



SENSOR GUIDE

LIDAR Ceilometer - Lufft CHM8k

SENSOR GUIDE - Contents

1. Challenges in Cloud Height Measurement Applications (customer issues)
2. Product Description
3. How to Overcome Challenges with CHM8k
4. Fields of Applications
5. Experiences with CHM8k (Measurement Examples & References)
6. Summary
7. More Info about CHM8k



1. Challenges for ceilometers (customer issues)

Meteorological Institute Munich



Source: Meteorological Institute of the Ludwig-Maximilians-University Munich

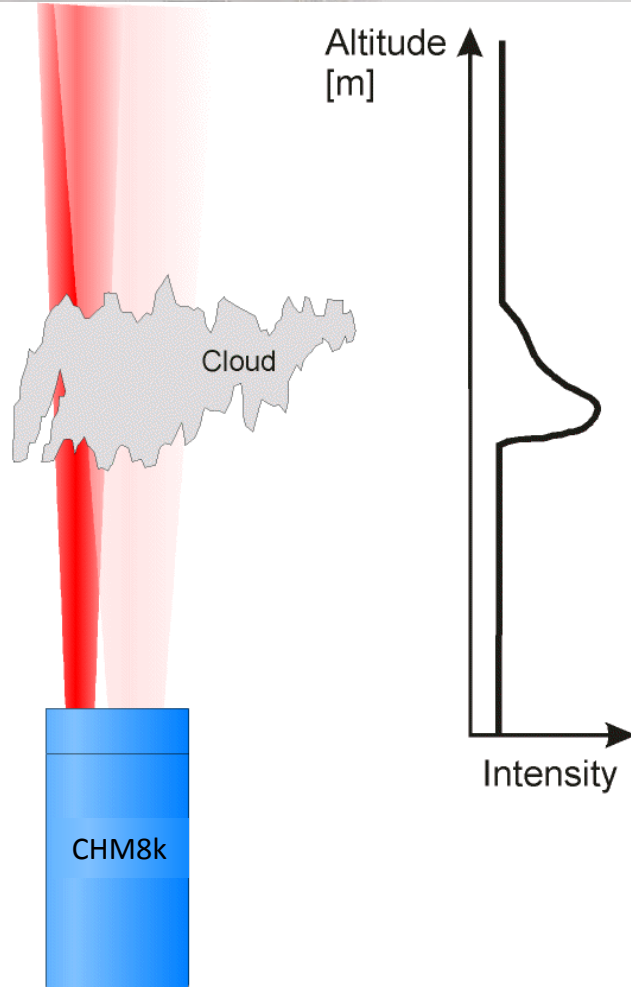
- Customer application require different measuring distances and sensitivities
 - ≈2 km (helipads: clouds & VOR) to 15 km (meteo service: aerosols and clouds), < 3 km (EPA: fine dust, aerosol layers)
 - High sensitivity for volcanic ash ↔ low might be better for strong water clouds (otherwise saturation) or fog
 - On airports, for instance, 8km ranges are sufficient, focus is on base cloud <1.5 km, vertical visual range output is important
- Lower prices for equipment allows to form a denser network, airports require redundancy, ...

➤ Does one unit fit at all?

2. Product Description – CHM8k Ceilometer

- Measures **particle scattering** and generates time and range resolved **backscatter profiles** from atmospheric particles and droplets
- **LIDAR** technique
- Calculation of **aerosol layers, cloud base heights, penetration depths, vertical visibility and cloud amount**
- Detection of **cirrus clouds & multiple cloud layers**
- Operating range **5 m up to 8 kilometers (26,200 feet)**
- **Service-friendly**

2. Product Description – CHM8k Ceilometer – LIDAR Technique



1. Laser pulses are emitted from instrument, light pulses are scattered by molecules, particles and droplets in all directions in the atmosphere.
2. Very small part of light that is scattered back can be collected and processed by the instrument. → backscatter profile contains the useful information

Scattering process depends on wavelength λ and size/ shape of aerosols & particles:

- molecules: Rayleigh scattering $\sim \lambda^{-4}$ (*nm to μm wavelengths*)
- Small particles (soot,...): Mie $\sim \lambda^{-1}$
- large particles (*droplets, volcanic ash,...*): $\sim \lambda$ (*μm to cm wavelengths*)

