1.7,
  works correctly with firmware 0.747

Why a different cloud detection mode?

→ Customer requirements to be compatible with cloud base height given from Vaisala
  instruments

→ Cloud base defined on different MOR levels 300 m, 500 m
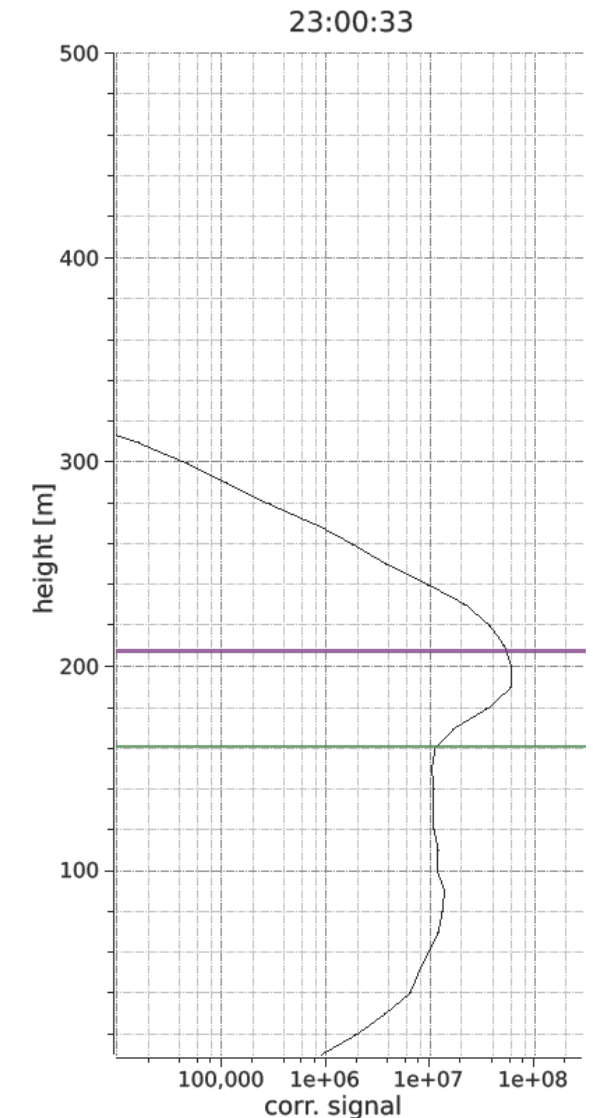
Any Questions please feel free to reach out to us

Lufft USA, Inc

1110 Eugenia Place Unit B

Carpinteria, CA

Tel: 805-335-8500/805-222-4356

Email: sales@lufftusainc.com

guillermo.esquivel@lufftusainc.com

Lufft Berlin – Optical Sensors

Carl-Scheele-Str. 16

12489 Berlin

Technical Hotline / Service

Klaus Riegler (Jessika Schugardt)

Tel: **+49 (0) 711 - 518 22 - 0**

Email: service@lufft.de

■ **Thank you for your attention!**

   ■ **More on www.Lufft.com**