⇒ Backscatter signal for fog for near infrared LIDAR is orders of magnitude more intense than for molecules

⇒ CHM8k detects mainly particles and water droplets and is not sensitive for molecules

- Range/ altitude information results from time of flight measurement

2. Product Description – CHM8k/ CHM15k Ceilometer vs. LIDAR

| | |
|---|--|
| LIDAR (light detection and ranging) → a technique like radar, but also used for specific instrument class | Ceilometer (acronym used for instruments using the LIDAR technique to detect the ceiling) |
| <p>UV, visible and infrared wavelengths used by LIDARs</p> <ul style="list-style-type: none">➤ LIDAR detects particles, water droplets, molecules by elastic (Rayleigh) and sometimes inelastic (Raman) scattering➤ To detect, quantify and characterize aerosols and clouds➤ Standard calibration method on atmospheric molecular signal | <p>Near infrared wavelengths used by ceilometers mainly due to costs and stability reasons</p> <ul style="list-style-type: none">➤ Ceilometers detect particles and water droplets by elastic (Rayleigh) scattering processes➤ To detect and partly quantify aerosol and cloud layers➤ Calibration method on molecular signal (CHM15k only), on total column of aerosols with photometer AOD measurements, in general manufacturer calibration method needed |
| <p>Service, maintenance, operational time</p> <ul style="list-style-type: none">➤ Maintenance can be necessary on daily bases➤ Well trained service and operator with background in electrical engineering or physics➤ Due to high operational costs, operational time for some hours per day or per week | <p>Service, maintenance</p> <ul style="list-style-type: none">➤ Low level maintenance rate within a year (cleaning optics, changing de-humidifier)➤ standard service staff for operation and service➤ 24/7 operation |
| <p>Markets:</p> <p>environmental studies (intense, none-permanent studies), sciences, (partly) weather service</p> | <p>Markets:</p> <p>aviation, off-shore, weather services, environmental market (long term studies)</p> |

2. Product Description – CHM8k compared with CHM15k

| Laser Optical System (LOM - 2017) | CHM15k | CHM8k |
|---|---------------------------------------|--------------------------------------|
| Technique laser emitter/ wavelength | Micro-chip Nd:YAG Laser @ 1064 nm | Laserdiode @ 905 nm |
| Laser divergence | < 0.3 mrad | < 0.5 mrad |
| Pulse energy, average power Pulse length | 8 μ J, < 50 mW 1 ns | < 3 μ J, < 24mW 100 ns |
| Receiver field of view (FOV) | 0.5 mrad | 1.1 mrad |
| Receiver spectral bandwidth – FWHM | 1 nm | 25 nm |
| Detection technique: | Photon counting detection mode | 16 Bit analog detection mode |
| Range resolution | 5 m (16.4 ft) | 5 m (16.4 ft) |
| Range (min ... max) for cloud detection | 5 m ... 15 km (16.4 ... 49.2 ft) | 5 m ... 8 km (16.4 ft ... 5 mi) |
| Overlap range for aerosol detection | 230 m ... 12 km (754.6 ft ... 7.5 mi) | 80 m ... 7 km (262.5 ft ... 4.35 mi) |

2. Product Description – CHM8k Ceilometer – Measurands

Multiple cloud layer detection up to **8 km height**

- 3 layers are standard, up to 9 layers programmable.

Cloud detection

Particle (aerosol) backscatter profiles

- Attenuated backscatter coefficient
- Aerosol layer identification
- Mixing layer height

Cloud amount due to WMO code 2700

Sky condition index: precipitation, fog

Vertical visual range (VOR)

2. Product Description – CHM8k Ceilometer – Characteristics



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

- Measuring range: **8 km (26250 ft)**
- Range resolution: **5 m (16.4 ft)**
- Enhanced integrated wavelet algorithms for real time calculations
- Simple and **eye-safe** routine operation, laser class: 1M
- 110-120 VAC or 220 -240 VAC version, **battery backup** available
- **Service-friendly** modular device setup (heaviest service part <10 kg or 22 pounds)
- Various data telegrams, including raw data in **NetCDF format**
- **Ethernet & RS485** communication, **web interface, ftp service**

2. Product Description – CHM8k Ceilometer – Technical Data

| Ceilometer | | | Order No. | Ceilometer | | | Order No. | |
|--|---------------------------------|---|-----------|---|----------------------------|--------------------------------|-----------|----------------------|
| CHM8k Measuring Principle & Parameters | Measuring principle | Lidar (optical, time of flight) | 8349.00 | Laser-optical Para- meters | Light source | Laserdiode | | |
| | Description | Aerosol backscatter profile $\beta_{att}(r)$ | | | Wavelength | 905 nm | | |
| | Range | 5 m ... 8 km (16 ... 26.246 ft) | | | Pulse energy | <3 μ J | | |
| | Time resolution | 2 ... 600 s | | | Pulse repetition frequency | 8 kHz | | |
| | Range resolution | 5, 10, 15 m | | | Filter Bandwidth | 25 nm | | |
| | Quality and auxiliary values | External and internal temperature, window status, laser status, receiver status | | | Field of view receiver | 1.1 mrad | | |
| | | | | | Operating Safety | Environmental compliance | | ISO 10109 - 11 |
| Target Parameters | Quantities given in layers | Cloud base height, cloud penetration depth, aerosol layer height | | Laser protection class | | 1M, DIN EN 60825 - 1:2015 | | |
| | | Accuracy (measured on hard target in 8 km distance) | | \pm 5 m (\pm 16 ft) | | Protection level housing | | IP65 |
| | | Additional quantities | | Cloud cover, vertical visibility, Sky Con- dition Index | | Electrical Safety | | EN 61326 - 1 Class B |
| | Communication | Standard interfaces | | RS485 (ASCII communication) LAN (web interface, (S-)FTP, NetTools) | | Operating Condi- tions | | Certifications |
| Optional interfaces | | DSL modem, RS232 for service | | Temperature range | -40 ... 55 °C | | | |
| Electrical Parame- ters | Power supply | 230 VAC or 115 VAC, \pm 10 % | | Physical | Relative humidity | 0 ... 100 % | | |
| | Power consumption | 250 W (Standard) 800 W (in maximum heating mode) | | | Wind | 55 m/s | | |
| | UPS functionality (opt.) | Internal backup battery for electronics, > 1 hrs | | | Dimensions | 500 x 500 x 1550 mm | | |
| | | | | | Weight | 70 kg (130 kg incl. packaging) | | |

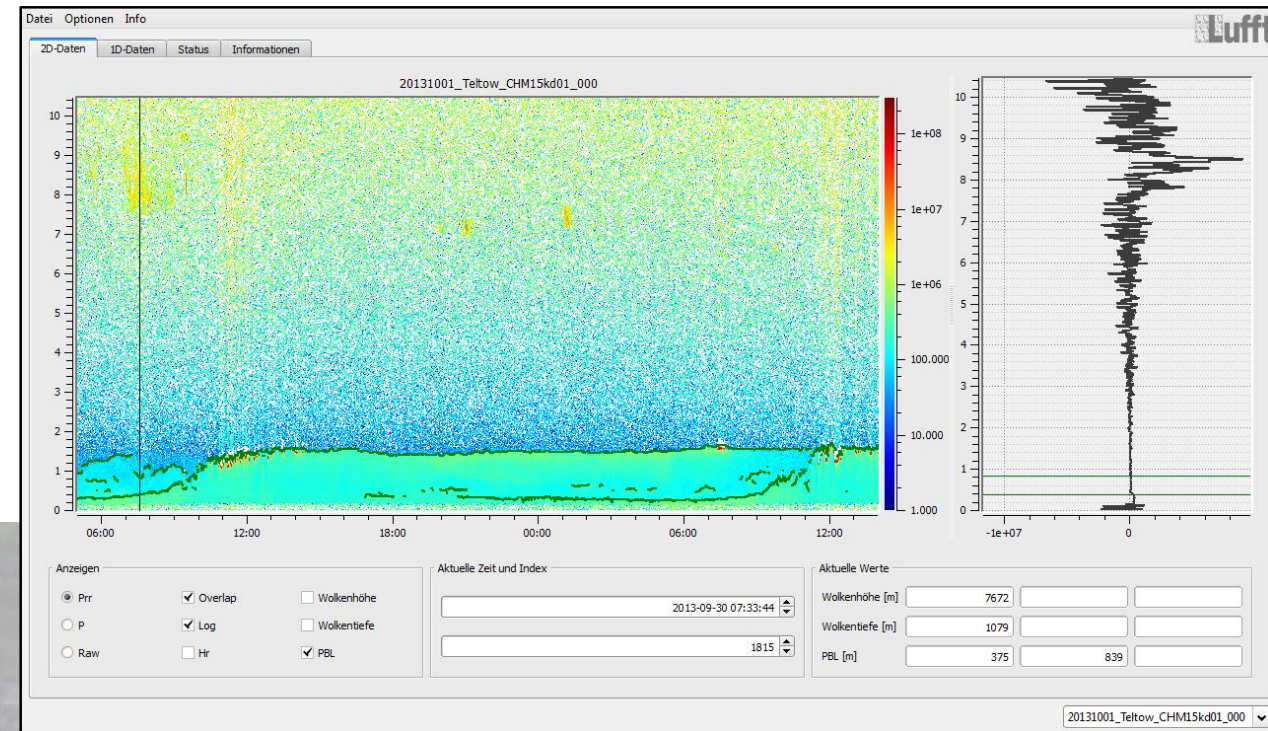
2. Product Description – CHM8k Ceilometer – Accessories - Software

RS485 device communication:

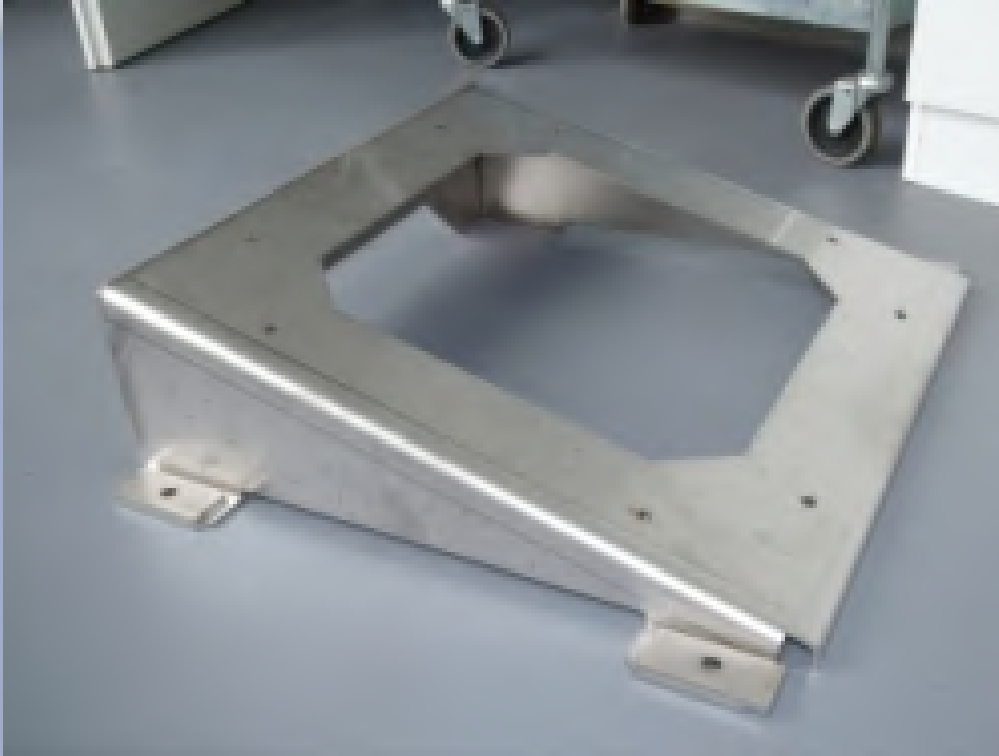
- GUI software „Data client“ (free of charge)
- Text based: any terminal program

Offline display software for CHM 15k NetCDF files: „CHM Viewer“ (extra charged)

- Display of measured backscatter data in contour plots
- Display and correlation with clouds, aerosol layers, modified overlap functions
- History of status parameter
- Plot generation, PDF export,....



2. Product Description – CHM8k Ceilometer – Accessories – Hardware (on request)



Tilt adapter enables installation of the CHM xk at an angle of 15° → usage is recommended between 30°N and 30°S



Additional accessories:

- Cloud simulator
- Battery backup

3. How to Overcome Challenges with CHM8k

- Lower price than CHM 15k
- Range optimized for aviation and low altitude studies without having saturation problems due to fog or low stratus clouds that can occur in single axis ceilometers
- High accuracy and measurements of several parameters simultaneously
- No compromises with regards to functions/ quality compared to CHM15k
- Rugged housing & service-friendliness



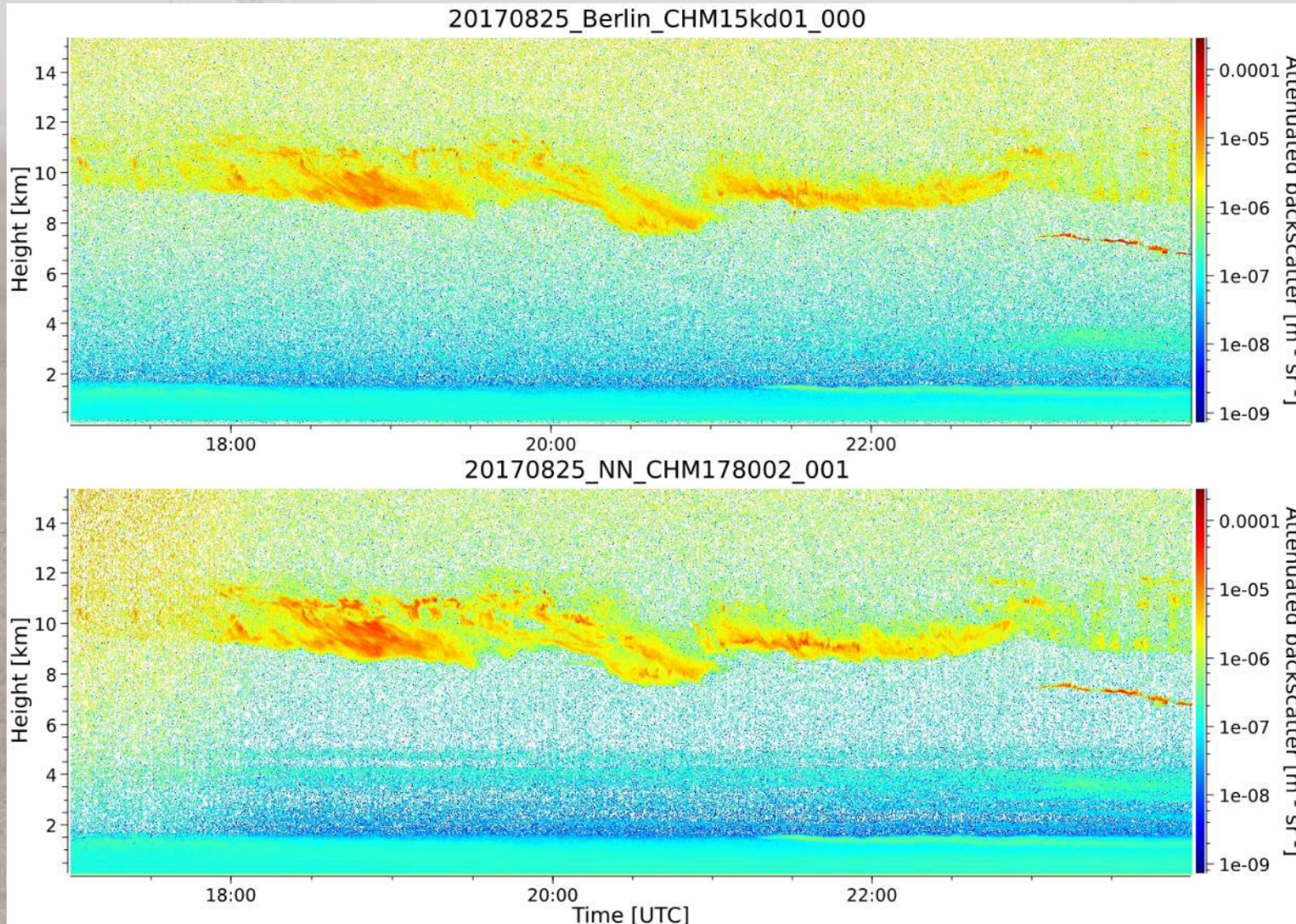
4. CHM8k Ceilometer – Fields of Application

- Weather services
- ASOS systems, aviation market
- EPA/ Universities: Environmental studies of fine dust, mixing layer
- Renewable energy market
 - cloud cover → solar
 - cloud base → wind energy



ILVA, Taranto (It), 3x CHM 15k

5. Experiences with CHM8k – Measurement of Cirrus Clouds



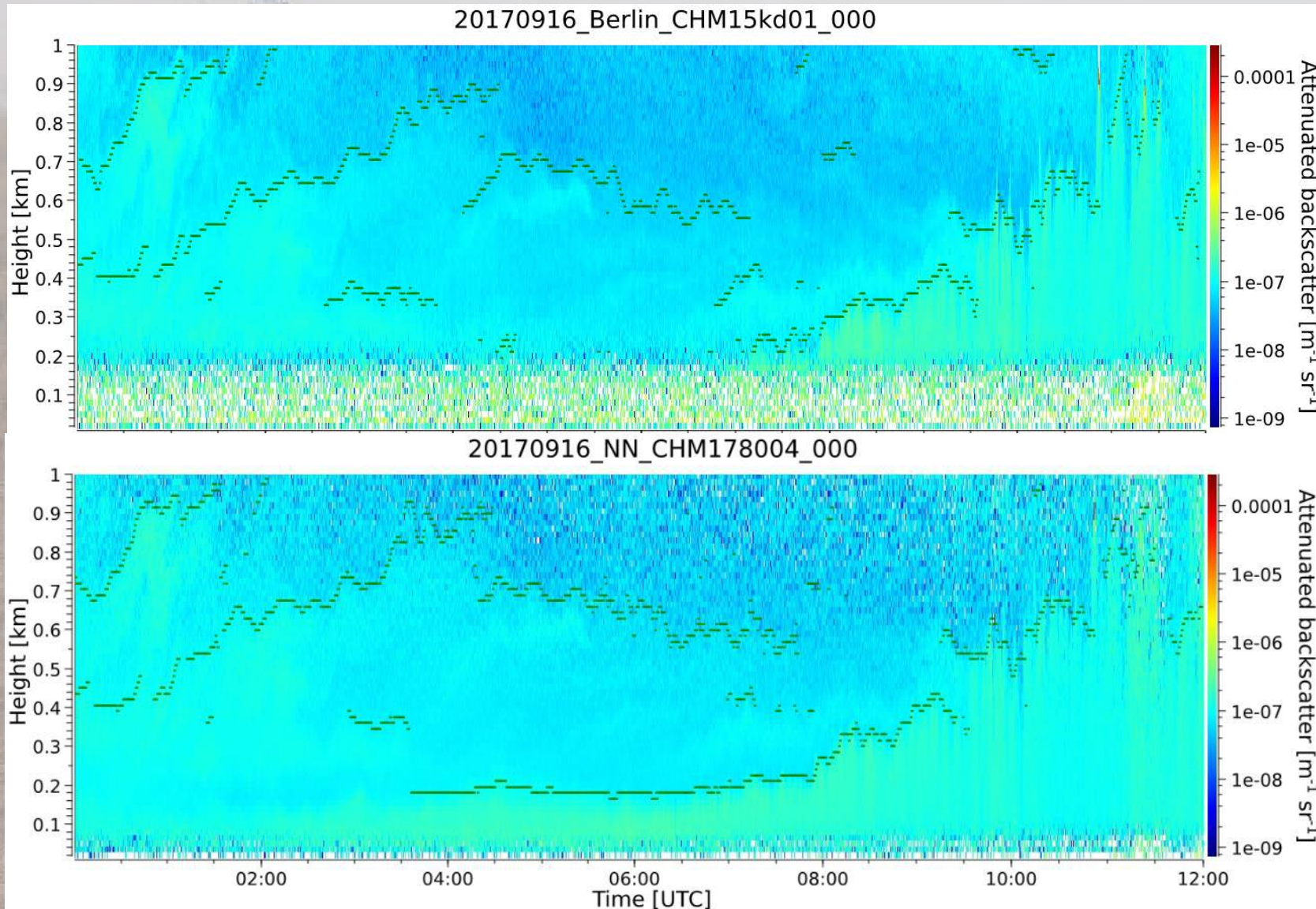
Cirrus Cloud comparison

CHM 15k
+ full day high
performance

CHM 8k
+ higher dynamic range

→ CHM8k performance at
night similar to CHM15k

5. Experiences with CHM8k – Measurement of aerosol layer

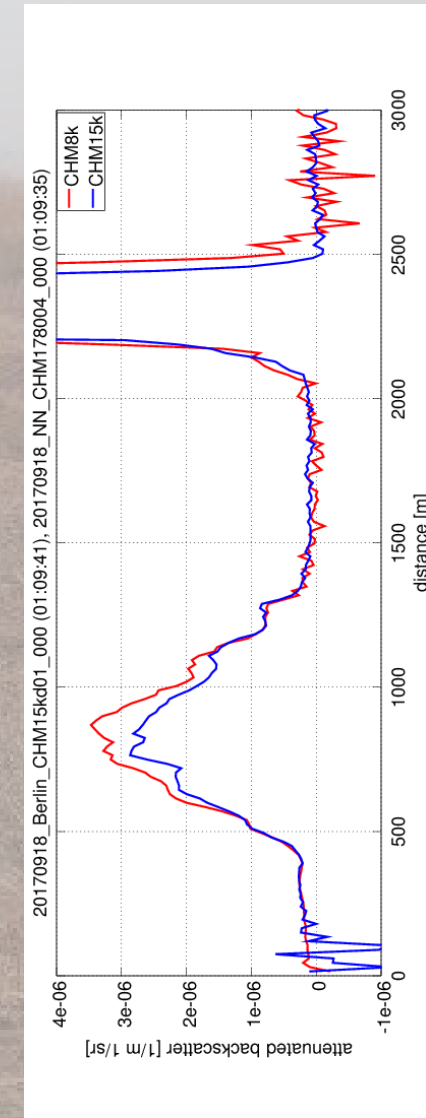
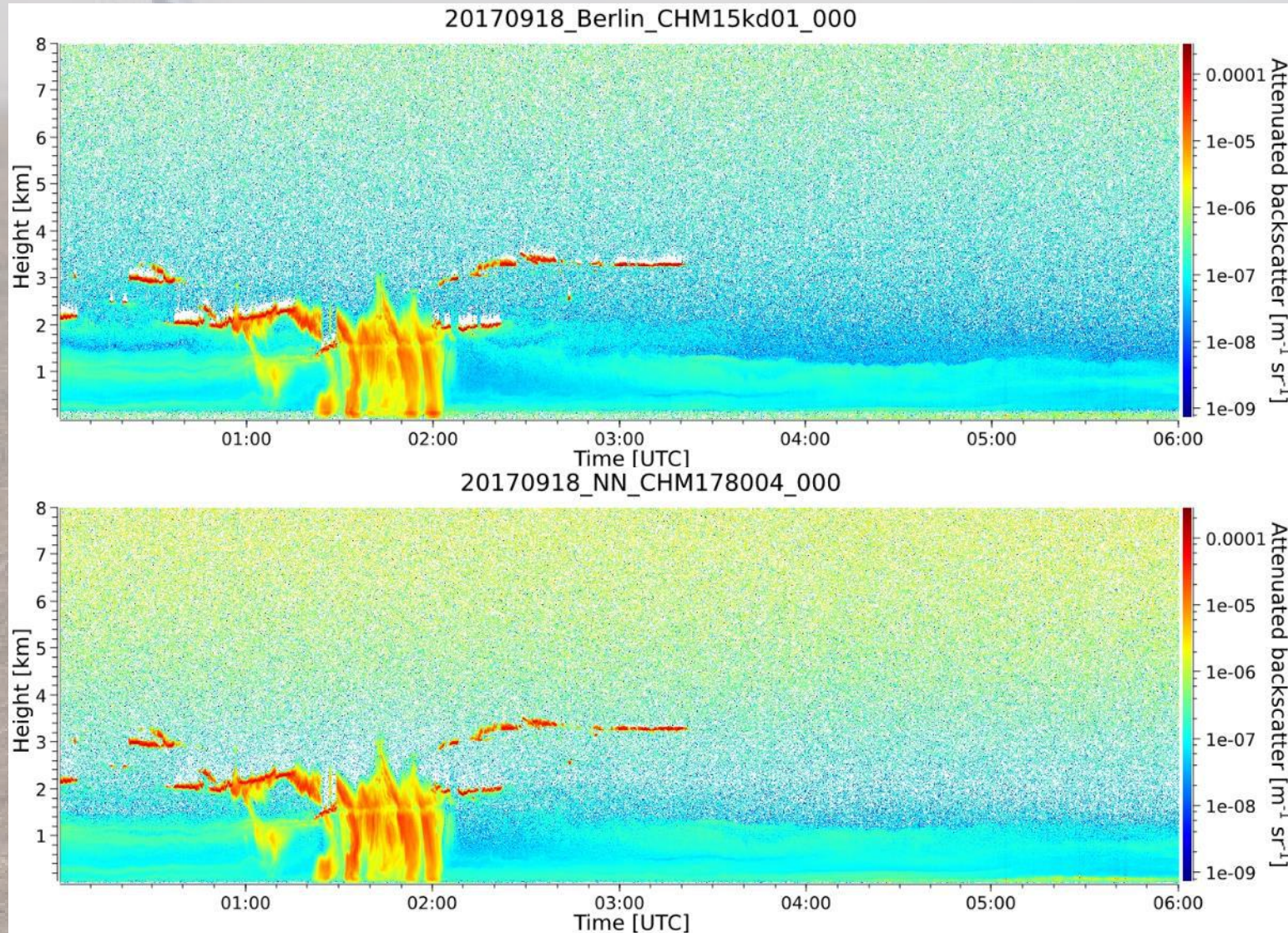


Aerosol layer/
mixing layer comparison

CHM 15k
+ full day high
(performance, lower noise
level

CHM 8k
+ low overlap for single
scattering measurements
($\approx 50 \text{ m}$) \rightarrow identification of
low mixing layer before
sunrise is better

5. Experiences with CHM8k – Measurement profile/ precipitation event



6. Summary

CHM8k is a high-performance ceilometer for the 5 m to 8 km range

Main market focus is for ASOS/ AWOS systems

Suitable for the most demanding environments (heater, window blower, battery backup, tilting option against direct sunlight)

No local PC or other communication device required, remote control, data storage via LAN, RS485 available

Sensitivity in the range of CHM 15k → better than competition (CS135, CL31, ...)

6. Summary

[Click here to visit the CHM8k product page for more info](#)

Lufft Ceilometer CHM8k

SHARE PRINT

The LIDAR-based cloud height sensor / ceilometer CHM8k is prepared to work throughout the year and in any climate



The CHM8k is the latest ceilometer from Lufft. Using the LIDAR technique, it detects backscatter aerosol profiles / structure in multiple layers, cloud bases, cloud penetration depths as well as vertical visibility and issues the sky condition index. It has an operating range of up to 8,000m (26,200 ft) and is equipped with an integrated controller offering a fully embedded real-time calculation of all target parameters and comfortable user interfaces. The Lufft ceilometer series is prepared to work throughout the year and in any climate. Due to their double case structure combined with a window blower and an automatic heating system, the ceilometers are free of fogging, precipitation, freezing or overheating issues.

| | |
|-------------------------|---|
| Parameters measured: | Aerosol backscatter profile, cloud base height, cloud penetration depth, aerosol layer height, cloud cover, vertical visibility, Sky Condition Index |
| Measurement technology: | Optical (LIDAR) |
| Product highlights: | Measuring range of up to 8 km (26.246 ft), simple & eye-safe, service-friendly due to modularity, various data telegrams, sensitivity in the range of the Lufft CHM 15k, suitable for the most demanding environments |
| Interfaces: | RS485 (ASCII communication), LAN (Web-Interface, (S-)FTP, NetTools); optional: DSL modem, RS232 for service |
| Article number: | 8349.01-010 |

Request a quote or advice



7. More Info about CHM8k Ceilometer

Lufft Business Unit Optical Laser Sensors

Contact:

Nicolas Jalby (sales)

Jessika Schugardt (sales)

Holger Wille (product management)

Carl-Scheele-Str. 16

Berlin – Adlershof

Germany



Thank you!